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PROSA-1: A PROBABILISTIC RESPONSE-SURFACE ANALYSIS CODE

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ABSTRACT

Techniques for probabilistic response-surface analysis have been developed to obtain the probability distributions of the consequences of postulated nuclear-reactor accidents. The uncertainties of the consequences are caused by the variability of the system and model input parameters used in the accident analysis. Probability distributions are assigned to the input parameters, and parameter values are systematically chosen from these distributions. These input parameters are then used in deterministic consequence analyses performed by mechanistic accident-analysis codes. The results of these deterministic consequence analyses are used to generate the coefficients for analytical functions that approximate the consequences in terms of the selected input parameters. These approximating functions are used to generate the probability distributions of the consequences with random sampling being used to obtain values for the accident parameters from their distributions.

A computer code PROSA has been developed for implementing the probabilistic response-surface technique. Special features of the code generate or treat sensitivities, statistical moments of the input and output variables, regionwise response surfaces, correlated input parameters, and conditional distributions. The code can also be used for calculating importance distributions of the input parameters.

The use of the code is illustrated in conjunction with the fast-running accident-analysis code SACO to provide probability studies of LMFBR hypothetical core-disruptive accidents. However, the methods and the programming are general and not limited to such applications.

I. INTRODUCTION

The development and use of response-surface techniques[1,2] represent a relatively new aspect in the development of probabilistic approaches to reactor safety following the well-known Reactor Safety Study.[3] Probably the first attempts in this direction were directed to a loss-of-coolant accident in a light-water reactor (LWR).[4,5] These techniques were also used to evaluate statistical uncertainties in thermal-hydraulic models.[6] The problem in general terms is to find the distribution of a random variable that is a function of many other random variables with known distributions of varying degrees of precision when each functional evaluation is expensive. Ott[7] suggested the development of fast-running accident-analysis codes to reduce the expense of these functional evaluations. Tukey[8] suggested that two steps of approximation be taken: first, the full code be replaced by a short code with the running time only a small fraction of that of the long code; second, a function be fitted to the results of the short code and evaluated in a Monte Carlo-type simulation to obtain the desired distribution.

This two-step approach has been independently developed and applied to probabilistic evaluations of LMFBR core-disruptive accidents.[9,10] The probabilistic/deterministic procedure introduced in Ref. 9 will be described and developed further in subsequent sections. In this procedure, probability distributions are assigned to the input parameters, and combinations of parameter values are systematically chosen from these distributions. These combinations of parameter values are then input to a deterministic accident-analysis code. The results of these deterministic consequence analyses are used to generate response surfaces for the consequences as functions of the selected system and model input parameters. These approximating functions are then used to generate the probability distributions and joint distributions of the consequences, with random sampling being used to obtain values for the accident parameters from their distributions. This use of response surfaces leads to considerable savings in computer time in comparison to direct simulation. Figure 1 illustrates the interaction between the PROSA code (the subject of this report) and a deterministic accident-analysis code.

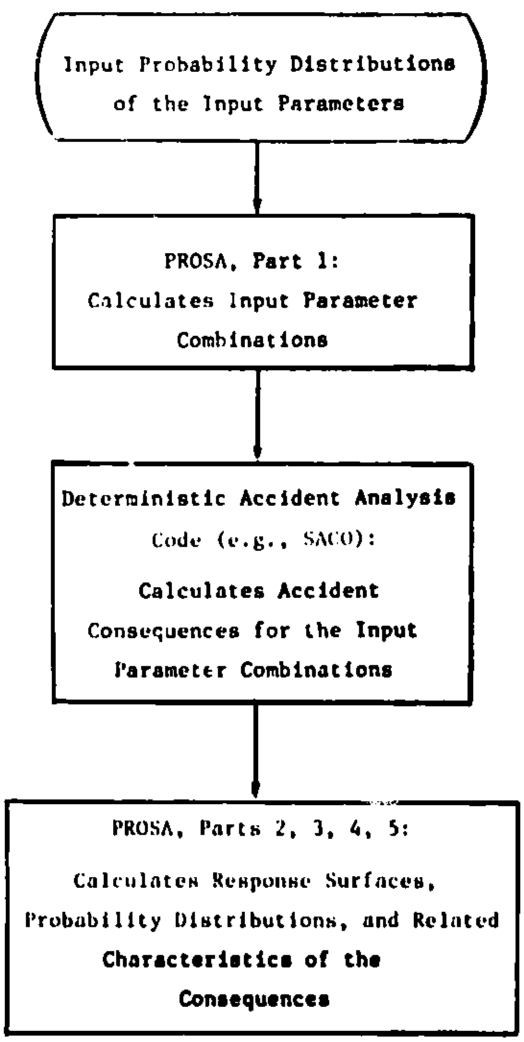

Fig. 1. Use of PROSA in a Probabilistic/ Deterministic Accident Analysis

Two schemes will be illustrated and compared for use in selecting the knot-point values of the input parameters. The first-scheme knot points are evaluated to generate a single second-order polynomial for the entire parameter space; the second-scheme knot points are evaluated to generate separate polynomials for specified regions of the parameter space. The use of regionwise response surfaces for reactor-safety applications was first suggested in Ref. 2. The technique derived and applied here to generate separate polynomials is economical in effectively using the results of the single-polynomial scheme. For determining all coefficients, the Lagrange interpolation technique is extended to a multivariate case. Algebraic expressions are obtained for the coefficients, thereby avoiding the need for a matrix inversion.

A technique to handle nonindependent or correlated input parameters is presented. Many important input parameters depend systematically on a common parameter. For example, the reactivity coefficients, material worths, and power shapes are functions of fuel burnup. Therefore, it is incorrect, in some cases, to assume independence of the input parameters. To illustrate these considerations, correlations between burnup and the reactivity-worth curves are assumed, and the effects of these correlations are studied for a test problem.

A technique is presented for calculating conditional distributions of the consequences. In certain cases, interesting consequences (e.g., failures) appear only when some criterion function exceeds a critical value. A procedure is given for calculating the distributions of consequences when such a criterion is stated. It is shown that the conditional distributions of the input parameters can also be calculated with this procedure and that they provide optimal importance functions for importance-sampling Monte Carlo methods.

The procedures discussed are illustrated in studies of a postulated loss-of-flow transient with failure to scram in a CRBR-type reactor.

The procedures extend the methods used in the Reactor Safety Study[3] by providing a viable method to produce a continuous distribution of consequences rather than a discrete set of consequence categories. The results can also be used to quantitatively identify the relative importance of system and model parameters, both independently and jointly, by the individual and joint sensitivities.

In addition to direct applications in probabilistic risk evaluations, the methods illustrated can be used for determining the required accuracy of deterministic computer codes in light of the natural uncertainties caused by variations of the input parameters.

The remainder of this report describes these procedures and the computer code developed to implement them. Chapter II describes the systematic sensitivity and approximation technique used to find approximate expressions for the consequence functions and to calculate the probability distributions for the consequences. Chapter III describes the test problem and applications of the procedures described. The deterministic fast-running SACO code[9] is used to perform the accident analyses needed to provide "data points." Results obtained using the techniques are discussed. Chapter IV consists of the User's Manual for the PROSA code, and contains a summary, an abstract, and detailed user-oriented information. Program listing and input/output examples are given in the appendices. Finally, future efforts and needs are described in Chapter V.

II. PROBABILISTIC RESPONSE-SURFACE TECHNIQUE

This chapter describes the basic computational features of the response-surface techniques developed for current probabilistic safety evaluations.

A. Problem Description

The consequences of interest, ζ, which might include, for example, accident energetics, and degrees of core and vessel damage, depend on many system and model parameters $z_1, z_2, \ldots, z_n$:

$$\zeta = \zeta(z_1, z_2, \ldots, z_n) \equiv \zeta(\bar{z}). \tag{1}$$

The statistical variations of the parameters z_i, which include reactivity coefficients, burnup, and heat-transfer parameters, cause variations in ζ. Model uncertainties, stemming from a lack of precise knowledge of the phenomenology involved, are another source of uncertainties in ζ. It is possible in principle to sample values of the parameters z_i from their probability distributions and calculate ζ for a sufficient number of cases using comprehensive accident-analysis codes such as SAS[11] and MELT,[12] or more economically with a fast-running semimechanistic code such as SACO.[9] Nevertheless, even with the current computing times of well under a minute per case with SACO, a large number of simulations are a considerable economical burden. One more approximation step is therefore taken in our approach, namely, that of finding a multivariate analytical approximation $\tilde{\zeta}$ to ζ and performing the accident simulations for randomly selected values of $\bar{z}$ with $\tilde{\zeta}$. The adequacy of the approximation depends on our ability to minimize the error $\zeta - \tilde{\zeta}$ in the important domain of $\bar{z}$ space.

B. Response Surfaces

1. Determination of Coefficients

A second-order response surface for the approximation of a given consequence $\zeta(\bar{z})$ as a function of the accident parameters $z_1, \ldots, z_n$ has the following functional form:

$$\tilde{\zeta}(\bar{z}) = A + \sum_{j=1}^{n} \left\{ \left[B_j + C_j(z_j - z_{j_0}) + \sum_{k=j+1}^{n} D_{jk}(z_k - z_{k_0}) \right] (z_j - z_{j_0}) \right\}. \tag{2}$$

To determine the unknown coefficients, a set of $1 + 2n + n(n - 1)/2$ knot points $\bar{z}$ are selected at which the approximation $\tilde{\zeta}(\bar{z})$ is made equal to the actual values of $\zeta(\bar{z})$ calculated by a deterministic accident-analysis code. (This is different from the standard response-surface techniques[1,2] in which least-squares fitting is used for solving the coefficients.) Here the Lagrange interpolation technique[13] is extended to a multivariate case, leading to the expression

$$\tilde{\zeta} = \zeta_0 + \sum_{j=1}^{n} \left\{ [\zeta_1(j) - \zeta_0] \frac{(z_j - z_{j_0})(z_j - z_{j_2})}{(z_{j_1} - z_{j_0})(z_{j_1} - z_{j_2})} + [\zeta_2(j) - \zeta_0] \frac{(z_j - z_{j_0})(z_j - z_{j_1})}{(z_{j_2} - z_{j_0})(z_{j_2} - z_{j_1})} \right\}$$

$$+ \sum_{\substack{\text{pairs} \\ k \neq j}} [\zeta_{11}(j,k) + \zeta_0 - \zeta_1(j) - \zeta_1(k)] \frac{(z_j - z_{j_0})(z_k - z_{k0})}{(z_{j_1} - z_{j_0})(z_{k1} - z_{k0})}, \tag{3}$$

where $\bar{z} = \bar{z}_0 = (z_{10}, z_{20}, \ldots, z_{n0})$ is the reference point, z_{j_1} and z_{j_2} are two other selected values of z_j for all $j = 1, \ldots, n$, and

$$\zeta_0 = \zeta(\bar{z}_0); \quad \zeta_1(j) = \zeta(z_j = z_{j_1}); \quad \zeta_2(j) = \zeta(z_j = z_{j_2});$$

$$\zeta_{11}(j,k) = \zeta(z_j = z_{j_1}, z_k = z_{k1}).$$

The components of $\bar{z}$ not explicitly given as arguments of $\zeta(\cdot)$ have as their reference values $z_\ell = z_{\ell 0}$. Combining Eqs. 2 and 3 yields the coefficients

$$A = \zeta_0,$$

$$B_j = R_{j_1}(z_{j_0} - z_{j_2}) + R_{j_2}(z_{j_0} - z_{j_1}),$$

and

$$C_j = R_{j_1} + R_{j_2},$$

where

$$R_{j_1} = \frac{\zeta_1(j) - \zeta_0}{(z_{j_1} - z_{j_0})(z_{j_1} - z_{j_2})}, \tag{4}$$

$$R_{j_2} = \frac{\zeta_2(j) - \zeta_0}{(z_{j_2} - z_{j_0})(z_{j_2} - z_{j_1})},$$

and

$$D_{jk} = \frac{\zeta_0 + \zeta_{11}(j,k) - \zeta_1(j) - \zeta_1(k)}{(z_{j_1} - z_{j_0})(z_{k1} - z_{k0})},$$

for all $j = 1, \ldots, n$ and selected pairs j, k. Thus, a numerical matrix inversion is avoided with this untraditional knot-point selection. Note that the only condition upon the knot-point coordinates for the determination of coefficients is that, for each parameter j, the quantities z_{j_0}, z_{j_1}, and z_{j_2} have different values.

2. Selection of Knot-point Coordinates

The knot-point coordinates z_{j_0}, z_{j_1}, and z_{j_2} should be selected so that (1) the approximation $\zeta(\bar{z})$ is valid in the interesting region of $\bar{z}$ space and (2) appropriate sensitivities can be defined for the parameters in terms of the consequence values calculated for Eq. 3. The sensitivity should reflect both the uncertainty in the parameter and the degree of impact the parameter has upon the consequences. In the PROSA code, z_{j_0} is taken as $E(z_j)$, the mean value of z_j, and a user-specified probability truncation limit P^* is used to calculate z_{j_1} and z_{j_2} from the conditions

$$\int_{z_{j_1}}^{\infty} f_j(z_j)dz_j = \int_{-\infty}^{z_{j_2}} f_j(z_j)dz_j = P^* \quad \text{for} \quad P^* < 0.5, \tag{5}$$

where $f_j(z_j)$ is the probability density function of z_j. Thus, z_{j_1} and z_{j_2} represent the high and low values of z_j in the interesting range. For the uniform and exponential distributions of Table I, z_{j_1} and z_{j_2} can be solved exactly from Eq. 5. Approximate solutions are used for beta distributions and a numerical inverse-error function[14] for normal and log-normal distributions.

The above formulation is directly applicable when the parameters z_j are mutually independent. For correlated input parameters (to be discussed further in Sec. II.C) such that z_k can be presented as the sum

$$z_k = z_k' + \alpha_{jk}(z_j - z_{j_0}), \tag{6}$$

where z_k' and z_j are mutually independent parameters with known distributions, and α_{jk} is a constant, Eq. 5 is first used to calculate z_{j_1}, z_{j_2}, z_{k_1}', and z_{k_2}'. Then z_{k_1} and z_{k_2} are calculated from

$$\left.\begin{aligned} z_{k_1} &= z_{k_0} + \left[(z_{k_1}' - z_{k_0})^2 + \alpha_{jk}^2(z_{j\nu} - z_{j_0})^2\right]^{1/2} \\ &\text{and} \\ z_{k_2} &= z_{k_0} - \left[(z_{k_2}' - z_{k_0}')^2 + \alpha_{jk}^2(z_{j\mu} - z_{j_0})^2\right]^{1/2} \end{aligned}\right\}, \tag{7}$$

where

$$\nu = 1;\ \mu = 2 \ \text{if}\ \alpha_{jk} > 0;$$

$$\nu = 2;\ \mu = 1 \ \text{if}\ \alpha_{jk} < 0,$$

and $z_{k_0} = z_{k_0}' = E(z_k)$. However, if both z_k' and z_j possess a uniform distribution, the equations used are

$$\left.\begin{aligned} z_{k1} &= z'_{k1} + \alpha_{jk}(z_{j\nu} - z_{j0}); \\ \text{and} \qquad & \\ z_{k2} &= z'_{k2} + \alpha_{jk}(z_{j\mu} - z_{j0}). \end{aligned}\right\} \qquad (8)$$

It can be shown that z_{k1} and z_{k2} of Eq. 7 exactly satisfy the conditions of Eq. 5 if both z'_k and z_j are normally distributed. Note, however, that Eqs. 2-4 do not require Eq. 5 to be exactly satisfied.

TABLE I. Probability Distributions Available in the PROSA Code

Name of Distribution	Functional Form	Parameters to be Specified
Uniform	$\frac{1}{b-a}$; $a \le z \le b$	a,b ; $b>a$
Normal	$\frac{1}{\sigma\sqrt{2\pi}} e^{-(z-\mu)^2/2\sigma^2}$	μ,σ ; $\sigma>0$
Exponential I	$\frac{1}{\beta} e^{-(z-\alpha)/\beta}$; $z \ge \alpha$	α,β ; $\beta>0$
Exponential II	$\frac{1}{\beta} e^{+(z-\alpha)/\beta}$; $z \le \alpha$	α,β ; $\beta>0$
Truncated Normal I	$\frac{K_a}{\sigma\sqrt{2\pi}} e^{-(z-\mu)^2/2\sigma^2}$; $z \ge a$, $K_a = \frac{1}{1-F(a)}$ *	a,μ,σ ; $\sigma>0$
Truncated Normal II	$\frac{K_b}{\sigma\sqrt{2\pi}} e^{-(z-\mu)^2/2\sigma^2}$; $z \le b$, $K_b = \frac{1}{F(b)}$	b,μ,σ ; $\sigma>0$
Beta	$\frac{1}{b-a} \frac{\Gamma(\gamma+\eta)}{\Gamma(\gamma)\,\Gamma(\eta)} \left(\frac{z-a}{b-a}\right)^{\gamma-1} \left[1-\frac{z-a}{b-a}\right]^{\eta-1}$; $a \le z \le b$	a,b,γ,η ; $\gamma,\eta>0, b>a$
Log-normal	$\frac{1}{\sigma z\sqrt{2\pi}} e^{-(\ln z-\mu)^2/2\sigma^2}$; $z > 0$	μ,σ ; $\sigma>0$

*$F(x) = .5 + .5\,\mathrm{erf}\left(\frac{x-\mu}{\sigma\sqrt{2}}\right)$

Two different schemes or "designs" have been developed for selecting knot points for the generation of the response surfaces within the constraints of Eq. 5. These are illustrated in Fig. 2. The first design shows the selection when a single polynomial is used to represent a consequence in the entire parameter space. This design provides deterministically calculated "data" for the low and high values of each parameter in the truncated range, a center datum point at the origin for which all parameters are at their mean value (or best estimate), and an interaction datum point for each pair of parameters. The interaction-point coordinates have been chosen to be in "Quadrant I" ($z_j - z_{j_0}$ and $z_k - z_{k_0}$ both positive).

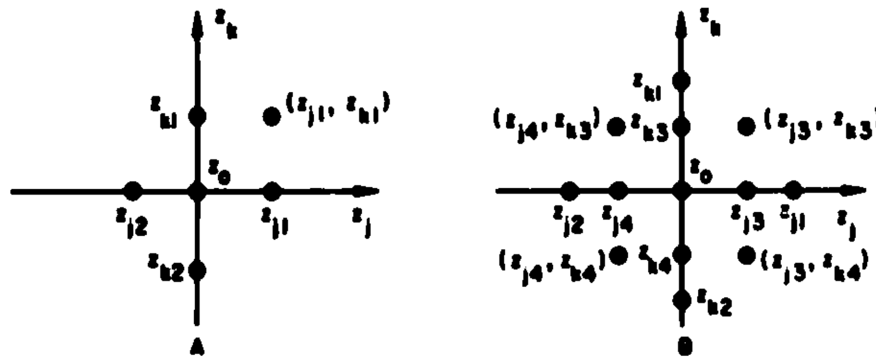

Fig. 2. Schemes for Knot-point Selection

The advantages of this design are that (1) it solves the second-degree response surfaces with a minimum number of deterministic analyses and without a numerical matrix inversion, and (2) it provides a direct calculation of individual parameter sensitivities. Its main weaknesses are that (1) a single response surface is used over the entire parameter space and (2) the interaction term is determined in one quadrant only. The number of calculations required to generate the coefficients of a response surface with this design is given by $1 + 2n + n(n - 1)/2$, where n is the number of parameters evaluated.

The second scheme illustrated in Fig. 2 provides additional knot-point coordinates z_{j_3} and z_{j_4}, where $z_{j_3} = z_{j_0} + \theta(z_{j_1} - z_{j_0})$ and $z_{j_4} = z_{j_0} + \theta(z_{j_2} - z_{j_0})$, $j = 1, 2, \ldots, n$, with θ a specified constant, so that separate response surfaces are generated for each "quadrant." Each quadrant has six data points to uniquely determine the coefficients for that quadrant. For the results presented later in this report, θ was set to $\sqrt{2}/2$ to keep the interaction terms within the sphere of points bounded by P^*.

This design also has the advantages of allowing unique algebraic calculations of the coefficients of the response surfaces. The weaknesses of the first design are mitigated by dividing the parameter space into subsections to predict more accurately both the main effects and the interaction effects over specified ranges of the parameters. However, the number of deterministic calculations required to generate the response surfaces is larger, being given by $1 + 4n + 2n(n - 1)$. For the studies presented later in this report, the number of parameters investigated was small and the deterministic calculations were inexpensive; therefore the computational penalty relative to the one-quadrant scheme was not severe.

In the simulation phase, the coefficients to be used for a particular combination of input parameters (sampled from their distributions) are uniquely determined by the quadrants these parameters fall into. For example, if the randomly selected values of z_j and z_k satisfy $z_j > z_{j0}$, and $z_k < z_{k0}$, the coefficients corresponding to Quadrant IV of Fig. 2B would be used to generate a point in the consequence histogram.

For the single-surface scheme, θ is set to unity. Sensitivity/importance measures

$$I_j = |\zeta_1(j) - \zeta_0| + |\zeta_2(j) - \zeta_0|$$

and

$$I_{jk} = |\zeta_{11}(j, k) + \zeta_0 - \zeta_1(j) - \zeta_1(k)|$$

are used to organize the individual parameters and the cross terms, respectively, by their orders of importance. These indicators can be used to eliminate less important input parameters in order to focus the more detailed scheme of Fig. 2B on the important parameters.

3. Adequacy of Response Surfaces

To determine the adequacy of the response surface presents a potential problem. Since a deterministic analysis at each set of knot points yields a unique value, the standard F test to determine lack of fit cannot be used. We have used the following measures to evaluate the adequacy of the response surfaces obtained in this work:

a. Comparison of response surfaces generated for different sets of knot points, corresponding to different values of P*.

b. Comparison of the response surface representing the entire parameter space with surfaces representing the individual quadrants of the parameter space.

c. Comparison of the consequence distributions generated with the single- and multi-quadrant response surfaces of item b.

d. Comparison of response-surface predictions for parameter sets other than the knot points.

Items b and c are illustrated in Sec. III.C.

Although the above measures yield an estimate for the accuracy of the response surfaces, exact procedures to quantify the maximum errors need to be developed.

C. Characteristics of Consequence Distributions

The moments and central moments of the parameter distributions of Table I are summarized in Table II up to the fourth-order moments. Most of these can also be found in the literature.[15] The notation $E[g(z)]$ is defined as the expectation value

$$E[g(z)] = \int_{-\infty}^{\infty} g(z)f(z)dz, \tag{9}$$

where $f(z)$ is the probability density of z.

The moments of Table II can be used for calculating the moments of $\tilde{\zeta}$ of Eq. 2 in analytical form, as will be done in Eq. 10-15 below. These moments of $\tilde{\zeta}$ can then be used to (1) establish histogram categories of the consequences (for the Monte Carlo simulation) as a specified fraction of the standard deviations of the consequences, and (2) find upper limits for interesting probabilities with Tchebysheff and Cantelli inequalities.[16]

For mutually independent parameters, moments have been extensively studied by Evans.[17] For correlated input parameters, Eqs. 13-15 have been derived and used in this work.

1. Independent Input Parameters

When the input parameters z_j are mutually independent, the mean value of $\tilde{\zeta}(\tilde{z})$ is

$$E[\tilde{\zeta}] = A + \sum_{j=1}^{n} C_j\sigma_j^2, \tag{10}$$

and the covariance between consequences $\tilde{\zeta}_a$ and $\tilde{\zeta}_b$ is

$$E[\tilde{\zeta}_a\tilde{\zeta}_b] - E[\tilde{\zeta}_a]E[\tilde{\zeta}_b] = \sum_{j=1}^{n} B_j^a B_j^b \sigma_j^2 + \sum_{j=1}^{n}\left(B_j^a C_j^b + B_j^b C_j^a\right)\gamma_j\sigma_j^3$$

$$+ \sum_{j=1}^{n} C_j^a C_j^b(\Gamma_j - 1)\sigma_j^4 + \sum_{j=1}^{n}\sum_{k=j+1}^{n} D_{jk}^a D_{jk}^b \sigma_j^2\sigma_k^2, \tag{11}$$

where

$$\sigma_j^2 = \text{var}(z_j) \equiv E(z_j - z_{j0})^2,\quad \gamma_j = E(z_j - z_{j0})^3/\sigma_j^3,\quad \text{and}\quad \Gamma_j = E(z_j - z_{j0})^4/\sigma_j^4.$$

TABLE II. Moments of the Distributions

Name of Distribution	Mean value $M=E(z)$	Variance $E[z-E(z)]^2$	$E[z-E(z)]^3$	$E[z-E(z)]^4$
Uniform	$\frac{a+b}{2}$	$\frac{(b-a)^2}{12}$	0	$\frac{(b-a)^4}{80}$
Normal	μ	σ^2	0	$3\sigma^4$
Exponential I	$\alpha+\beta$	β^2	$2\beta^3$	$9\beta^4$
Exponential II	$\alpha-\beta$	β^2	$-2\beta^3$	$9\beta^4$
Truncated Normal I	$\mu+\Delta$ [a]	$\sigma^2+(a-\mu)\Delta-\Delta^2$	Note [b]	Note [c]
Truncated Normal II	$\mu+\Delta$ [d]	$\sigma^2+(b-\mu)\Delta-\Delta^2$	Note [e]	Note [f]
Beta	$a+(b-a)\frac{\gamma}{\gamma+\eta}$	$\frac{(b-a)^2\gamma\eta}{(\gamma+\eta)^2(\gamma+\eta+1)}$	$\frac{2(b-a)^3\gamma\eta(\eta-\gamma)}{(\gamma+\eta)^3(\gamma+\eta+1)(\gamma+\eta+2)}$	$\frac{3(b-a)^4\gamma\eta[2\gamma^2+2\eta^2+\gamma\eta(\gamma+\eta-2)]}{(\gamma+\eta)^4(\gamma+\eta+1)(\gamma+\eta+2)(\gamma+\eta+3)}$
Log-normal	$e^{\mu+\sigma^2/2}$	$(e^{\sigma^2}-1)\,M^2$	$(e^{3\sigma^2}-3e^{\sigma^2}+2)\,M^3$	$(e^{6\sigma^2}-4e^{3\sigma^2}+6e^{\sigma^2}-3)\,M^4$

a $\quad \Delta = \sigma\frac{K_a}{\sqrt{2\pi}}\,e^{-(a-\mu)^2/2\sigma^2}$

b $\quad E[z-E(z)]^3 = [(a-\mu)^2-\sigma^2]\Delta-3(a-\mu)\Delta^2+2\Delta^3$

c $\quad E[z-E(z)]^4 = 3\sigma^4+[(a-\mu)^3+3\sigma^2(a-\mu)]\Delta-[2\sigma^2+4(a-\mu)^2]\Delta^2+6(a-\mu)\Delta^3-3\Delta^4$

d $\quad \Delta = -\sigma\frac{K_b}{\sqrt{2\pi}}\,e^{-(b-\mu)^2/2\sigma^2}$

e $\quad E[z-E(z)]^3 = [(b-\mu)^2-\sigma^2]\Delta-3(b-\mu)\Delta^2+2\Delta^3$

f $\quad E[z-E(z)]^4 = 3\sigma^4+[(b-\mu)^3+3\sigma^2(b-\mu)]\Delta-[2\sigma^2+4(b-\mu)^2]\Delta^2+6(b-\mu)\Delta^3-3\Delta^4$

The indices a and b of the coefficients refer to $\tilde{\zeta}_a$ and $\tilde{\zeta}_b$, respectively. The variance of a consequence is the special case $\tilde{\zeta}_a = \tilde{\zeta}_b$ of Eq. 11. Equation 11 can also be used for calculating correlations between consequence and input parameters z_i by substituting $B_i^b = 1$, $B_j^b = 0$ for $j \neq i$, and $C_j^b = D_{jk}^b = 0$ for all j, k.

2. Correlated Input Parameters

The general expression for the mean value of $\tilde{\zeta}(\overline{z})$ is

$$E[\tilde{\zeta}] = A + \sum_{j=1}^{n} C_j\sigma_j^2 + \sum_{j=1}^{n} \sum_{k=j+1}^{n} D_{jk}\mathrm{cov}(z_j, z_k), \tag{12}$$

and the covariance between two consequences is

$$\begin{aligned}
\mathrm{cov}(\tilde{\zeta}_a, \tilde{\zeta}_b) = {} & \sum_{j=1}^{n} B_j^a B_j^b \sigma_j^2 + \sum_{j=1}^{n} \sum_{k=j+1}^{n} \left(B_j^a B_k^b + B_k^a B_j^b\right)\mathrm{cov}(z_j, z_k) \\
& + \sum_{j=1}^{n} \left(B_j^a C_j^b + B_j^b C_j^a\right)\gamma_j\sigma_j^3 + \sum_{j=1}^{n} \sum_{k\neq j} \left(B_j^a C_k^b + B_j^b C_k^a\right)\mathrm{cok}(z_j, z_k, z_k) \\
& + \sum_{j=1}^{n} C_j^a C_j^b (\Gamma_j - 1)\sigma_j^4 + \sum_{j=1}^{n} \sum_{k=j+1}^{n} \left(C_j^a C_k^b + C_j^b C_k^a\right)\left[\mathrm{coe}(z_j, z_j, z_k, z_k) - \sigma_j^2\sigma_k^2\right] \\
& + \sum_{j=1}^{n} \sum_{k=1}^{n} \sum_{i=k+1}^{n} \left(B_j^a D_{ki}^b + B_j^b D_{ki}^a\right)\mathrm{cok}(z_j, z_k, z_i) \\
& + \sum_{j=1}^{n} \sum_{k=1}^{n} \sum_{i=k+1}^{n} \left(C_j^a D_{ki}^b + C_j^b D_{ki}^a\right)\left[\mathrm{coe}(z_j, z_j, z_k, z_i) - \sigma_j^2\mathrm{cov}(z_k, z_i)\right] \\
& + \sum_{j=1}^{n} \sum_{k=j+1}^{n} \sum_{i=1}^{n} \sum_{m=i+1}^{n} D_{jk}^a D_{im}^b [\mathrm{coe}(z_j, z_k, z_i, z_m) \\
& - \mathrm{cov}(z_j, z_k)\mathrm{cov}(z_i, z_m)],
\end{aligned} \tag{13}$$

where

$$\mathrm{cov}(z_j, z_k) = E[(z_j - z_{j0})(z_k - z_{k0})],$$

$$\mathrm{cok}(z_j, z_k, z_i) = E[(z_j - z_{j0})(z_k - z_{k0})(z_i - z_{i0})],$$

and

$$\mathrm{coe}(z_j, z_k, z_i, z_m) = E[(z_j - z_{j0})(z_k - z_{k0})(z_i - z_{i0})(z_m - z_{m0})].$$

The moments of the parameters needed in these equations cannot all be obtained from Table II directly. However, if the linear correlation Eq. 6 can be used for the dependent input parameters, it is not too difficult to calculate the needed moments as functions of the moments of the independent parameters. It is useful to divide the input parameters into two classes: independent parameters z_j, $j = 1, \ldots, n_1$ (Class 1) and dependent parameters z_k, $k > n_1$ (Class 2). For each parameter z_k of Class 2, there is a unique leading parameter z_j in Class 1, denoted as $j = L(k)$, so that $z_k = z'_k + \alpha_{jk}(z_j - z_{j0})$ with z'_k and z_j independent. Several Class 2 parameters can have a common leading parameter. The distributions of the Class 1 parameters and those of $z'_k (k > n_1)$ are provided as input to the PROSA code.

The moments of the Class 1 parameters are obtained from Table II. For Class 2 parameters, $E(z_k) = E(z'_k) = z'_{k0}$ and

$$\left.\begin{aligned} \sigma_k^2 &= \mathrm{var}(z'_k) + \alpha_{jk}^2 \mathrm{var}(z_j); \\ \gamma_k \sigma_k^3 &= E(z'_k - z'_{k0})^3 + \alpha_{jk}^3 E(z_j - z_{j0})^3; \\ \Gamma_k \sigma_k^4 &= E(z'_k - z'_{k0})^4 + 6\alpha_{jk}^2 \mathrm{var}(z_j)\mathrm{var}(z'_k) + \alpha_{jk}^4 E(z_j - z_{j0})^4, \end{aligned}\right\} \qquad (14)$$

where $j = L(k)$, $k > n_1$. The covariance between two parameters ($i \neq k$) is

$$\mathrm{cov}(z_i, z_k) = \begin{cases} \alpha_{ik}\sigma_i^2 & \text{if } i = L(k) \\ \alpha_{ki}\sigma_k^2 & \text{if } k = L(i) \\ \alpha_{jk}\alpha_{ji}\sigma_j^2 & \text{if } j = L(k) = L(i) \\ 0 & \text{all other cases.} \end{cases} \qquad (15)$$

In a similar fashion, expressions can be found for the higher moments needed in Eq. 13. In the simulation phase, PROSA also calculates the moments and correlations from the samples, independent of the above analytical expressions.

D. Generation of Distributions of Consequences

A detailed distribution of a consequence $\tilde{\zeta}$ is calculated by sampling values from the distributions of the parameters $\bar{z}$ and calculating $\tilde{\zeta}(\bar{z})$ from Eq. 2 for a large number of such $\bar{z}$ values. (In the multiquadrant scheme, the coefficients of Eq. 2 depend on $\bar{z}$.) The distribution is obtained in the form of a histogram with categories on each side of the mean value $E[\tilde{\zeta}]$. The width of each category is a certain user-specified fraction (input variable SCALE) of the standard deviation $\sqrt{\text{var}(\tilde{\zeta})}$. Thus, the analytical moments calculated in Sec. C are used in the simulation. The joint distributions of the pairs of consequences $\tilde{\zeta}_a$ and $\tilde{\zeta}_b$ are calculated in the same way as two-dimensional histograms.

The random variates with the distributions given in Table I are generated using the standard (or slightly modified) methods of Refs. 18-20. The methods must be exact in the tails of the distributions because interesting consequences may occur with unlikely combinations of the input parameters.

1. Correlated Input Parameters

The joint probability density function of the input parameters can always be presented as a product of the conditional distributions

$$f(\bar{z}) = f_1(z_1)f_{2c}(z_2|z_1) \ldots f_{nc}(z_n|z_{n-1}, \ldots, z_1). \tag{16}$$

The random sampling of the components of $\bar{z}$ can be accomplished from left to right on the right-hand side of Eq. 16. The values $z_1, \ldots, z_{r-1}$ must be known, in principle, before z_r can be sampled. If the parameters are mutually independent, the conditional distributions in Eq. 16 are also total (marginal) distributions, and the order in which the parameters are sampled is immaterial.

To demonstrate the method for correlated input parameters, we divide the parameters into two classes: Class 1 consists of n_1 mutually independent parameters z_j with given total distributions $f_j(z_j)$, $j = 1, 2, \ldots, n_1$. The rest of the n parameters belong to Class 2, and we assume that their conditional distributions depend on Class 1 parameters only.

In a typical case, the expected value (conditional mean value) of a Class 2 parameter depends on the actual value of a Class 1 parameter. For example, the expected value of a reactivity coefficient is a deterministic function of fuel burnup. The width and form of the conditional distribution may also depend on Class 1 parameters. Usually more experimental or theoretical evidence is available about the dependence of the conditional expectation value than about the form of the distribution. In this work, the forms of the conditional distributions of Class 2 parameters are assumed to be independent of other parameters, but the conditional mean values are assumed to be linear functions of Class 1 parameters. This means that any parameter z_k of Class 2 can be presented as a sum

$$z_k = z_k' + \alpha_{jk}(z_j - z_{j0}), \qquad (17)$$

where α_{jk} is a constant, z_j belongs to Class 1 and is called the leading parameter of z_k, and z_k' is an independent random parameter with known distribution $f(z_k')$. PROSA samples z_k' and z_j from their distributions to obtain z_k from Eq. 17. The coefficient α_{jk} can be determined when the conditional mean value of z_k is known at two different values of z_j. Figure 3 illustrates the distributions, with z_k a factor with which to multiply the Doppler coefficient and z_j the fraction of the fuel-cycle time, referred to as burnup. The conditional distribution of z_k (and z_k') is assumed normal, the mean value moving from 0.92 to 1.08 as a function of burnup. The distribution of z_j is assumed uniform, and the total distribution of z_k is a convolution of a uniform and a normal distribution. There is no need, however, to calculate this total distribution in analytical form.

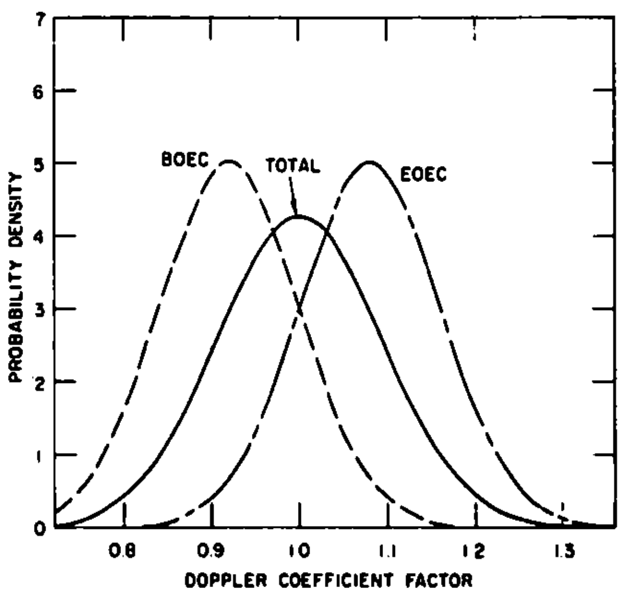

Fig. 3

Conditional and Total (Marginal) Probability Distributions of Doppler-coefficient Factor

The random sampling and the calculation of the distributions of the consequences can be easily extended to more general correlations than the linear correlation of Eq. 17.

2. Conditional Distributions

In many applications, interesting consequences (e.g., failures) appear only when some criterion function exceeds a critical value. Up to four simultaneous criteria or conditions can be specified for the PROSA code as input data. The conditions can be specified for input parameters, for consequence variables, or for both. PROSA calculates the conditional distributions (histograms), counting but rejecting the samples that do not satisfy the conditions. This technique is applicable for estimating the probability that a certain consequence variable (e.g., stress, strain, or temperature) is exceeded in an accident, and the distributions of other interesting consequences for that condition. Examples are shown in Fig. 7 (on p. 27).

The fact that input parameters can also be defined as consequence variables allows the calculation of conditional distributions of input parameters. Examples calculated with this technique are presented in Figs. 5 and 6 (on p. 26). These conditional distributions can be used as <u>importance functions</u> of the parameters in an Importance Sampling Monte Carlo (ISMC) simulation, as will be shown.

Let $\eta(\bar{z})$ be a criterion function. We are interested in the probability Q that η belongs to a certain domain A: $\eta \in A$. The indicator $q(\bar{z})$ is defined so that $q(\bar{z}) = 1$ if $\eta \in A$ and $q(\bar{z}) = 0$ if $\eta \notin A$. The problem is to calculate the integral

$$Q = \int q(\bar{z}) f(\bar{z}) d\bar{z} \tag{18}$$

over all parameters. In the ISMC simulation, this is estimated by

$$Q = \frac{1}{N} \sum_{i=1}^{N} \frac{q(\bar{z}_i) f(\bar{z}_i)}{f^*(\bar{z}_i)}, \tag{19}$$

where the N samples $\bar{z}_i$ are selected from an importance function $f^*(\bar{z})$ instead of the original distribution $f(\bar{z})$. The optimal importance function[21] would be

$$f_0^*(\bar{z}) = q(\bar{z}) f(\bar{z}) / Q. \tag{20}$$

Of course, Q and q(z) are not known explicitly. Instead, the conditional distribution function $f_c(z|\eta \in A)$ of the parameters can be estimated by using PROSA as indicated in Figs. 5 and 6. From the basic properties of conditional distributions

$$Q f_c(\bar{z}|\eta \in A) = f(\bar{z}) q(\bar{z}), \tag{21}$$

proving that $f_c(\bar{z}|\eta \in A) = f_0^*(\bar{z})$. Thus, the conditional distributions of the input parameters as calculated by PROSA are near-optimal importance functions, exactly optimal if the response-surface functions are accurate.

The importance function can also be used to select new knot points to determine a new response surface that is more accurate in the interesting domain of $\bar{z}$ space.

3. <u>Moment Matching</u>

The simulation techniques described yield the probability distributions as histograms with a finite number of categories. If a continuous curve is desired for approximating the distribution, the sample moments calculated by PROSA can be used for fitting an analytical distribution from the Pearson family or from the Johnson family.[22] The first four moments of the sampled data are needed in this procedure.

III. APPLICATIONS

This chapter illustrates the use of the above procedures for a postulated loss-of-flow (LOF) transient with failure to scram in an LMFBR. The problem and input parameters are defined, the deterministic accident-analysis models described, and finally the probabilistic results presented.

A. A Sample Problem

To illustrate the procedure, a postulated LOF transient with failure to scram in a CRBR-type reactor was deterministically analyzed through the voiding phase to a point in the accident at which considerable amounts of cladding and fuel are molten and fuel/cladding motion would probably occur. Since fast-running models to reliably analyze the transient beyond the initiation of fuel and cladding motion to the point of permanent subcriticality have not yet been developed, the consequences studied here are intermediate consequences, rather than final end-of-accident consequences. The consequences investigated included end-of-analysis energetics, power levels, reactivities, and fractions of core with molten cladding and fuel. The power and reactivity consequences were chosen because they provide an important set of state variables at the initiation of cladding and fuel motion. The molten core fractions serve as core-damage indicators as well as plausible source terms for fuel and cladding relocation. Although these consequences depend on a large number of system and model parameters, a preliminary study indicated that only a few parameters make major contributions to consequence uncertainties. The parameters shown in Table III were selected for the present study.

TABLE III. Input Parameters and Assigned Distributions

Parameter	Distribution	Mean Value	Distributional Characteristic[a]
Fraction of fuel-cycle time (burnup)	Uniform	0.5	0, 1[b]
Fuel specific heat	Normal	357 J/kg·K	12%
Doppler-coefficient factor	Normal	1.00[c]	8%[d]
Void-worth factor	Normal	1.00[e]	10%[d]

[a]Lower and upper limits for uniform distribution; standard deviation for normal distribution.
[b]Limits correspond to BOEC and EOEC, respectively.
[c]0.94 at BOEC; 1.06 at EOEC.
[d]At fixed burnup.
[e]0.92 at BOEC; 1.08 at EOEC.

The dependencies of the Doppler and voiding reactivity factors upon the fraction of fuel-cycle time, referred to as "burnup," shown in Table III, were chosen as representative based on neutronics calculations for CRBR.[23,24] Hence, the burnup was the "leading parameter" for the study of correlations between parameters. From Eqs. 14 and 15, the correlation coefficients can be computed as 0.5 for burnup and Doppler, 0.32 for burnup and void worth, and 0.16 for Doppler and void worth.

A value of $P^* = 0.0228$, corresponding to the 2σ or approximately 95% confidence interval for a normal distribution, was chosen for the generation of the knot-point values, as described in Sec. II.B.

B. Deterministic Models

The feasibility of the methods described above for performing probabilistic evaluations of reactor accidents hinges upon the ability to perform economically the accident analyses needed for calculating the coefficients of the approximating consequence polynomials. This is especially true when the number of input parameters is large. The accident analyses required must be able to be performed quickly, yet with enough accuracy to provide confidence in the results. Accordingly, as a parallel development with the probabilistic studies at ANL, the fast semimechanistic accident-analysis code SACO is being developed.

This code has been described in earlier reports,[9,25,26] and was used to perform the deterministic calculations needed to generate the coefficients of the response surfaces. The analyses performed with SACO for this study used essentially the same simulation model for a CRBR-type core as reported earlier.[9] The SACO analyses required an average of 20-s computing time on the IBM 370/195 for each case. The computer storage requirements for the SACO evaluations reported here were less than 250 kilobytes.

C. Results

The results in this section were generated to highlight (1) the comparison of different schemes for knot-point selection, (2) the treatment of correlated input parameters, and (3) the calculation of different conditional distributions. The input parameters and the assigned distributions are specified in Table III. The correlations between input parameters are illustrated in Fig. 3 with the probability distributions of the Doppler factor.

Figure 4 compares the probability distributions generated using the single response surface and the "multiquadrant" response surfaces. The power consequence was chosen for this illustration because it provided the largest difference between the probability density curves of the single- and multiresponse schemes. In general, for the consequences indicated in Table IV, the consequence distributions obtained with the two schemes were close, providing one measure of the adequacy of a single second-order response surface for prediction.

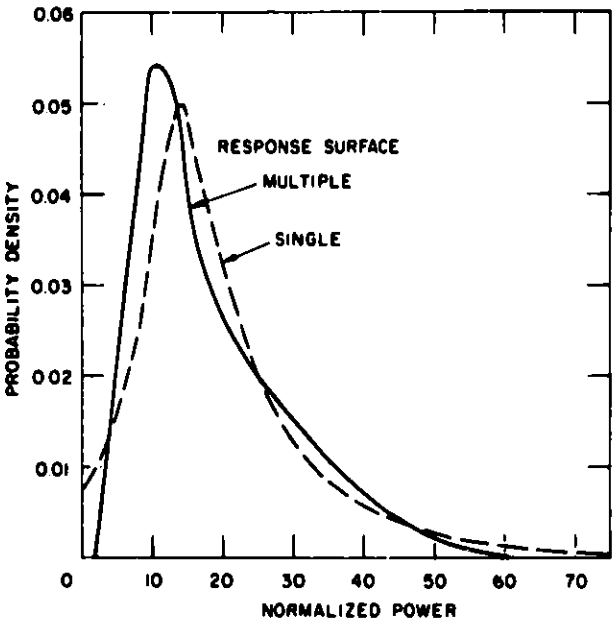

Fig. 4

Probability Density Functions for Power Resulting from Single- and Multiple-response-surface Approximations

TABLE IV. Distribution Characteristics of Selected Consequences[a]

Consequence	SACO Base Case	PROSA Mean Value	PROSA Standard Deviation
Power[b]	15.9	19.0	13.0
Energy[c]	17.3	17.4	0.9
Net reactivity, $	0.88	0.87	0.06
Fraction of cladding molten	0.14	0.16	0.08
Fraction of fuel molten	0.09	0.15	0.18

[a]Evaluated at 0.6 s after boiling initiated in the coldest group of subassemblies; single-response-surface results quoted.
[b]Relative to steady-state full power.
[c]Steady-state full-power seconds.

For the example of Fig. 4, the discrepancy between the distributions was caused by the Doppler-voiding reactivity-worth interaction being much greater in the first-parameter "quadrant" (as indicated by the strongly negative D coefficient) than in the other quadrants, as measured by the multi-quadrant scheme. As a result, the single-surface scheme overpredicted powers when the indicated parameters fell into quadrants 2 and 4, and underpredicted power for quadrant 3, the latter quadrant sampling leading to physically unreal negative powers.

Although the multisurface scheme was needed here to provide a good approximation for this example, other methods exist to improve a single-surface approximation. One approach is to search for and use more optimal designs[1,27,28] or knot-point-selection schemes. Transformations of the input variable and/or the consequences could also be used to improve the accuracy. However, such techniques are based on the hindsight provided by initial studies and could be used to complement the techniques here. For this work, emphasis has been on the use of an automated routine with the assumption of no prior knowledge or evaluations.

Table IV presents distribution characteristics for the selected consequences. The differences between the SACO base case and PROSA mean-value results reflect the nonlinearities of the consequences (see Eq. 10). The uncertainties of the consequences as measured by their standard deviations are usually much larger than the differences between the base case and the mean values caused by the nonlinearities, supporting the adequacy of a quadratic response surface. Essentially the same results for mean values and standard deviations of the consequences were obtained for the cases of mutually independent and correlated input parameters. This was caused by the effect of the increase in the Doppler factor with burnup tending to cancel the effect of the increase in void worth with burnup.

The calculation of conditional distributions of the input parameters (listed in Table III) as potential importance functions is illustrated in Figs. 5 and 6. Figure 5 shows the variation of the distribution of the burnup input

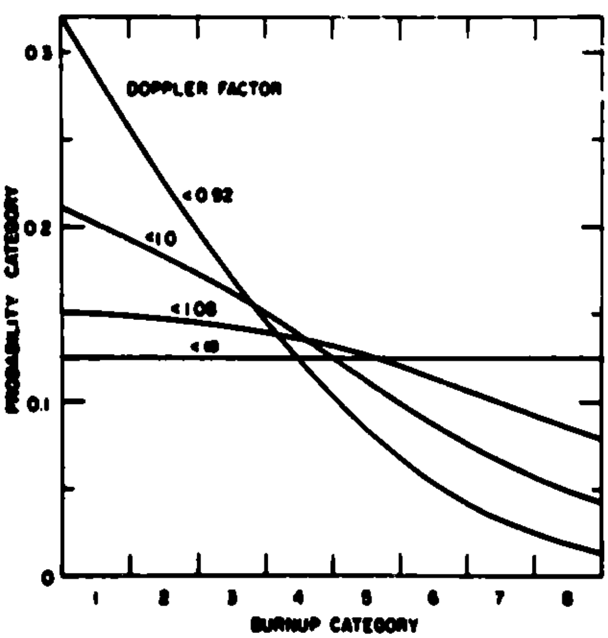

Fig. 5. Conditional Distributions of Burnup Parameter (Eight categories from BOEC to EOEC): Conditions for Doppler-coefficient Factor

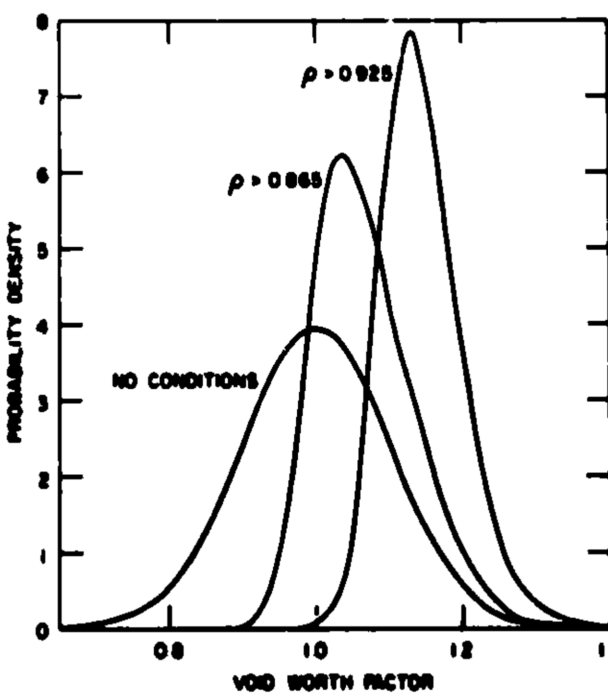

Fig. 6. Conditional Distributions of the Void Worth Factor: Conditions for Reactivity (ρ)

parameter when conditions are specified for the Doppler factor. The deviation of the burnup distribution from the original uniform distribution is a direct consequence of the correlation between input parameters. The correlation is explained in Sec. III.A.

Figure 6 illustrates the variation of the conditional distribution of the void worth when conditions are specified for the reactivity consequence variable. These conditional distributions indicate where new knot points should be selected if an improved response surface were desired for analyzing the high-reactivity cases in more detail. They also would provide the optimal distributions for using importance sampling to generate more accurate conditional distributions of the consequences, as described in Sec. II.D.

To demonstrate the effect of the input-parameter correlations, the distribution of the fraction of molten cladding was calculated with and without correlations between the input parameters. This is illustrated in Fig. 7 with several conditions specified for reactivity at the end of the calculation. The probabilities obtained for exceeding the reactivity values 0.895, 0.925, and 0.955 $ were 0.35, 0.14, and 0.025, respectively, for independent input parameters and 0.35, 0.13, and 0.018, respectively, for correlated input parameters.

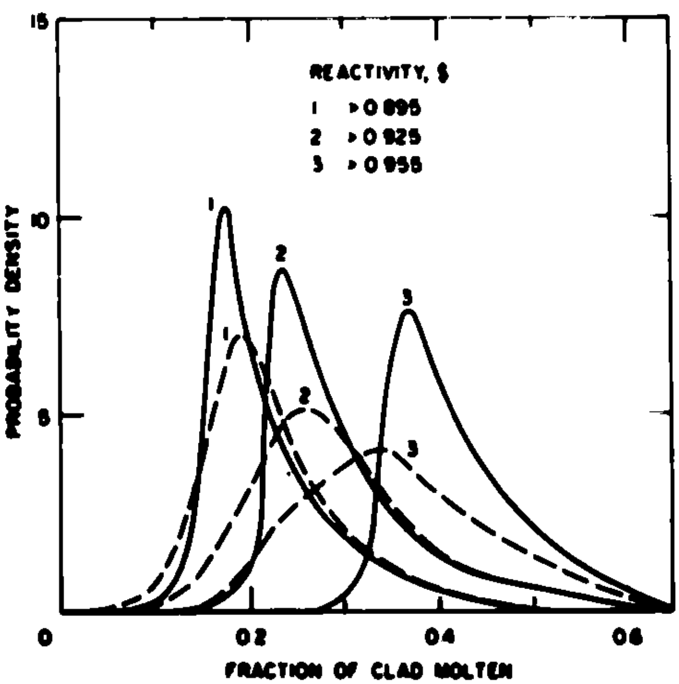

Fig. 7

Conditional Distributions of Fraction of Molten Cladding; Conditions for Reactivity ($). Solid lines for independent input parameters, dotted lines for correlated input parameters.

Typically 50,000-100,000 simulation cycles were used to generate the probability distributions reported here. Each cycle included the sampling of values for all parameters, calculation of all consequences from the response surfaces, and the generation of the conditional and unconditional histograms, joint histograms, and moments. The computer time on the IBM 370/195 for 100,000 simulations for four input parameters (maximum 12) and five consequences (maximum 6) was roughly 100 s.

IV. USER'S MANUAL

A. Program Summary

The program performs three main functions.

1. With input-specified distribution functions, e.g., means and standard deviations for a preselected number of parameters, the program selects points from a specified confidence interval on these distributions to serve as input for evaluation by deterministic codes.

2. With "consequences" from the deterministic code(s) for each input-parameter combination provided above, the program generates multivariate quadratic response surfaces approximating the functionality between the input and output of the deterministic analysis.

3. By use of the generated response surfaces, the program generates histograms, approximating consequence probability distributions. Special features of the code generate or treat sensitivities, consequence distributional moments, regionwise response surfaces, correlated input parameters, and conditional and joint distributions.

The code has been used extensively in conjunction with the fast-running accident-analysis code SACO to provide probability studies of LMFBR hypothetical core-disruptive accidents. However, the methods and the programming are completely general and not limited to such applications.

B. Program Abstract

This program abstract is provided in the form recommended by the Argonne Code Center.

1. Name of Program: PROSA

2. Computer for Which Program is Designed: IBM 370/195

3. Description of Problem: The problem is to find the distribution of a random variable that is a function of many other random variables when this functionality is not known in analytical form and can be obtained only through parametric studies with a deterministic computer code.

PROSA first systematically provides input-parameter combinations for evaluation by a deterministic code. With the output of the deterministic code for each of these parameter combinations, PROSA then generates response surfaces to describe the functionality between the input and output of the deterministic code. These response surfaces are then used in PROSA for calculating sensitivities, probability distributions, and related characteristics of the program output. This technique leads to considerable savings in computer time in comparison to direct use of the deterministic code for randomly sampled input.

4. Method of Solution: As input data, the program needs the probability distributions of the variable parameters (e.g., reactivity and heat-transfer coefficients considered as sources of uncertainties in an accident analysis). In the first part of the program knot-point coordinates of the parameters are calculated. These serve as input for deterministic codes (such as accident-analysis codes SACO or SAS) to calculate interesting consequences in the specified knot points. The knot-point coordinates are determined by a user-specified probability range (confidence interval).

The consequence values in the knot points (as calculated by accident-analysis codes such as SACO or SAS) are used by the second part of PROSA to solve (1) the approximating functions (response surfaces), (2) the sensitivity/importance of each parameter with respect to the consequence variables, (3) the statistical moments of the input parameters, (4) the mean values and standard deviations of the consequences, and (5) the correlation coefficients for all pairs of the consequences.

By use of random-number sampling of the parameter distributions and simulation with the as-calculated response surface the program also calculates (6) the probability distributions and the first four moments of the consequences, (7) the joint distributions, and (8) the statistical-error estimates for the distributions.

The individual and joint distributions are obtained in forms of histograms with 12 and 144 categories, respectively. The width of each category is a user-specified fraction of the standard deviations of the consequences.

5. Restrictions on the Complexity of the Problem: The maximum number of variable input parameters and consequence variables that can be analyzed simultaneously are 12 and 6, respectively. Eight different distributions are available for the input parameters, including uniform, exponential, normal, truncated normal, log normal, and beta distributions. The correlations (if any) between the input parameters are limited to linear correlations.

6. Typical Running Time: Typical running time for six input parameters and six consequence variables is 60 s for 40,000 simulations (IBM 370/195).

7. Unusual Features of the Program: In the simplest case, a single multivariate second-degree surface is matched to the knot-point consequences. It is possible as an option to use regionwise response surfaces, that is, distinct second-degree surfaces for every "quadrant" of the multivariate parameter

space. The program includes a technique to handle nonindependent (correlated) input parameters. Conditional distributions can also be calculated. Up to four simultaneous criteria or conditions can be specified for the consequences. The distributions are obtained in forms of histogram tables with 12 categories and plots in 26 categories. The joint distributions have 12 x 12 = 144 categories. The width of each category is a user-specified fraction of the standard deviations of the consequences. By defining one or more input parameters to be consequences as well, we can use the code for calculating optimal importance distributions for the input parameters.

8. Related and Auxiliary Programs: The PROSA code can be used in conjunction with a deterministic/mechanistic accident-analysis code (such as SACO, SAS, and RELAP). The first part of PROSA provides input for the accident-analysis code, which in turn provides input for the second part of PROSA.

9. Status: PROSA-1 is available in the Argonne Code Center.

10. References: References 9 and 29.

11. Machine Requirements: IBM 370/195; Card Read/Punch; Line Printer.

12. Programming Language Used: FORTRAN IV

13. Operating System: IBM System/370 Model 195; FORTRAN IV (G) or (H) compiler with optimizer.

14. Other Programming or Operating Information or Restrictions:

a. The program contains a few FORMAT statements in the T format code as well as ERR= and END= operatives in a READ statement. These are IBM extensions to ANS FORTRAN.

b. The program calls uniform random numbers U (between 0 and 1) by the statement

U = FLTRNF (0).

The FLTRNF function subprogram[18] is a private library routine at ANL and should be provided separately in installations outside of ANL. Other random variates are calculated from U in the PROSA code.

15. Name and Establishment of Authors: J. K. Vaurio and C. Mueller, Argonne National Laboratory, Reactor Analysis and Safety Division, 9700 South Cass Avenue, Argonne, Illinois 60439.

16. Material Available: Source decks, sample problem, job-control cards, and documentation.

17. Category: P, General Mathematical and Computing System Routines.

18. Keywords: Accident analysis, Approximation, Distribution, Histogram, Joint distribution, Moments, Monte Carlo, Probabilistic/Deterministic, Probabilistic safety, Random sampling, Response surface, Risk, Sampling, Sensitivity, Simulation.

C. Program Use

PROSA can be directed to perform five different tasks. The task to be executed is specified by the input variable JOBI. The tasks can be associated with major parts of the main program, Part 1 through Part 5 in Fig. 8, (p. 32) corresponding to the values JOBI = 1 through 5. The tasks are described in Sec. IV.C.1. The input for each task is specified in Sec. IV.C.2. The flow diagrams of the program are presented in Sec. IV.C.3, and the function of each subroutine is briefly described in Sec. IV.C.4.

1. Task Descriptions

Each execution of the program performs one of the following five tasks, specified by the input variable JOBI. After each task, the program control returns to the beginning and a new job starts (if not stopped by an End-Of-File).

Task 1 (JOBI = 1): Knot-point Coordinates

(1) Calculates and prints the knot-point coordinates of the parameters.

(2) Prints and punches the knot points.

(3) If TEST = 0, returns control to the beginning and a new job starts (if not stopped by an EOF).

(4) If TEST = 1, calculates "consequences" in the knot points using test subroutine TEXAS, and prints and punches these consequences. (This consequence output serves as input to Tasks 2 through 5 for testing purposes.)

Task 2 (JOBI = 2): Moments and Coefficients

(1) Calculates and prints the knot-point coordinates of the parameters (same as 1 of Task 1).

(2) Calculates, organizes, and prints sensitivity/importance measures of the parameters with respect to the consequences.

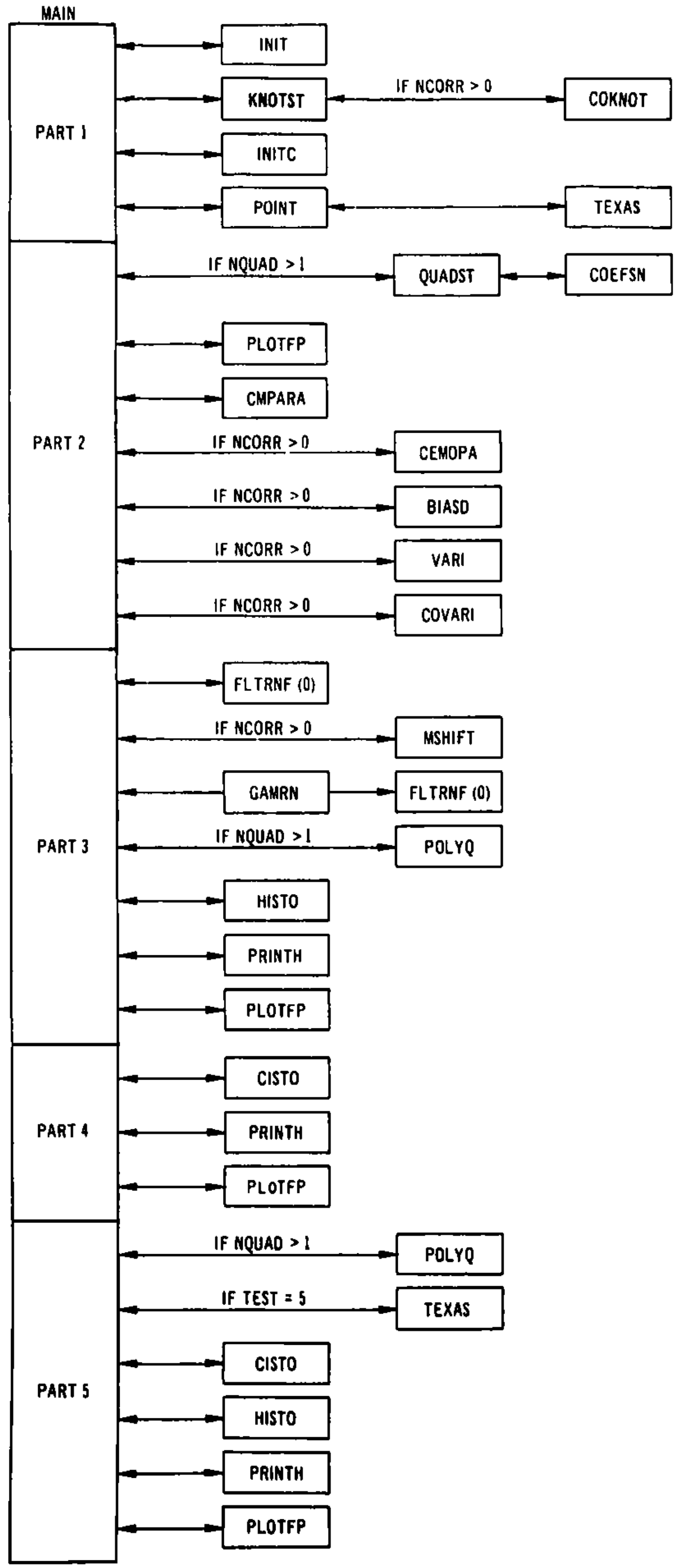

Fig. 8. Sequence of Subprograms in PROSA

(3) Calculates and prints the coefficients of the response surfaces, moments and correlation coefficients of the parameters, and analytical moments and correlation coefficients of the response-surface consequences.

(4) Sketches response-surface consequences versus parameters.

Note 1: No randon-number sampling/simulation takes place in Task 2.

Note 2: When regionwise ("multiquadrant") response surfaces are used (NQUAD = 4), separate coefficients are obtained for each region ("quadrant"), but the analytical moments of the consequences are for the "overall" response surface.

Task 3 (JOBI = 3): Distributions

(1) Performs all steps of Task 2.

(2) Defines 12 consequence categories for each consequence, six on each side of the analytical mean value obtained in Task 2. The width of each category is a user-specified fraction (input variable SCALE) of the analytical standard deviation of the consequence.

(3) Samples values for each parameter from its distribution, calculates values of the consequences in these sample points using the response surfaces, and forms the histograms and joint-histograms of the consequences.

(4) Calculates the sample moments of the consequences (up to the fourth-order) and the statistical-error estimates of the histogram category probabilities.

(5) Prints the above moments, consequence category limits, histograms, probability estimates and error estimates, and sketches the distributions in half-category intervals.

Task 4 (JOBI = 4): Conditional Distributions

(1) Performs all steps of Task 3.

(2) Calculates and prints the conditional distributions, conditional joint distributions, and conditional sample moments of the response-surface consequences (the condition being the criterion specified in the input for Task 4).

(3) Calculates and edits the fractions satisfying unrelieved (original) and relieved (see Note 2 below) criteria.

(4) If input variable NSC > 0, Task 4 punches (also prints if TEST = 4) sampled parameter combinations that satisfy relieved criteria (see Note 2).

Note 1: The category widths are the same as in Task 3, but the category limits may be shifted for conditional distributions.

Note 2: "Relieved criteria" here refer to the conditions for the conditional distributions [e.g., $p(\zeta | C > C_{cr} - \text{TOLE}*\sigma_c)$, where ζ is the consequence and $C > C_{cr}$ is the unrelieved criterion] that are changed (relieved) by an input-specified fraction TOLE of the analytical standard deviation of the consequence. TOLE can be used to study the sensitivity of conditional probabilities to the criteria. Make NSC > 0 only if Task 5 will be used.

Task 5 (JOBI = 5): Difference Distributions

Task 5 is provided to test the quality of the conditional distributions obtained in Task 4 using the response-surface consequences. It is presumed that the parameter combinations punched in Task 4 are input for the deterministic code and the consequence values so obtained are input for Task 5. Here, as in Fig. 13 (p. 44), these consequences are called "real consequences."

(1) Calculates and edits the conditional distributions of the real consequences.

(2) Calculates and edits the distributions of the differences between the real consequences and the response-surface consequences.

Note 1: If TEST = 5, the real consequences are calculated in the test-subroutine TEXAS rather than input.

Note 2: The width of each difference category is TOLE/2 times the analytical standard deviation of the consequence.

2. Input Instructions

Card 1

Variable	Columns	Format	Descriptions
NPARA	1-2	I2	Number of input parameters (≤12).
LMPAIR	3-4	I2	Indicator to limit cross terms in a quadratic response surface; LMPAIR = 0, no limitation; LMPAIR = 1, pairs limited (LMPAIR is in use only with NQUAD = 1).
JOBI	5-6	I2	Task indicator (see Sec. IV.C.1).
PROB	7-16	F10.8	Probability range to select the knot-point coordinates (<0.5).
NCONS	17-19	I3	Number of consequence variables (≤6).
NSA	20-27	I8	Number of simulation cycles.
SCALE	28-33	F6.2	Histogram-category-width indicator (as a fraction of standard deviation).
TEST	34-36	I3	Control variable for testing (0, 1, 4, 5).
WORK	37-42	I6	Work number.
NCORR	43-47	I5	Number of correlations between the input parameters.
NQUAD	48-52	I5	Response-surface option: = 1, single quadratic response surface; = 4, regionwise "multiquadrant" response surfaces.

Note: NCONS, NSA, and SCALE are not used in Task 1 (JOBI = 1); NSA and SCALE are not needed in Task 2 (JOBI = 2).

Next NPARA Cards

Variable	Columns	Format	Descriptions
K	1-2	I2	Parameter number (1, 2, ..., 12)
NAME	4-9	A6	Parameter name
JDIS	10-11	I2	Parameter-distribution indicator (1 ≤ JDIS ≤ 8)
ADIS	12-22	F11.5	First distribution parameter

Variable	Columns	Format	Descriptions
BDIS	23-33	F11.5	Second distribution parameter
CDIS	34-44	F11.5	Third distribution parameter
DDIS	45-55	F11.5	Fourth distribution parameter
JJK(12)	57-68	12I2	Used when LMPAIR = 1 to indicate the pairs of parameter K to be taken into account in the cross terms of the response surface.

Note: The distributions and parameters available are as follows:

JDIS	ADIS	BDIS	CDIS	DDIS
1 = Uniform	Upper limit	Lower limit	-	-
2 = Normal	Mean value	Standard deviation	-	-
3 = Exponential I	Lower limit	Scale constant	-	-
4 = Exponential II	Upper limit	Scale constant	-	-
5 = Truncated normal I	Mean value	Standard deviation	Lower limit	-
6 = Truncated normal II	Mean value	Standard deviation	Upper limit	-
7 = Beta	Lower limit	Upper limit	Mean value	Standard deviation
8 = Log-normal	Mean value	Standard deviation	-	-

For distributions 5 and 6, the mean value and standard deviation are those for the untruncated normal distribution. For distribution 8, the mean value and standard deviation are those of the logarithm of the parameter. The mathematical expressions for these distributions are given in Table I.

Next NCORR Cards
(if NCORR > 0)

Variable	Columns	Format	Descriptions
ITYPE	1-5	I5	Correlation type, not in use.
ILEAD	6-10	I5	Number (K) of a leading parameter.

Variable	Columns	Format	Descriptions
FLEAD	11-25	E15.6	A value of the leading parameter (other than mean value).
IDEP	26-30	I5	Number (K) of a dependent parameter.
FDEP	31-45	E15.6	Expected value of the dependent parameter when the leading parameter has the value FLEAD.

Note 1: The order of the parameters must satisfy ILEAD $<$ IDEP.

Note 2: Several dependent parameters may have a common leading parameter; not more than one leading parameter may be assigned for any dependent parameter.

KNOT-POINT Consequence Cards

These cards are needed for Tasks 3, 4, and 5 (JOBI = 3, 4, 5) and are normally generated by a deterministic code outside of PROSA (or by subroutine TEXAS if TEST = 1 in Task 1). The first six columns (INDEX, variables J and K) are copied directly from the knot-point-coordinate cards produced by Task 1 (JOBI = 1) without any manipulation.

The last consequence card should be followed by a card with -1 in columns 1-2. (This indicates the end of the consequence cards.)

Variable	Columns	Format	Descriptions
INDEX	1-2	I2	Indicates the location of the knot point with respect to the mean value(s) of parameters(s) J (and K).
J	3-4	I2	Parameter number ($1 \leq J \leq$ NPARA).
K	5-6	I2	Parameter number ($J < K \leq$ NPARA), $\neq 0$ only for cross terms, i.e., when INDEX $>$ 10.
CONS(1)	9-20	E12.6	The value of the first consequence variable at the knot point specified by (INDEX, J, K).
CONS(2)	21-32	E12.6	The second consequence variable.
.			.
.			.
.			.
CONS (NCONS)		E12.6	The last consequence variable (maximum NCONS = 6).

Note: Relevant values of INDEX are

NQUAD = 1: 0, 1, 2, 11
NQUAD = 4: 0, 1, 2, 3, 4, 11, 22, 33, 44

Condition Card

This card specifies conditions for conditional distributions, is needed in Tasks 4 and 5 (JOBI = 4, 5), and should follow the -1 card at the end of the knot-point consequence cards.

Variable	Columns	Format	Descriptions
NSB	1-6	I6	Number of simulation cycles satisfying conditions (limit). Either NSA or NSB (whichever occurs first) ends the simulation.
NSC	7-12	I6	Number of output cards in Task 4 (limit). NSC < 1000. NSC ≠ 0 only if Task 5 will be used later.
TOLE	13-18	F6.2	Tolerance for relieved conditions (as a fraction of standard deviation).
NCR(1)	21-22	I2	Number of the consequence variable (1, ..., NCONS) that is also a criterion/condition variable.
LCR(1)	23-24	I2	Condition type, = 1, when FCR is upper limit; = 0, when FCR is lower limit.
FCR(1)	25-35	G11.4	Limit/condition value for consequence NCR(1).
NCR(2)	36-37	I2	Second condition (if any).
LCR(2)	38-39	I2	
FCR(2)	40-50	G11.4	
NCR(3)	51-52	I2	Third condition (if any).
LCR(3)	53-54	I2	
FCR(3)	55-65	G11.4	
NCR(4)	66-67	I2	Fourth condition (if any).
LCR(4)	68-69	I2	
FCR(4)	70-80	G11.4	

Note: Columns may be left blank (NCR(I) = 0) for conditions not needed.

Conditional Parameter Cards

These NSC (or 2 NSC) cards are needed for Task 5 only (JOBI = 5) and are output from Task 4.

Variable	Columns	Format	Descriptions
Z(1)	9-20	E12.6	Value of parameter 1
Z(2)	21-32	E12.6	Value of parameter 2
.			.
.			.
.			.
Z(NPARA)		E12.6	Value of parameter NPARA (≤12).

This information specifies one parameter combination that satisfies relieved conditions. It consists of one card if NPARA ≤ 6 or two cards if 7 ≤ NPARA ≤ 12. Thus, the total input is NSC or 2 NSC cards depending on the number of parameters, NPARA.

Real Consequence or Parameter Input

This input is needed for Task 5 only and depends on whether the consequences are calculated by an external deterministic code (TEST = 0) or in the subroutine TEXAS (TEST = 5).

TEST = 5: The "Conditional Parameter Cards" as described above.

TEST = 0: NSC cards with the following information, calculated in the parameter points generated in Task 4.

Variable	Columns	Format	Descriptions
CONS(1)	9-20	E12.6	Value of the first consequence variable.
CONS(2)	21-32	E12.6	Value of the second consequence variable.
.			.
.			.
.			.
CONS (NCONS)		E12.6	Value of the consequence variable NCONS (≤6).

3. **Flow Diagrams**

Figure 8 shows the flow diagram of the program. Major parts of the main program are presented in more details in Figs. 9-13. Encircled numbers in these diagrams refer to FORTRAN statement numbers where execution continues. Exit or entry is indicated by an arrow. For example, exit to 501 in Fig. 11 appears as an entry in Fig. 13.

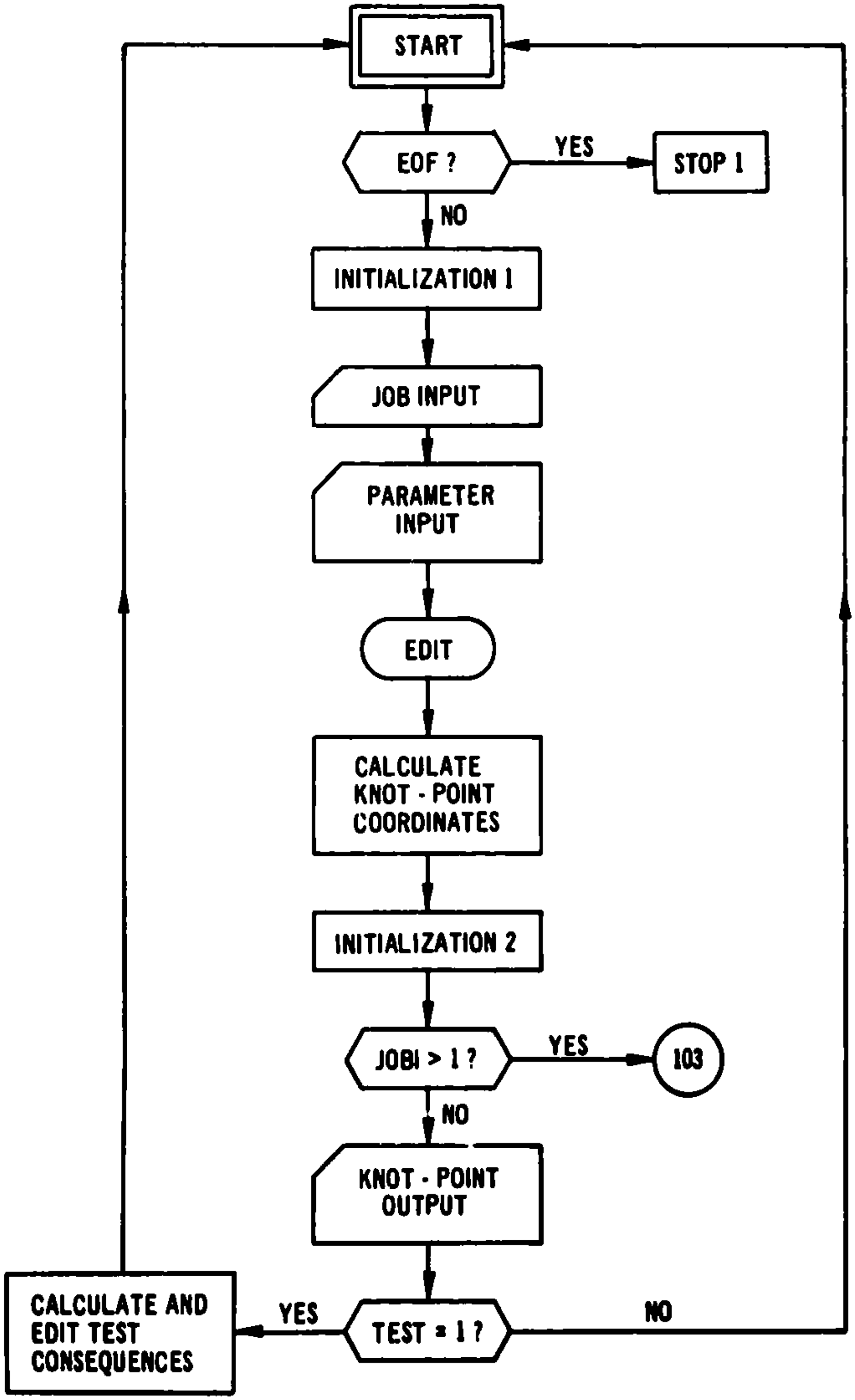

Fig. 9. Flow Diagram for Part 1 (JOBI = 1)

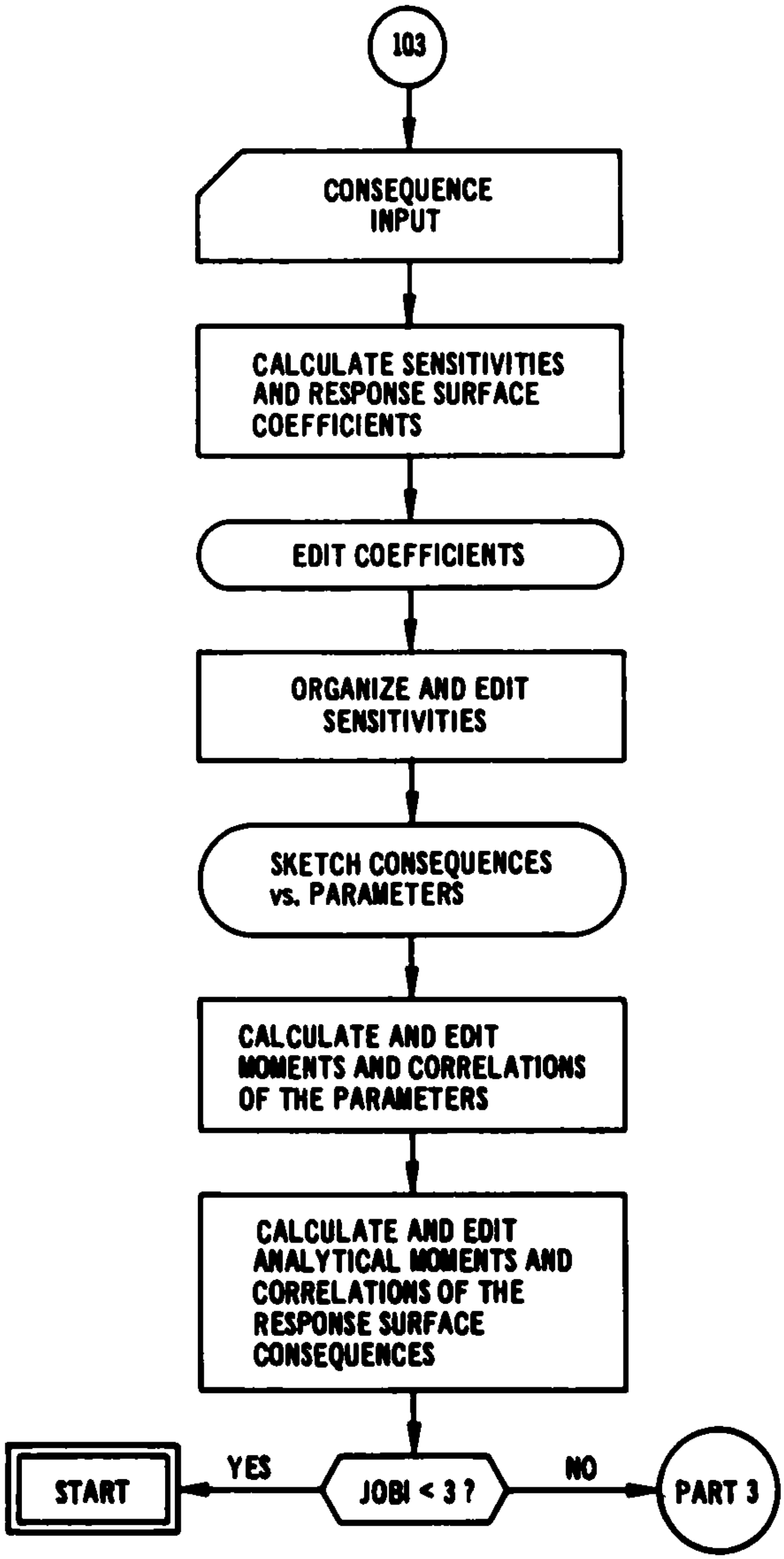

Fig. 10. Flow Diagram for Part 2

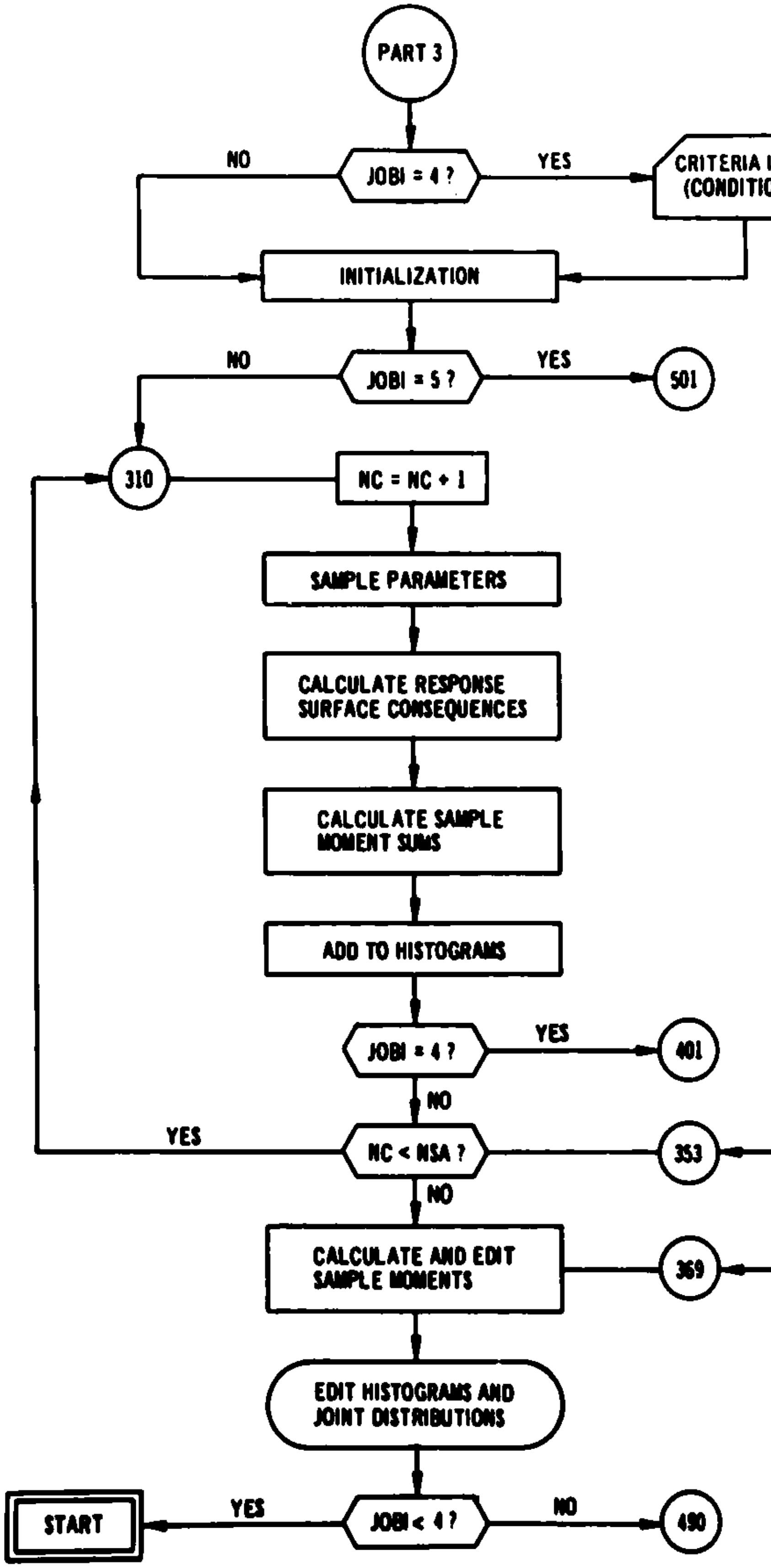

Fig. 11. Flow Diagram for Part 3

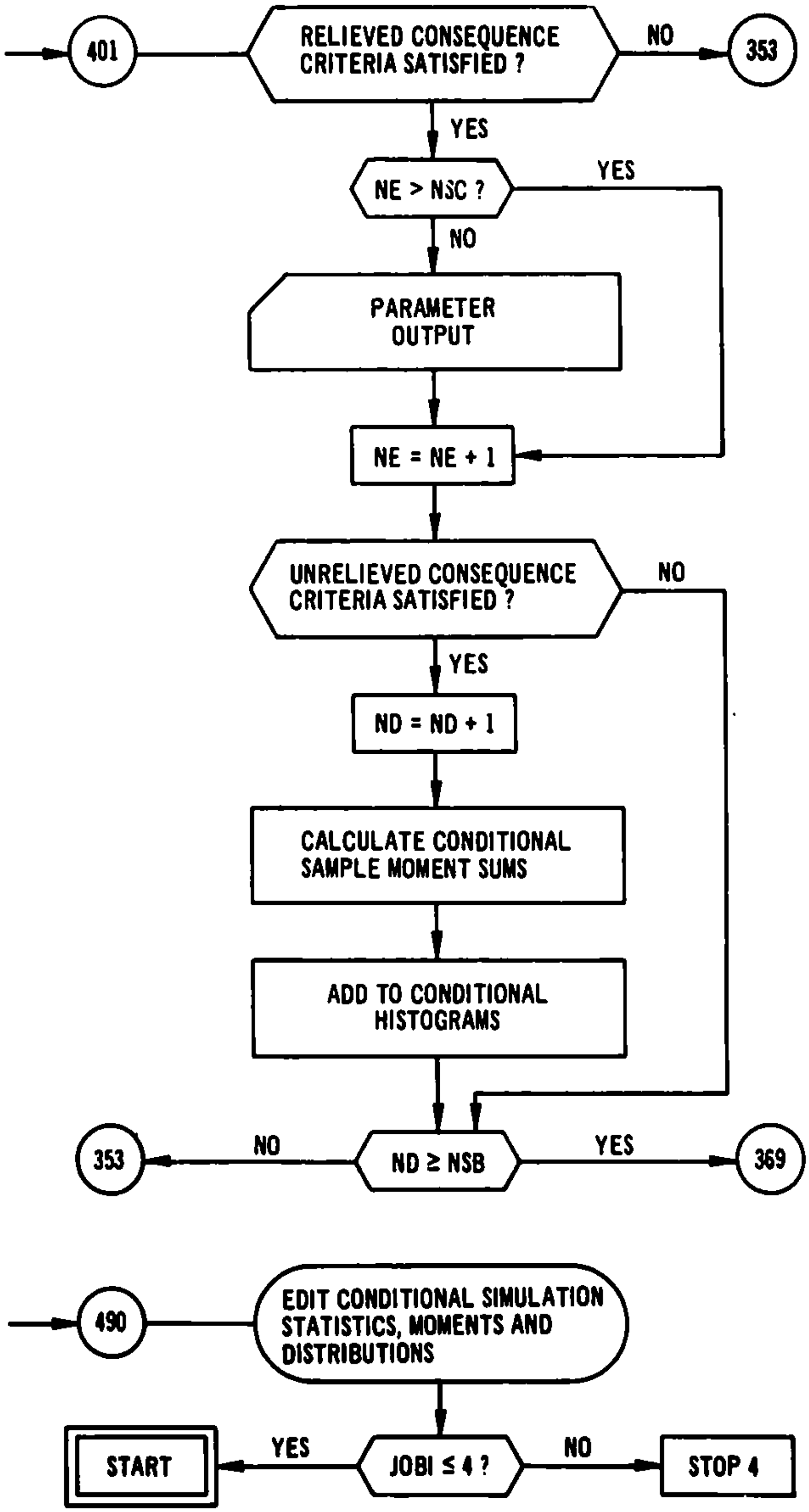

Fig. 12. Flow Diagram for Part 4

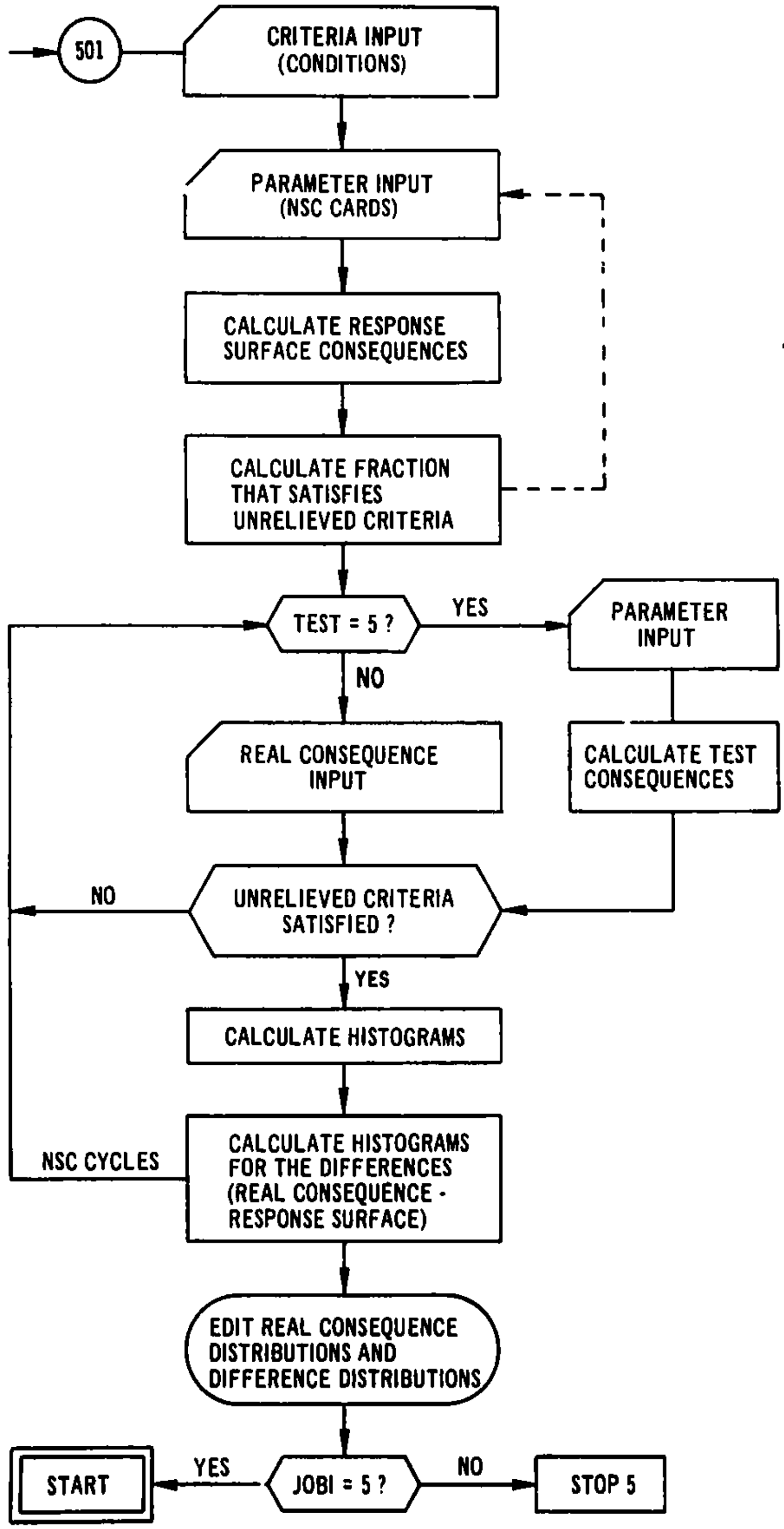

Fig. 13. Flow Diagram for Part 5

4. Subroutine Functions

Figure 8 shows the calling sequence and calling conditions of all subroutines. The function of each subroutine is described briefly below.

BIASD	Calculates additional terms in analytical mean values of the consequences.
CEMOPA	Calculates additional terms for the central moments of the parameters.
CISTO	Calculates conditional histograms and joint histograms.
CMPARA	Calculates the mean values and central moments of the parameters.
COEFSN	Calculates polynomial coefficients for multiquadrant response surfaces.
COKNOT	Calculates knot-point coordinates for correlated input parameters.
COMMP	Comdeck COMMP is a group of COMMON statements called by the subroutines.
COVARI	Calculates terms in analytical correlations between the consequences.
FLTRNF(0)	Samples a uniformly distributed random number (0, 1) (a library-function subprogram).
GAMRN	Function subprogram in the MAIN program; calculates gamma-distributed random variates from uniform random variates.
HISTO	Calculates histograms and joint histograms.
INIT	Sets initial value zeros.
INITC	Sets initial value zeros.
KNOTST	Calculates the knot-point coordinates.
MAIN	Overall control routine.
MSHIFT	Calculates the shift term for correlated input parameters in sampling.
PLOTFP	Plots the sketches of the consequences versus parameters and the distributions of the consequences.
POLYQ	Calculates consequences of multiquadrant response surfaces in the simulation phase.
POINT	Edits knot-point coordinates (and calculates consequences if TEST = 1).
PRINTH	Edits probability distributions, joint distributions, and error estimates.

QUADST	Calculates coefficients for multiquadrant response surfaces.
TEXAS	Calculates consequence values; used as a testing subroutine.
VARI	Calculates additional terms in analytical variances of the consequences.

V. SUMMARY AND DISCUSSION

This report has described probabilistic methods for response-surface analysis and the computer code PROSA developed for implementing these techniques. Features illustrated included (1) the use of regionwise multiple response surfaces, (2) a treatment to handle correlated input parameters, and (3) the calculation of conditional distributions with an indication of their potential role in importance-sampling routines to investigate more fully the responses in an interesting region of parameter space.

This report also contains the User's Manual for the PROSA code. The use of the code has been illustrated by probabilistic evaluations of LMFBR core-disruptive accidents,[29] although, as mentioned earlier, the techniques are general and not limited to such applications.

The use of distinct polynomials for different regions of parameter space as discribed here retains the continuity of a response surface, but destroys the continuity of the derivatives at the parameter-space interfaces. This limitation could be eliminated by introducing weighting functions $W(\bar{z})$ such that

$$\tilde{\zeta}(\bar{z}) = W_0(\bar{z})\varphi_0(\bar{z}) + \sum_i W_i(\bar{z})\varphi_i(\bar{z}),$$

where φ_0 and φ_i denote the response surfaces for the entire parameter space and each quadrant of parameter space, respectively, and W_0 and W_i denote the corresponding weighting functions. Continuous weighting functions, W, with continuous derivatives will generate continuous response surfaces $\tilde{\zeta}$, with similarly continuous derivatives.

In the correlated-parameter treatment described, a linear relationship between input parameters was assumed. This treatment could be extended for more general relationships.

The importance-sampling techniques and conditional-distribution fitting routines described here will be incorporated into the PROSA code as an obvious extension of the current capabilities of the code.

Another line of development includes the use of functions other than polynomials for fitting consequences over parameter space. An automated use of transformations for input variables and responses is also desirable.

The use of fast-running deterministic tools to provide the data points to determine the coefficients of the response surfaces was cited. For LMFBR applications, the SACO code is being extended to treat the transition and disassembly phases of LOF transients. For other applications, an analogous development of a deterministic code is needed whenever functional safety evaluations are expensive, an obvious example being loss-of-coolant-accident studies for light-water reactors.

APPENDIX A

Program Listing

```
MEMBER NAME  MAIN
         CC MAIN PROGRAM
              DIMENSICN IPLO(6,26),TP(26),XP(26)
              DIMENSION ICPLO(6,26),TC(26),XC(26)
              DIMENSION SUMA(6),SUMB(6),SUMC(6),SUMD(6)
              DIMENSICN SAMEAN(6),SASD(6)
              DIMENSION CSUMA(6),CSUMB(6),CSUMC(6),CSUMD(6)
              DIMENSION CSMEAN(6),CSSD(6)
              DIMENSICN APZ(1000,6)
              DIMENSION SAVZEP(6)
          1000 FORMAT(1H1,T40,'INPUT DATA - WORK',I6,3X,6H JOBI ,I2/)
          1001 FORMAT(3I2,F10.8,I3,I8,F6.2,I3,I6,I5,I5)
          1002 FORMAT(I2,1X,A4,A2,I2,4F11.5,1X,12I2)
          1003 FORMAT(1H0,26H NUMBER OF PARAMETERS    = ,I3/)
          1004 FORMAT(7H        ,I4,4X,A4,A2,I6,6X,4G11.5,4X,12I3)
          1005 FORMAT(1H0,T8,'NUMBER',T17,'NAME',T24,'DISTRIBUTION',T43,'PARAMETE
              1RS',T94,'PAIRS IF LIMITED NUMBER'/)
          1006 FORMAT(1H ,10X,I5,39H CORRELATIONS BETWEEN INPUT PARAMETERS/)
          1007 FORMAT(34H SINGLE RESPONSE SURFACE (NQUAD=1)//)
          1008 FORMAT(42H MULTI QUADRANT RESPONSE SURFACE (NQUAD=4)//)
          1009 FORMAT(32H NQUAD BETWEEN 1 AND 4, SET TO 1//)
          1010 FORMAT(29H INDEPENDENT INPUT PARAMETERS//)
          1011 FORMAT(24H NUMBER OF PAIRS LIMITED/)
          1012 FORMAT(18H  PAIRS UNLIMITED /)
          1013 FORMAT(27H  NUMBER OF CONSEQUENCES = ,I3/)
          1014 FORMAT(20H  PROBABILITY RANGE ,F12.8/)
          1015 FORMAT(31H  NUMBER OF SIMULATION CYCLES =,I10/16H  CATEGORY WIDTH
              1=,F8.2,20H STANDARD DEVIATIONS/)
          1016 FORMAT(52H  CONSEQUENCES CALCULATED BY TEST SUBROUTINE (TEXAS)//)
          1017 FORMAT(I5,I5,E15.6,I5,E15.6)
          1018 FORMAT(1H0,6X,16HCORRELATION TYPE,I4,11H  LEAD PARA,I4,8H, VALUE=,
              1E14.6,3X,14HDEPENDENT PARA,I4,15H  SHIFTED MEAN=,E14.6/)
          1019 FORMAT(1H0)
          1020 FORMAT(91H0 DISTRIBUTION    FIRST PARAMETER  SECOND PARAMETER
              1 THIRD PARAMETER   FOURTH PARAMETER/)
          1021 FORMAT(86H    1=UNIFORM        UPPER LIMIT     LOWER LIMIT
              1 N/A              N/A          )
          1022 FORMAT(86H    2=NORMAL         MEAN VALUE      STANDARD DEVIATION
              1 N/A              N/A          )
          1023 FORMAT(86H    3=EXPONENTIAL    LOWER LIMIT     SCALE CONSTANT
              1 N/A              N/A          )
          1024 FORMAT(86H    4=EXPONENTIAL    UPPER LIMIT     SCALE CONSTANT
              1 N/A              N/A          )
          1025 FORMAT(86H    5=NORMAL         MEAN VALUE      STANDARD DEVIATION
              1 LOWER LIMIT      N/A          )
          1026 FORMAT(86H    6=NORMAL         MEAN VALUE      STANDARD DEVIATION
              1 UPPER LIMIT      N/A          )
          1027 FORMAT(93H    7=BETA           LOWER LIMIT     UPPER LIMIT
              1 MEAN             STANDARD DEVIATION)
          1028 FORMAT(96H    8=LOG NORMAL     MEAN VALUE      STANDARD DEVIATION
              1 N/A              N/A          )
          1029 FORMAT(////4X,'FOR DISTRIBUTIONS 5 AND 6, THE VALUES FOR THE MEAN
              1AND STANDARD DEVIATION ARE THOSE FOR THE UNTRUNCATED NORMAL DISTRI
              2BUTIONS.',///,4X,'FOR DISTRIBUTION 8, THE VALUES FOR MEAN AND STAN
              3DARD DEVIATION ARE THOSE OF THE LOGARITHM OF THE PARAMETER.')
         C
         *CALL COMMP
             3 CONTINUE
         CALL INIT
```

```
MEMBER NAME  MAIN
          CALL INIT
C  READ  JOB  INFO
C  LMPAIR GT 0 IF PAIRS LIMITED
          READ(5,1001,END=989)NPARA,LMPAIR,JOBI,PROB,NCONS,NSA,SCALE,TEST,WO
         1RK,NCORR,NQUAD
          WRITE(6,1000)WORK,JOBI
          WRITE(6,1003)NPARA
          IF(NCORR.GT.0) WRITE(6,1006)NCORR
          IF(LMPAIR.LE.0) WRITE(6,1012)
          WRITE(6,1014) PROB
          IF(NCONS.GT.0) WRITE(6,1013)NCONS
          IF(JOBI.EQ.3) WRITE(6,1015) NSA,SCALE
          IF(JOBI.EQ.4) WRITE(6,1015) NSA,SCALE
          IF(TEST.EQ.1)  WRITE(6,1016)
C  DEFAULT NQUAD = 1 OR 4
          IF(NQUAD.LE.3) WRITE(6,1007)
          IF(NQUAD.GT.1.AND.NQUAD.LT.4) WRITE(6,1009)
          IF(NQUAD.GT.1.AND.NQUAD.LT.4)NQUAD=1
          IF(NQUAD.LE.1) NQUAD = 1
          IF(NQUAD.GE.4) WRITE(6,1008)
          IF(NQUAD.GE.4)NQUAD=4
          IF(NQUAD.GE.4) LMPAIR=0
          IF(LMPAIR.GT.0) WRITE(6,1011)
          NQ=NQUAD
          IF(NCORR.LE.0) WRITE(6,1010)
          WRITE(6,1005)
C  READ PARAMETER INFO AND ORGANIZE
          DO 11 I=1,NPARA
          READ(5,1002) K,NAMEA,NAMEB,JDIS,UADIS,UBDIS,UCDIS,UDDIS,JJK
          WRITE(6,1004) K,NAMEA,NAMEB,JDIS,UADIS,UBDIS,UCDIS,UDDIS,JJK
          IPARA(K)=K
          PNAMEA(K)= NAMEA
          PNAMEB(K)= NAMEB
          IDIS(K)=JDIS
          ADIS(K)=UADIS
          BDIS(K)=UBDIS
          CDIS(K)=UCDIS
          DDIS(K)=UDDIS
C  IF CROSS-TERMS NOT LIMITED GO TO 11
          IF(LMPAIR.LE.0) GO TO 11
          DO 12 L=1,12
          JA= JJK(L)
          IF(JA.LE.K) GO TO 13
          JK(K,JA)= 1
          GO TO 12
   13     IF(JA.LE.0) GO TO 12
          JK(JA,K)= 1
   12     CONTINUE
   11     CONTINUE
          IF(NCORR.LE.0) GO TO 16
          DO 18 I=1,NCORR
          READ(5,1017) ITYPE(I),ILEAD(I), FLEAD(I),IDEP(I),  FDEP(I)
          WRITE(6,1018)ITYPE(I),ILEAD(I), FLEAD(I),IDEP(I),  FDEP(I)
   18     CONTINUE
   16     WRITE(6,1019)
          WRITE(6,1020)
          WRITE(6,1021)
          WRITE(6,1022)
```

```
MEMBER NAME  MAIN
             WRITE(6,1023)
             WRITE(6,1024)
             WRITE(6,1025)
             WRITE(6,1026)
             WRITE(6,1027)
             WRITE(6,1028)
             WRITE(6,1029)
      C
      CALL KNOTST TO SET KNOT POINTS
             CALL KNOTST
      C ZEROS FOR JOBI 2 , EARLY BECAUSE OF TESTING  (TEXAS)
             CALL INITC
      C  PRINT  KNOT POINT Z-VALUES
      C
       1600 FORMAT(27H1 PARAMETER VALUES SELECTED/ T5,'NUMBER',T14,'NAME',T26,
           1'Z2',T40,'Z0',T54,'Z1'/)
       1601 FORMAT(4H    ,I4,3X,A4,A4,3E14.6)
       1602 FORMAT(27H1 PARAMETER VALUES SELECTED/ T5,'NUMBER',T14,'NAME',T26,
           1'Z2',T40,'Z4',T54,'Z0',T68,'Z3',T82,'Z1'/)
       1603 FORMAT(4H    ,I4,3X,A4,A4,5E14.6)
       1610 FORMAT (16H0 KNOT  - POINTS//T7,'INDEX',T15,'J    K    Z-VALUES'/)
       1611 FORMAT (5H     ,3I5,(6E16.6))
       1613 FORMAT (42H0   END  OF  FIXED  KNOT  -  POINT  OUTPUT)
             IF(NQ.GT.1) GO TO 46
             WRITE(6,1600)
         46 IF(NQ.GT.1) WRITE(6,1602)
             DO 48 L=1,NPARA
             IF(NQ.GT.1) GO TO 47
             WRITE(6,1601) IPARA(L),PNAMEA(L),PNAMEB(L),Z2(L),Z0(L),Z1(L)
         47 IF(NQ.GT.1) WRITE(6,1603) IPARA(L),PNAMEA(L),PNAMEB(L),
           1Z2(L),Z4(L),Z0(L),Z3(L),Z1(L)
         48 CONTINUE
             IF(JOBI.GT.1) GO TO 103
      C  PUNCH AND PRINT  KNOT - POINTS
      C  REFERENCE  POINT
             WRITE(6,1610)
             DO 49 L=1,12
             Z(L)=Z0(L)
         49 CONTINUE
             INDEX=0
             J = 0
             K = 0
             CALL POINT
      C  OFF  REFERENCE  POINTS
         50 DO 51 L=1,NPARA
             Z(L)=Z1(L)
             INDEX=1
             J =L
             CALL POINT
             Z(L)=Z2(L)
             INDEX=2
             CALL POINT
             IF(NQ.EQ.1) GO TO 70
             Z(L)=Z3(L)
             INDEX=3
             CALL POINT
             Z(L)=Z4(L)
             INDEX=4
```

```
MEMBER NAME  MAIN
          CALL POINT
      70 CONTINUE
         Z(L)=Z0(L)
      51 CONTINUE
         NPAI=NPARA-1
   C   CROSS  POINTS
         INDEX=0
      59 CONTINUE
         INDEX=INDEX+11
         DO 52 J=1,NPAI
         JPI=J+1
         DO 53 K=JPI,NPARA
         IF(INPAIR.GT.0)  GO TO 60
      71 CONTINUE
         IF(INDEX.EQ.22)  GO TO 56
         IF(INDEX.EQ.33)  GO TO 57
         IF(INDEX.EQ.44)  GO TO 58
      54 CONTINUE
         Z(J)=Z3(J)
         Z(K)=Z3(K)
         CALL POINT
         Z(K)=Z0(K)
         GO TO 53
      56 CONTINUE
         Z(J)=Z4(J)
         Z(K)=Z3(K)
         CALL POINT
         Z(K)=Z0(K)
         GO TO 53
      57 CONTINUE
         Z(J)=Z4(J)
         Z(K)=Z4(K)
         CALL POINT
         Z(K)=Z0(K)
         GO TO 53
      58 CONTINUE
         Z(J)=Z3(J)
         Z(K)=Z4(K)
         CALL POINT
         Z(K)=Z0(K)
      53 CONTINUE
         Z(J)=Z0(J)
      52 CONTINUE
         IF(NQ.LT.1)  GO TO 55
         IF(INDEX.LT.44)  GO TO 59
         GO TO 55
      60 IF(JK(J,K).EQ.1)  GO TO 71
         GO TO 53
      55 WRITE(6,1613)
         IF(TEST.EQ.0)  GO TO 3
   C  CONSEQUENCE  OUTPUT FOR TESTING ONLY (TEST.GT.0)
    1700 FORMAT(36H1     TEST CONSEQUENCE OUTPUT -TEXAS //)
    1701 FORMAT(3I2,2X,(6E12.6))
    1702 FORMAT(5H      ,3I5,(6E16.6))
         WRITE(6,1700)
         INDEX = 0
         J=0
         K=0
```

```
MEMBER NAME  MAIN
           WRITE(7,1701) INDEX,J,K,(ZETA0(L),L=1,NCONS)
           WRITE(6,1702) INDEX,J,K,(ZETA0(L),L=1,NCONS)
           DO 81 J=1,NPARA
           INDEX =1
           WRITE(7,1701) INDEX,J,K,(ZETA1(L,J),L=1,NCONS)
           WRITE(6,1702) INDEX,J,K,(ZETA1(L,J),L=1,NCONS)
           INDEX =2
           WRITE(7,1701) INDEX,J,K,(ZETA2(L,J),L=1,NCONS)
           WRITE(6,1702) INDEX,J,K,(ZETA2(L,J),L=1,NCONS)
           IF(NQ.LE.1) GO TO 72
           INDEX=3
           WRITE(7,1701) INDEX,J,K,(ZETA3(L,J),L=1,NCONS)
           WRITE(6,1702) INDEX,J,K,(ZETA3(L,J),L=1,NCONS)
           INDEX=4
           WRITE(7,1701) INDEX,J,K,(ZETA4(L,J),L=1,NCONS)
           WRITE(6,1702) INDEX,J,K,(ZETA4(L,J),L=1,NCONS)
        72 CONTINUE
           IF(J.EQ.NPARA) GO TO 81
           JPI=J+1
           INDEX=0
        84 CONTINUE
           INDEX=INDEX+11
           DO 82 K=JPI,NPARA
           IF(LMPAIR.GT.0) GO TO 86
        83 CONTINUE
           IF(INDEX.EQ.22) GO TO 85
           IF(INDEX.EQ.33) GO TO 87
           IF(INDEX.EQ.44) GO TO 88
           WRITE(7,1701) INDEX,J,K,(ZETA11(L,J,K),L=1,NCONS)
           WRITE(6,1702) INDEX,J,K,(ZETA11(L,J,K),L=1,NCONS)
           GO TO 82
        85 CONTINUE
           WRITE(7,1701) INDEX,J,K,(ZETA22(L,J,K),L=1,NCONS)
           WRITE(6,1702) INDEX,J,K,(ZETA22(L,J,K),L=1,NCONS)
           GO TO 82
        87 CONTINUE
           WRITE(7,1701) INDEX,J,K,(ZETA33(L,J,K),L=1,NCONS)
           WRITE(6,1702) INDEX,J,K,(ZETA33(L,J,K),L=1,NCONS)
           GO TO 82
        88 CONTINUE
           WRITE(7,1701) INDEX,J,K,(ZETA44(L,J,K),L=1,NCONS)
           WRITE(6,1702) INDEX,J,K,(ZETA44(L,J,K),L=1,NCONS)
        82 CONTINUE
           IF(NQ.LE.1) GO TO 73
           IF(INDEX.LT.44) GO TO 84
        73 CONTINUE
           K=0
        81 CONTINUE
           GO TO 3
        86 IF(JK(J,K).EQ.1) GO TO 83
           GO TO 82
      C END OF TEST OUTPUT - JOBI 1
      C  JOBI 2
       2000 FORMAT(36H1  INPUT CONSEQUENCES IN KNOT POINTS//T7,'INDEX', T15,'J
          1    K   ',13,14H -CONSEQUENCES/)
       2001 FORMAT(3I2,2X,(6E12.6))
       2002 FORMAT(5H     ,3I5,(6E16.6))
      C  READ  CONSEQUENCES IN KNOT POINTS
```

```
MEMBER NAME  MAIN
C  NEGATIVE  INDEX  CARD  ENDS  JOBI2 INPUT FOR SEPARATE PROBLEMS IF MORE THAN 1
  103 WRITE(6,2000) NCONS
  107 READ(5,2001,ERR=980,END=990) INDEX, J, K,(CONS(I),I=1,NCONS)
      WRITE(6,2002) INDEX,J,K,(CONS(I),I=1,NCONS)
      IX=INDEX
      IF(IX.LT.0) GO TO  990
      IF(IX.GT.44) GO TO 981
      DO 111 L=1,NCONS
      IF(INDEX.EQ.0) ZETA0(L)=CONS(L)
      IF(INDEX.EQ.1) ZETA1(L,J)=CONS(L)
      IF(INDEX.EQ.2) ZETA2(L,J)=CONS(L)
      IF(INDEX.EQ.3) ZETA3(L,J)=CONS(L)
      IF(INDEX.EQ.4) ZETA4(L,J)=CONS(L)
      IF(INDEX.EQ.11) ZETA11(L,J,K)=CONS(L)
C  SINGLE RESPONSE SURFACE CASE  ZETA3 = ZETA1
      IF(NQ.EQ.1.AND.INDEX.EQ.1) ZETA3(L,J) = ZETA1(L,J)
      IF(NQ.EQ.1) GO TO 111
      IF(INDEX.EQ.22) ZETA22(L,J,K)=CONS(L)
      IF(INDEX.EQ.33) ZETA33(L,J,K)=CONS(L)
      IF(INDEX.EQ.44) ZETA44(L,J,K)=CONS(L)
  111 CONTINUE
      GO TO 107
  980 WRITE(6,2500)
 2500 FORMAT(36H0 ERROR IN CONSEQUENCE INPUT -JOBI 2//)
      STOP
  981 WRITE(6,2501)
 2501 FORMAT(42H0 INDEX ERROR IN CONSEQUENCE INPUT -JOBI 2//)
      STOP
  989 STOP 1
  990 CONTINUE
      WRITE(6,2003)
 2003 FORMAT(32H0 NEGATIVE INDEX IS FOR EOF ONLY/)
C  OVERALL
C  SENSITIVITIES  AND  COEFFICIENTS CALCULATION
C  SINGLE SURFACE CASE  (NQ=1) REMEMBER Z3=Z1 AND ZETA3= ZETA1
  119 DO 120 L=1,NCONS
      DO 121 J=1,NPARA
      IF(J.EQ.NPARA)GO TO 128
      JPI=J+1
      DO 122 K=JPI,NPARA
      IF(LNPAIR.GT.0)GO TO 130
  126 IF(ZETA11(L,J,K).EQ.0.) GO TO 132
  125 DIFF = ZETA11(L,J,K)+ZETA0(L)- ZETA3(L,J) -ZETA3(L,K)
      SENSCB(L,J,K)=ABS(DIFF)
      D(L,J,K)= DIFF/ ((Z3(J)-Z0(J))* (Z3(K)- Z0(K)))
  122 CONTINUE
  128 SENS(L,J)=ABS(ZETA1(L,J)-ZETA0(L)) + ABS(ZETA0(L)-ZETA2(L,J))
      R1= (ZETA1(L,J)- ZETA0(L)) / ((Z1(J)-Z0(J))*(Z1(J)-Z2(J)))
      R2= (ZETA2(L,J)- ZETA0(L)) / ((Z2(J)-Z0(J))*(Z2(J)-Z1(J)))
      C(L,J)= R1+R2
      B(L,J)= R1*(Z0(J)-Z2(J)) + R2 *(Z0(J)-Z1(J))
  121 CONTINUE
  120 CONTINUE
C MULTI QUADRANT COEFFICIENTS
      IF(NQUAD.GT.1) CALL QUADST
C
C  EDIT POLYNOMIAL COEFFICIENTS
C
```

```
MEMBER NAME  MAIN
C  FOR MULTIQUADRANT CASES IQ = QUADRANT INDICATOR
C  THE ORDER OF THE PARAMETERS IS IMPORTANT IN DEFINING THE QUADRANT
C  IF NQ=4 WE HAVE 2 B-AND C-COEFFICIENTS FOR EACH PARAMETER, 4 D-COEFFICIENTS
C  QUADRANTS 1 AND 4 HAVE SAME B AND C COEFFICIENTS
C  QUADRANTS 2 AND 3 HAVE SAME B AND C COEFFICIENTS
C  THIS CONVENTION IMPORTANT IN THE SAMPLING AND SIMULATION PHASE
C
 2050 FORMAT(41H1      THE COEFFICIENTS OF THE POLYNOMIALS/1)H          /
     162H    A                                                          /
     262H   + B(J)  *  (Z(J)-Z0(J))                    , SUM J          /
     362H   + C(J)  *  (Z(J)-Z0(J))**2                 , SUM J          /
     462H   + D(J,K)  *  (Z(J)-Z0(J))  *  (Z(K)-Z0(K)) , SUM J,K (K.GT.J)  /
     580H0  IN MULTIQUADRANT CASE (NQUAD=4) IQ INDICATES THE QUADRANT IN
     6 Z(J)/Z(K)  -PLANE//)
 2051 FORMAT(1H0/1H0,12X,11HCONSEQUENCE,I4,//)
 2052 FORMAT( 8H      A =,G15.6//)
 2053 FORMAT(10H0  B(J)   =,(6G15.6))
 2054 FORMAT(10H0  C(J)   =,(6G15.6))
 2055 FORMAT(5H0  D(,I2,5H,K) =,(6G15.6))
 2156 FORMAT(4H IQ=,I2,/10H BQ(IQ,J)=,(6G15.6)/)
 2157 FORMAT(4H IQ=,I2,/10H CQ(IQ,J)=,(6G15.6)/)
 2158 FORMAT(4H IQ=,I2,/7H DQ(IQ,,I2,4H,K)=,(6G15.6)/)
 2160 FORMAT(1H1)
      WRITE(6,2050)
      DO 141 L=1,NCONS
      WRITE(6,2051) L
      WRITE(6,2052) ZETA0(L)
      DO 143 IQ=1,NQ
      WRITE(6,2053) (B(L,J),J=1,NPARA)
      IF(NQ.GT.1) WRITE(6,2156)IQ,(BQ(L,IQ,J),J=1,NPARA)
      WRITE(6,2054) (C(L,J),J=1,NPARA)
      IF(NQ.GT.1) WRITE(6,2157)IQ,(CQ(L,IQ,J),J=1,NPARA)
      DO 142 J=1,NPARA
      IF(J.EQ.NPARA) GO TO 142
      NKI=J+1
      WRITE(6,2055) J,(D(L,J,K),K=NKI,NPARA)
      IF(NQ.GT.1) WRITE(6,2158)IQ,J,(DQ(L,IQ,J,K),K=NKI,NPARA)
  142 CONTINUE
  143 CONTINUE
      WRITE(6,2160)
  141 CONTINUE
      GO TO 140
  132 WRITE(6,2510) L,J,K
      WRITE(6,2511)
 2510 FORMAT(25H0 JK(J,K)=1 BUT ZETA11 L=,I3,3H J=,I4,3H K=,I4,5H ZERO/)
 2511 FORMAT(66H   YOU BETTER MAKE SURE ALL CROSS TERM INPUT CARDS IN, I
     1  CONTINUE)
      GO TO 125
  130 IF(JK(J,K).EQ.1) GO TO 126
      IF(JK(J,K).EQ.0) ZETA11(L,J,K)=ZETA1(L,J)+ZETA1(L,K)-ZETA0(L)
      IF((JK(J,K).NE.0).AND.(JK(J,K).NE.1)) WRITE(6,2513)
 2513 FORMAT(50H0  SOMETHING  WRONG WITH  JK(J,K) NOT EQUAL 0 OR 1/)
      GO TO 125
C  SENSITIVITY / IMPORTANCE ORGANIZATION -SINGLE PARAMETERS
  140 N= 0
      WRITE(6,2011)
  150 N=N+1
      DO 151 L=1,NCONS
```

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MEMBER NAME  MAIN
          SEMAX(L)= 0.
          DO 152 J=1,NPARA
          IF(SEMAX(L).GT.SENS(L,J)) GO TO 152
          SEMAX(L)= SENS(L,J)
          JMAX(L)= J
      152 CONTINUE
          K=JMAX(L)
          SENS(L,K)= - SENS(L,K)-1.0E-49
      151 CONTINUE
     2011 FORMAT(1H1,T40,'SENSITIVITIES'//T6,'CONSEQUENCE 1',T24,'CONSEQUENC
         1E 2',T42,'CONSEQUENCE 3',T60,'CONSEQUENCE 4',T78,'CONSEQUENCE 5',T
         296,'CONSEQUENCE 6'/ T5,'PARA  SENSITIVITY',T23,'PARA  SENSITIVITY'
         3,T41,'PARA  SENSITIVITY',T59,'PARA  SENSITIVITY',T77,'PARA  SENSIT
         4IVITY',T95,'PARA  SENSITIVITY'/ )
     2012 FORMAT(1H ,6(I4,E14.6))
          WRITE(6,2012) (JMAX(L),SEMAX(L),L=1,NCONS)
          IF(M.LT.NPARA) GO TO 150
          M= 0
          IF(NPARA.LT.2) GO TO 170
C CROSS-TERM SENSITIVITY ORGANIZATION
          WRITE(6,2013)
          NALL=(NPARA*(NPARA-1))/2
     2013 FORMAT(1H1,T30,'CROSS-TERM SENSITIVITIES'//T2,'CONSEQUENCES',T16,'
         11',T35,'2',T54,'3',T73,'4',T92,'5',T111,'6'/ T7,'PAIR  SENSITIVITY
         2',T26,'PAIR  SENSITIVITY',T45,'PAIR  SENSITIVITY',T64,'PAIR  SENSI
         3TIVITY',T83,'PAIR  SENSITIVITY',T102,'PAIR  SENSITIVITY'/)
      160 M= M+1
          NPAI=NPARA-1
          DO 161 L=1,NCONS
          SECMAX(L)=0.
          DO 162 J= 1,NPAI
          JPI=J+1
          DO 163 K=JPI,NPARA
          IF(SECMAX(L).GT.SENSCR(L,J,K)) GO TO 163
          SECMAX(L)=SENSCR(L,J,K)
          JMAX(L)= J
          KMAX(L)= K
      163 CONTINUE
      162 CONTINUE
          IJ=JMAX(L)
          IK=KMAX(L)
          SENSCR(L,IJ,IK)= -SENSCR(L,IJ,IK) -1.0E-49
      161 CONTINUE
          WRITE(6,2015) (JMAX(L),KMAX(L),SECMAX(L),L=1,NCONS)
          IF(M.LT.NALL) GO TO 160
     2015 FORMAT(4H    ,6(I3,I3,E13.6))
      170 CONTINUE
C CONSEQUENCE PLOTTING INFO
     2060 FORMAT(1H1,30X,26HCONSEQUENCES VS PARAMETERS//55H    NINE EQUALLY
         1SPACED VALUES FROM Z2(J) THROUGH Z1(J)/)
     2061 FORMAT(1H0,30X,11HCONSEQUENCE,I4,/)
     2062 FORMAT(1H0,I4,2X,2A4,2X,9G11.4)
     2063 FORMAT(1H ,11HCONSEQUENCE,I4,1X,9G11.4,/)
          WRITE(6,2060)
          DO 145 L=1,NCONS
          WRITE(6,2061) L
          CEE= ZETA0(L)
          DO 146 J=1,NPARA
```

```
MEMBER NAME  MAIN
            BB=B(I,J)
            CC=C(I,J)
            ZEE=Z0(J)
            ZZ=Z2(J)-ZEE
            DELTA =(Z1(J)-Z2(J))/8.
            DO 147 K=1,9
            FK=FLOAT(K-1)
            ZZZ = ZZ +FK * DELTA
            ZPLOT(K) = ZZZ +ZEE
            CPLOT(K) = CEE + (BB + CC*ZZZ) *ZZZ
       147 CONTINUE
            WRITE(6,2062) J,PNAMEA(J),PNAMEB(J), ZPLOT
            WRITE(6,2063) L,CPLOT
            WRITE(     6,2601)
      2601 FORMAT(1H0,12X,36H CONSEQUENCE VERSUS PARAMETER SKETCH/)
            WRITE(     6,2602)
      2602 FORMAT(1H ,18X,9HPARAMETER,3X,11HCONSEQUENCE,20X, 7H SKETCH/)
            CALL PLCTPP(9,ZPLOT,CPLOT)
       146 CONTINUE
       145 CONTINUE
     C CENTRAL  MOMENTS  OF  THE  PARAMETERS
            CALL CMPARA
     C ADDITIONAL TERMS IF CORRELATED INPUT PARAMETERS PRESENT
            IF(NCCRB.GT.0) CALL CEMOPA
     C PRINT MOMENTS OF THE PARAMETERS
      2016 FORMAT(1H1,25X,26H MOMENTS OF THE PARAMETERS//13H  PARAMETER  ,5X,
          15H MEAN,9X,3HCM2,10X,4HCM3 ,10X,3HCM4/)
      2017 FORMAT(1H ,I3,2X,A4,A4,G14.6,G14.6,G14.6,G14.6)
            WRITE(6,2016)
            DO 172 J=1,NPARA
            WRITE(6,2017) J,PNAMEA(J),PNAMEB(J),CM1(J),CM2(J),CM3(J),CM4(J)
       172 CONTINUE
            WRITE(6,2056)
      2056 FORMAT(1H0,10X,55HANALYTICAL CROSS CENTRAL MOMENTS OF THE PARAMETE
          1R PAIRS/16H  PARA 1  PARA 2,4X,4HCM11,5X,12HCORREL COEFF,6X,4HCM21
          2,6X,4HCM12,6X,4HCM31,6X,4HCM22,6X,4HCM13/)
            DC 250 J=1,NPARA
            IF(J.EQ.NPARA) GO TO 250
            JPI= J+1
            DC 251 K=JPI,NPARA
            WRITE(6,2057) J,K,CM11(J,K), COR(J,K)
      2057 FORMAT(1H ,I5,3X,I5,4X,7G13.6)
       251 CONTINUE
       250 CONTINUE
     C  ANALYTICAL MOMENTS OF THE RESPONSE SURFACE CONSEQUENCES
     C  (OVERALL RESPONSE SURFACE IF NQUAD.GT.1)
            DO 181 L=1,NCONS
            AVZET(L)= ZETAO(L)
            DC 182 J=1,NPARA
            BIAS= C(L,J)* CM2(J)
            AVZET(L)=AVZET(L)+ BIAS
       182 CONTINUE
       181 CONTINUE
            IF(NCCPB.GT.0) CALL BIASD(D,NPARA)
            DC 184 L=1,NCONS
            VARSUB =0.
            SIMSUB =0.
            DC 185 J=1,NPARA
```

```
MEMBER NAME  MAIN
          SIMVA= B(L,J)*B(L,J)*CM2(J)
          VARA = SIMVA+2.*B(L,J)*C(L,J)*CM3(J)
          VARA =VARA +C(L,J)*C(L,J)*(CM4(J)-CM2(J)*CM2(J))
          VARB =0.
          IF(J.EQ.NPARA)GO TO 186
          JPI=J+1
          DO 187 K=JPI,NPARA
          VARB = VARB + D(L,J,K)*D(L,J,K)*CM2(J)*CM2(K)
      187 CONTINUE
      186 VARSUM = VARSUM + VARA + VARB
          SIMSUM = SIMSUM + SIMVA
      185 CONTINUE
          SDZET(L) = VARSUM**.5
          SIMSD(L) = SIMSUM**.5
      184 CONTINUE
          IF(NCORR.GT.0) CALL VARI (B,NPARA)
C  ANALYTICAL CORRELATIONS BETWEEN THE RESPONSE SURFACE CONSEQUENCES
C  (OVERALL RESPONSE SURFACES IF NQUAD.GT.1)
          DO 191 L=1,NCONS
          IF(L.EQ.NCONS)GO TO 191
          LPI=L+1
          DO 192 M=LPI,NCONS
          COVSUM=0.
          SIMCUM=0.
          DO 193 J=1,NPARA
          SIMCO = B(L,J)*B(M,J)*CM2(J)
          COVA=SIMCO+CM3(J)*(B(L,J)*C(M,J)+B(M,J)*C(L,J))
          COVA=COVA+C(L,J)*C(M,J)*(CM4(J)-CM2(J)*CM2(J))
          COVB=0.
          IF(J.EQ.NPARA) GO TO 195
          JPI=J+1
          DO 194 K=JPI,NPARA
          COVB=COVB +D(L,J,K)*D(M,J,K)*CM2(J)*CM2(K)
      194 CONTINUE
      195 COVSUM=COVSUM +COVA +COVB
          SIMCUM=SIMCUM +SIMCO
      193 CONTINUE
          SDZL = SDZET(L)
          SDZM = SDZET(M)
          IF(SDZL.EQ.0.) SDZET(L) = 1.E-24
          IF(SDZM.EQ.0.) SDZET(M) = 1.E-24
          SDZL = SIMSD(L)
          SDZM = SIMSD(M)
          IF(SDZL.EQ.0.) SIMSD(L) = 1.E-24
          IF(SDZM.EQ.0.) SIMSD(M) = 1.E-24
          CORREL(L,M)= COVSUM/(SDZET(L)*SDZET(M))
          SIMCOR(L,M)= SIMCUM/(SIMSD(L)*SIMSD(M))
      192 CONTINUE
      191 CONTINUE
          IF(NCORR.GT.0) CALL COVARI(B,NPARA)
C  OUTPUT ANALYTICAL MOMENTS AND CORRELATIONS
      200 WRITE(6,2020)
     2020 FORMAT(63H1          MOMENTS OF THE ANALYTICAL RESPONSE SURFACE CONSE
        1QUENCES/)
     2021 FORMAT(1H ,9X,15HQUADRATIC MODEL,21X,16HLINEARIZED MODEL//)
     2023 FORMAT(1H ,I5,E15.6,E14.6,4X,E14.6,E14.6)
          WRITE(6,2021)
          WRITE(6,2022)
```

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MEMBER NAME  MAIN
          DO 201 L=1,NCONS
          WRITE(6,2023) L, AVZET(L), SDZET(L), ZETA0(L), SIMSD(L)
      201 CONTINUE
     2022 FORMAT(67H  CONSEQ   MEAN VALUE  STANDARD DEV        MEAN VALUE  S
         1TANDARD DEV/)
          IF(NCONS.LT.2) GO TO 208
     2030 FORMAT(54H0  CONS1  CONS2   CORREL COEFF       LIN CORREL COEFF /)
     2031 FORMAT(1H ,I5,3X,I4,6X,F10.8,12X,F10.8)
     2032 FORMAT(34H0   END OF MOMENT OUTPUT IN JOBI 2/)
          WRITE(6,2030)
          NCOI=NCONS-1
          DO 206 L=1,NCOI
          LPI=L+1
          DO 207 M=LPI,NCONS
          WRITE(6,2031) L,M,CORREL(L,M),SIMCOR(L,M)
      207 CONTINUE
      206 CONTINUE
      208 WRITE(6,2032)
          IF(JOBI.LT.3) GO TO 3
C JOBI 3 , DISTRIBUTIONS OF APPROXIMATE CONSEQUENCES
          ND=0
          NE=0
C NSA=NUMBER OF SIMULATION CYCLES IN JOBI 3
          IF(JOBI.EQ.4) READ(5,4001) NSB,NSC,TOLE,(NCR(K),LCR(K),PCR(K),K=1,4)
C  PCR IS UPPER LIMIT OF CONSEQ NCR IF LCR GT 0, OTHERWISE LOWER LIMIT
 4001 FORMAT(2I6,F6.2,2X,4(I2,I2,G11.4))
C  12 HISTOGRAM CATEGORIES , WIDTH = SCALE*ANALYTICAL STANDARD DEVIATION
          DO 360 L=1,6
          SUMA(L)=0.
          SUMB(L)=0.
          SUMC(L)=0.
          SUMD(L)=0.
          CSUMA(L) =0.
          CSUMB(L) =0.
          CSUMC(L) =0.
          CSUMD(L) =0.
          DO 364 J=1,12
          NHIS(L,J)=0
          NCIS(L,J)=0
          DO 362 M=1,6
          DO 363 K=1,12
          NJOINT(L,M,J,K) = 0
          NCOINT(L,M,J,K) = 0
      363 CONTINUE
      362 CONTINUE
      364 CONTINUE
          DO 365 KK=1,26
          IPLC(L,KK)=0
          ICPLO(L,KK)=0
      365 CONTINUE
      360 CONTINUE
          NC=0
          IF(JOBI.EQ.5) GO TO 501
      310 NC=NC+1
C RANDOM  SAMPLING
          DO 311 J=1,NPARA
          L=IDIS(J)
          GO TO (320,325,330,330,9335,9340,9345,9350),L
```

```
MEMBER NAME  MAIN
        320 U= FLTRNF(0)
            Z(J)= BDIS(J)+U*(ADIS(J)-BDIS(J))
            IF(NCORR.GT.0) CALL MSHIFT(Z0)
            GO TO 311
        325 U=FLTRNF(0)
            V=FLTRNF(0)
            W= 1./U
            G=((2.*ALOG(W))**.5) * COS(6.2831853 *V)
            Z(J)= Z0(J) + G* BDIS(J)
            IF(NCORR.GT.0) CALL MSHIFT(Z0)
            GO TO 311
        330 U= FLTRNF(0)
            Z(J)= ADIS(J) - BDIS(J) * ALOG(U)
            IF(L.EQ.4) Z(J)=ADIS(J)+BDIS(J)*ALOG(U)
            IF(NCORR.GT.0) CALL MSHIFT(Z0)
            GO TO 311
      C
      C
       9335 U=FLTRNF(0)
            V=FLTRNF(0)
            W=1./U
            G=((2.*ALOG(W))**.5) * COS(6.2831853 *V)
            Z(J)=ADIS(J)+G*BDIS(J)
            IF(Z(J).LT.CDIS(J))GO TO 9335
            IF(NCORR.GT.0) CALL MSHIFT(Z0)
            GO TO 311
       9340 U=FLTRNF(0)
            V=FLTRNF(0)
            W=1./U
            G=((2.*ALOG(W))**.5) * COS(6.2831853 *V)
            Z(J)=ADIS(J)+G*BDIS(J)
            IF(Z(J).GT.CDIS(J)) GO TO 9340
            IF(NCORR.GT.0) CALL MSHIFT(Z0)
            GO TO 311
      C     THE SAMPLING GENERATED FOR THE BETA DISTRIBUTION IS DONE USING A
      C     PAIR OF GAMMA RANDOM VARIATES WHICH IN TURN USE EXPONENTIAL, AND
      C     THEREFORE, THE UNIFORM RANDOM VARIATE.
       9345 BEEAY=BDIS(J)-ADIS(J)
            CEEAY=CDIS(J)-ADIS(J)
            GAMNEW=(CEEAY/BEEAY)*((CEEAY*(BDIS(J)-CDIS(J))/DDIS(J)**2)-1.)
            ETANEW=GAMNEW*(BEEAY/CEEAY-1.)
            Y=GAMRN(1.,GAMNEW)
            T=GAMRN(1.,ETANEW)
            Z(J)=(Y/(Y+T))*(BDIS(J)-ADIS(J))+ADIS(J)
            IF(NCORR.GT.0) CALL MSHIFT(Z0)
            GO TO 311
       9350 U=FLTRNF(0)
            V=FLTRNF(0)
            W=1./U
            G=((2.*ALOG(W))**.5)*COS(6.2831853*V)
            RN=ADIS(J)+G*BDIS(J)
            Z(J)=EXP(RN)
            IF(NCORR.GT.0) CALL MSHIFT(Z0)
        311 CONTINUE
      C CALCULATE POLYNOMIAL CONSEQUENCES
            IF(NQUAD.LT.2) GO TO 350
            CALL POLYQ
            GO TO 351
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MEMBER NAME  MAIN
          350 CONTINUE
              DO 341 L=1,NCONS
              APZETA(L)= ZETAO(L)
              DO 342 J=1,NPARA
              DTERM= 0.
              IF(J.EQ.NPARA)GO TO 344
              JPI=J+1
              DO 343 K= JPI,NPARA
              DTERM = DTERM + D(L,J,K)*(Z(K)-ZO(K))
          343 CONTINUE
          344 CONTINUE
              ATERM=  B(L,J)+C(L,J)*(Z(J)-ZO(J))+DTERM
              APZETA(L)= APZETA(L) + ATERM*(Z(J)-ZO(J))
          342 CONTINUE
          341 CONTINUE
          351 CONTINUE
        C   UNCONDITIONAL SAMPLE MEAN VALUE AND CENTRAL MOMENT SUMS
              DO 346 L=1,NCONS
              APZ1=APZETA(L)-AVZET(L)
              SUMA(L)=SUMA(L)+APZ1
              APZ2=APZ1*APZ1
              SUMB(L)=SUMB(L)+APZ2
              SUMC(L)=SUMC(L)+APZ1*APZ2
              SUMD(L)=SUMD(L)+APZ2*APZ2
          346 CONTINUE
        C HISTOGRAM
              CALL  HISTO(IPLO,NHIS,NJOINT)
              IF(JOBI.EQ.4) GO TO 401
          353 IF(NC.LT.NSA) GO TO 310
        C PRINT  DISTRIBUTIONS  JOBI 3
         3001 FORMAT(62H1 **DISTRIBUTIONS OF THE RESPONSE SURFACE CONSEQUENCES,
             1* WORK,I7//46H  **CATEGORIES DEFINED BY ANALYTICAL MOMENTS**/)
         3002 FORMAT(35H0     NUMBER OF SIMULATION CYCLES =,I8/)
          369 WRITE(6,3001) WORK
        C   PRINT UNCONDITIONAL SAMPLE CHARACTERISTICS
              WRITE(6,3100) WORK,NC
         3100 FORMAT(6X,'WORK',I7,1X,'NUMBER OF SAMPLES =',I8,///)
              WRITE(6,3102)
         3102 FORMAT(T2,'CONSEQUENCE',T15,'SAMPLE MEAN VALUE',T36,'SAMPLE STANDA
             1RD DEVIATION',T63,'SCM3',T83,'SCM4'/)
              FSAMPL=FLOAT(NC)
              DO 370 L=1,NCONS
              SAMEAN(L)=SUMA(L)/FSAMPL+AVZET(L)
              DEL=AVZET(L)-SAMEAN(L)
              SUB=SUMB(L)/FSAMPL-DEL**2
              SASD(L)=SQRT(FSAMPL*SUB/(FSAMPL-1.))
              SCM3= SUMC(L)/FSAMPL+3.*SUMB(L)/FSAMPL*DEL-2.*DEL**3
              SCM4= SUMD(L)/FSAMPL+4.*DEL*SUMC(L)/FSAMPL+6.*DEL**2*SUMB(L)/FSAMP
             1L-3.*DEL**4
              WRITE(6,3101) L,SAMEAN(L),SASD(L),SCM3,SCM4
         3101 FORMAT(5X,I2,8X,G14.6,11X,G14.6,6X,G14.6,6X,G14.6)
          370 CONTINUE
              IFLAG = 0
              WRITE(6,3002) NC
              CALL PRINTH (NHIS,NJOINT,NC)
              WRITE(6,3018)
         3018 FORMAT(40H0   END OF JOINT DISTRIBUTIONS IN JOBI 3)
        C DISTRIBUTION PLOTTING INFO
```

```
MEMBER NAME  MAIN
          WRITE(6,3200)
     3200 FORMAT(1H1/60H  PROBABILITY PER CATEGORY SKETCH IN HALF CATEGORY I
         1NTERVALS/1H0,18X,9H CATEGORY,3X,11HPROBABILITY,20X,7H SKETCH/)
          DO 380 L=1,NCONS
          DO 381 K=1,26
          FNC=FLOAT(NC)
          XP(K)= FLOAT(IPLO(L,K))/FNC * 2.
          TP(K)= FLOAT(INT(FLOAT(K)/2.))
      381 CONTINUE
          WRITE(6,3201) L
          CALL PLCTFP(26,TP,XP)
      380 CONTINUE
     3201 FORMAT(1H0,10X,11HCONSEQUENCE,I3/)
          IF(JOBI.LT.4) GO TO 3
C  JOBI 4
          GO TO 490
C RELIEVED CRITERIA CHECKING
      401 DO 403 K=1,4
          NCRIT= NCR(K)
          LCRIT= LCR(K)
          FCRIT= FCR(K)
          IF(NCRIT.LE.0) GO TO 403
          COZETA = APZETA(NCRIT)
          TOLL = TOLE * SDZET(NCRIT)
          IF(LCRIT) 405,405,406
      405 IF(COZETA - FCRIT + TOLL) 353,403,403
      406 IF(COZETA - FCRIT - TOLL) 403,403,353
      403 CONTINUE
C OUTPUT FOR CAC SIMULATION
          IF(NE.GE.NSC) GO TO 407
     4002 FORMAT(8X,(6E12.6))
          WRITE(7,4002) (Z(L),L=1,NPARA)
C SET TEST=4 IF CONDITIONAL POINTS TO BE PRINTED TOO (NSC CARDS) IN JOBI 4
          IF(TEST.EQ.4)  WRITE(6,4002) (Z(L),L=1,NPARA)
      407 NE=NE+1
C UNRELIEVED CRITERIA CHECKING
          DO 413 K=1,4
          NCRIT= NCR(K)
          LCRIT= LCR(K)
          FCRIT= FCR(K)
          IF(NCRIT.LE.0) GO TO 413
          COZETA = APZETA(NCRIT)
          IF(LCRIT) 415,415,416
      415 IF(COZETA - FCRIT) 417,413,413
      416 IF(COZETA - FCRIT) 413,413,417
      413 CONTINUE
          ND=ND+1
C CONDITIONAL SUMS
          DO 430 L=1,NCONS
          APZ1= APZETA(L)-AVZET(L)
          CSUMA(L)=CSUMA(L)+ APZ1
          APZ2= APZ1 *APZ1
          CSUMB(L) = CSUMB(L) +APZ2
          CSUMC(L) = CSUMC(L) +APZ1* APZ2
          CSUMD(L) = CSUMD(L) +APZ2* APZ2
      430 CONTINUE
C CONDITIONAL HISTOGRAM
          CALL CISTO(ICPLO,NCIS,NCOINT)
```

```
MEMBER NAME  MAIN
      417 IF(ND.GE.NSB)GO TO 369
          GO TO 353
     4010 FORMAT(70H1    CONDITIONAL DISTRIBUTIONS OF CONSEQUENCES -JOBI 4 -
         1 WORK NUMBER =,I8//)
      490 WRITE(6,4010) WORK
          WRITE(6,4020)
     4020 FORMAT(51H    SELECTIVE SIMULATION OF POLYNOMIAL CONSEQUENCES//)
          WRITE(6,4011) NSA,NSB,NSC,TOLE,(NCR(K),LCR(K),FCR(K),K=1,4)
          WRITE(6,4017)
          WRITE(6,4012) NC, ND ,NE
C LIMITS FOR SIMULATION CYCLES  NSA=UNCOND,NSB=UNREL COND,NSC=RELIEV CON
     4011 FORMAT(1H ,6X,46HLIMIT FOR UNCONDITIONAL SIMULATION CYCLES NSA=,I8
         1/1H ,6X,46HLIMIT FOR UNRELIEVED COND. SIMUL. CYCLES  NSB=,I7/1H ,6
         2X,46HLIMIT FOR RELIEVED COND. CARDS FOR JOBI 5 NSC=,I7,17H WITH TO
         3LERANCE =,F6.2//(1H ,9X,11HCONSEQUENCE,I3,12H LIMIT TYPE=,I3,3X,6H
         4VALUE=,G12.5))
     4017 FORMAT(1H ,20X,61HLIMIT TYPE   0    MEANS LOWER LIMIT,    1   MEAN
         1S UPPER LIMIT/46H TOLERANCE AS A FRACTION OF STANDARD DEVIATION/)
     4012 FORMAT(1H0,6X,29H NUMBERS OF SIMULATION CYCLES/1H ,6X,17HUNCONDITI
         1ONAL NC=,I8,/1H ,8X,15HCONDITIONAL ND=,I8,/1H , 2X,21HRELIEVED CON
         2DIT , NE=,I8/)
     4015 FORMAT(54H0 FOR POLYNOMIAL CONSEQUENCES WITH UNRELIEVED CRITERIA)
          FRACN= FLOAT(ND)/ FLOAT(NC)
          REFRAC= FLOAT(NE)/FLOAT(NC)
          WRITE(6,4014) FRACN
          WRITE(6,4018)REFRAC
     4014 FORMAT(42H0 FRACTION SATISFYING CONDITIONS = ND/NC =,F8.6/)
     4018 FORMAT(1H ,47H FRACTION SATISFYING RELIEVED CONDITIONS NE/NC=,F8.6
         1,//)
          WRITE(6,4015)
          WRITE(6,4013) ND
C PRINT CONDITIONAL SAMPLE MEAN VALUE AND CENTRAL MOMENT CHARACTERISTICS
C OF THE APPROXIMATE (RESPONSE SURFACE) CONSEQUENCES BASED ON ND VALUES
          WRITE(6,4400) JOBI,WORK
     4400 FORMAT(1H0,10X,57HSAMPLE CONDITIONAL MEAN AND OTHER CHARACTERISTIC
         1S IN JOBI,I3,32H (RESPONSE SURFACE CONSEQUENCES)/1H ,10X,9HOF  WOR
         2K ,I8/1H0,10X,11HCONSEQUENCE,3X,11H MEAN VALUE,4X,18HSTANDARD DEVI
         3ATION,6X,8HSCCM3   ,12X,10HSCCM4     /)
          FND=FLOAT(ND)
          DO 431 L=1,NCONS
          IF(ND.LE.1) FND=2.
          CSMEAN(L)=CSUMA(L)/FND+AVZET(L)
          DEL= AVZET(L)-CSMEAN(L)
          CUB=CSUMB(L)/FND - DEL**2
          CSSD(L) = SQRT(FND * CUB/(FND -1.))
          SCCM3 =CSUMC(L)/FND+3.*CSUMB(L)/FND*DEL - 2.*DEL**3
          SCCM4 =CSUMD(L)/FND+4.*DEL*CSUMC(L)/FND+6.*DEL**2*CSUMB(L)/FND
         1-3.*DEL**4
          WRITE(6,4401) L,CSMEAN(L), CSSD(L),SCCM3,SCCM4
     4401 FORMAT(1H ,15X,I3,5X,G12.6,6X,G12.6,6X,G12.6,10X,G12.6/)
      431 CONTINUE
     4013 FORMAT(1H ,10X,18HSTATISTICS FOR ND=,I7,25H RESPONSE S. CONSEQUENC
         1ES/)
          IFLAG = 1
          WRITE(6,4016)
     4016 FORMAT(1H1,20X,25HCONDITIONAL DISTRIBUTIONS//55H          (ANALYT
         1ICAL UNCONDITIONAL MOMENTS IN TITLES)/)
          CALL PRINTH (NCIS,NCOINT,ND)
```

```
MEMBER NAME  MAIN
        C CONDITIONAL DISTRIBUTION PLOTTING INFO
              WRITE(6,3200)
              WRITE(6,4200)
         4200 FORMAT(1H ,10X,47HCONDITIONAL DISTRIBUTIONS OF THE RESPONSE SURFS)
              DO 485 L=1,NCONS
              DO 486 K=1,26
              FND = FLOAT(ND)
              XC(K)= FLOAT(ICPLO(L,K))/FND*2.
              TC(K)= FLOAT(INT(FLOAT(K)/2.))
          486 CONTINUE
              WRITE(6,3201) L
              CALL PLOTPP(26,TC,XC)
          485 CONTINUE
              IF(JOBI.LE.4) GO TO 3
              STOP 4
          501 NA=0
              NB=0
              IF(JOBI.EQ.5)READ(5,4001)NSB,NSC,TOLE,(NCR(K),LCR(K),FCR(K),K=1,4)
              DO 502 I=1,NSC
              READ(5,4002)  (Z(L),L=1,NPARA)
        C CALCULATE POLYNOMIAL CONSEQUENCES
              IF(NQUAD.LT.2) GO TO 550
              CALL POLYQ
              GO TO 551
          550 CONTINUE
              DO 541 L=1,NCONS
              APZETA(L)= ZETAO(L)
              DO 542 J=1,NPARA
              DTERM= 0.
              IF(J.EQ.NPARA)GO TO 544
              JPI=J+1
              DO 543 K= JPI,NPARA
              DTERM = DTERM + D(L,J,K)*(Z(K)-ZO(K))
          543 CONTINUE
          544 ATERM=  B(L,J)+C(L,J)*(Z(J)-ZO(J))+DTERM
              APZETA(L)= APZETA(L)+ ATERM*(Z(J)-ZO(J))
          542 CONTINUE
              APZ(I,L) = APZETA(L)
          541 CONTINUE
          551 CONTINUE
        C UNRELIEVED CRITERIA CHECKING
              DO 513 K=1,4
              NCRIT= NCR(K)
              LCRIT= LCR(K)
              FCRIT= FCR(K)
              IF(NCRIT.LE.0) GO TO 513
              COZETA = APZETA(NCRIT)
              IF(LCRIT) 515,515,516
          515 IF(COZETA - FCRIT)502,513,513
          516 IF(COZETA - FCRIT)513,513,502
          513 CONTINUE
              NA=NA+1
          502 CONTINUE
              FRA= FLOAT(NA) / FLOAT(NSC)
              DO 504 I= 1,NSC
              IF(TEST.NE.5) READ(5,5004)  (CONS(M),M=1,NCONS)
         5004 FORMAT( 8X,(6E12.6))
              IF(TEST.EQ.5) READ(5,4002)  (Z(J),J=1,NPARA)
```

```
MEMBER NAME  MAIN
          IF(TEST.EQ.5) CALL TEXAS
          DO 531 L=1,NCCNS
          APZETA(L) = CONS(L)
      531 CONTINUE
    C UNRELIEVED CRITERIA CHECKING
          DO 573 K=1,4
          NCRIT= NCR(K)
          LCRIT= ICR(K)
          FCRIT= FCR(K)
          IF(NCRIT.LE.0) GO TO 573
          COZETA = APZETA(NCRIT)
          IF(LCRIT) 575,575,576
      575 IF(COZETA - FCRIT)504,573,573
      576 IF(COZETA - FCRIT)573,573,504
      573 CONTINUE
          NB=NB+1
          CALL CISTO(ICPLO,NCIS,NCOINT)
          SSAVE= SCALE
          SCALE = TOLE/2.
          DO 561 L=1,NCCNS
          APZETA(L)= CONS(L) - APZ(I,L)
          SAVZET(L) = AVZET(L)
          AVZET(L) = 0.
      561 CONTINUE
          CALL HISTO (IPLO,NHIS,NJOINT)
          SCALE = SSAVE
          DO 562 L=1,NCCNS
      562 AVZET(L) = SAVZET(L)
      504 CONTINUE
          FRB = FLOAT(NB) / FLOAT(NSC)
          WRITE(6,5005) WORK,NSC,FRA,TOLE,FRB
          WRITE(6,4011) NSA,NSB,NSC,TOLE,(NCR(K),LCR(K),FCR(K),K=1,4)
     5005 FORMAT(1H1,25X,23HJOBI 5 RESULTS FOR WORK,I7/1H0,15X,25HSTATISTICS
         1 BASED CN NSC= ,I4,18H CONSEQUENCE CARDS/1H0,15X,69HFRACTION OF AP
         2PROXIMATE CONSEQUENCES SATISFYING UNRELIEVED CONDITIONS/1H0,15X, 8
         3HNA/NSC =,F9.5/1H ,15X,11HWITH TOLE =,F6.2//1H0,15X,62HFRACTION OF
         4EXACT CCNSEQUENCES SATISFYING UNRELIEVED CONDITIONS/1H0,15X,8HNB/N
         5SC =,F9.5/1H0,15X,92HHISTOGRAMS FOR EXACT CONSEQUENCES (TITLE MOME
         6NTS FOR UNCONDITIONAL APPROXIMATE CONSEQUENCES)//)
          IF(TEST.EQ.5) WRITE(6,5007)
     5007 FORMAT(1H0,15X,38HEXACT CONSEQUENCES FROM TEXAS (TEST=5)///)
          IFLAG=1
          CALL PRINTH(NCIS,NCOINT,NB)
          WRITE(6,3200)
    C PLOTTING INFO
          DO 585 L=1,NCCNS
          DO 586 K=1,26
          FND= FLOAT(NB)
          XC(K)= FLOAT(ICPLO(L,K))/FND*2.
          TC(K)= FLOAT(INT(FLOAT(K)/2.))
      586 CONTINUE
          WRITE(6,3201)L
          CALL PLOTPP(26,TC,XC)
          AVZET(L) = 0.
      585 CONTINUE
          SCALE = TOLE/2.
          IFLAG=0
          WRITE(6,5006) NB,SCALE
```

```
MEMBER NAME  MAIN
      5006 FORMAT(1H1,15X,19HHISTOGRAMS FOR THE ,I4,51H DIFFERENCIES-EXACT MI
     1NUS APPROXIMATE- WITH SCALE =,F6.2,18H CENTERED AROUND 0/1H ,15X,
     218H(MEAN VALUE NOT 0)//)
           CALL PRINTH (NHIS,NJOINT,NB  )
           WRITE(6,3200)
           DO 580 L=1,NCONS
           DO 581 K=1,26
           FNC=FLOAT(NB)
           XP(K)= FLOAT(IPLO(L,K))/FNC * 2.
           TP(K)= FLOAT(INT(FLOAT(K)/2.))
       581 CONTINUE
           WRITE(6,3201) L
           CALL PLCTPP(26,TP,XP)
       580 CONTINUE
           IF(JOBI.LE.5) GO TO 3
           STOP 5
           END
C
C
           FUNCTION GAMRN (ALAM,ETA)
           N=ETA
           F=ETA-N
           IF(F.EQ.0) GO TO 8100
      8010 P=FLTRNF(0)
           IF(P.LT.F/(F+2.71828)) GO TO 8120
           Q=FLTRNF(0)
           Y=Q**(1./F)
           IF(P.GT.EXP(-Y)) GO TO 8100
           GO TO 8050
      8100 Y=0.
           GO TO 8070
      8120 S=FLTRNF(0)
           Y=1.-ALOG(S)
           IF(P.GT.Y**(F-1.)) GO TO 8010
      8050 IF(N.EQ.0) GO TO 8150
      8070 Z=1.0
           DO 8080 I=1,N
      8080 Z=Z*FLTRNF(0)
           Y=Y-ALOG(Z)
      8150 GAMRN=Y/ALAM
           RETURN
           END
```

```
MEMBER NAME  BIASC
             SUBROUTINE BIASD(DEE,NY)
      C
      C  SUBRCUTINE BIASC CALCULATES TERMS IN ANALYTICAL MEAN VALUES OF THE
      C  CCNSEQUENSES IF CORRELATED INPUT PARAMETERS PRESENT
      C  CALLED BY MAIN, ONLY IF NCORR.GT.0
      *CAIL CCMMF
             DIMENSICN DEE(6,12,12)
             DO 183 L= 1,NCONS
             SU=0.
             DO 188 J= 1,NY
             IF(J.EQ.NY) GO TO 188
             JPI=J+1
             DO 189 K= JPI,NY
             SU = SU + DEE(L,J,K)*CM11(J,K)
         189 CONTINUE
         188 CONTINUE
             AVZPT(L)= AVZET(L) + SU
         183 CONTINUE
              RETURN
             END
```

```
MEMBER NAME  CEMOPA
          SUBROUTINE CEMOPA
C
C  SUBROUTINE CEMOPA CALCULATES FINAL CENTRAL MOMENTS OF THE PARAMETERS
C  WHEN CORRELATED INPUT PARAMETERS PRESENT
C  CALLED BY MAIN, ONLY IF  NCORR.GT.0
C
*CALL CCMMF
          DO 173 I=1,NCORR
          JJ=ILEAD(I)
          KK=IDEP(I)
          AYES= ALFA(JJ,KK)**2
          CM2(KK)= CM2(KK)+CM2(JJ)*AYES
          CM3(KK)=CM3(KK)+AYES*CM3(JJ)*ALFA(JJ,KK)
          CM4(KK)= CM4(KK)+ AYES*(CM2(JJ)*CM2(KK)*6.+AYES*CM4(JJ))
           CM11(JJ,KK)= ALFA(JJ,KK)*CM2(JJ)
          CM11(KK,JJ)= CM11(JJ,KK)
          COR(JJ,KK)= CM11(JJ,KK)/(SQRT(CM2(JJ)*CM2(KK)) )
          COR(KK,JJ)= COR(JJ,KK)
          IF(I.EQ.NCORR) GO TO 173
          IL=I+1
          LSAV = L
          DO 175 L=IL,NCORR
          IF(ILEAD(L).NE.JJ) GO TO 175
          LL = IDEP(L)
          CM11(KK,LL)= CM2(JJ)*ALFA(JJ,KK)* ALFA(JJ,LL)
          CM11(LL,KK)= CM11(KK,LL)
  175     CONTINUE
  173     CONTINUE
          DO 177 I=1,NCORR
          IF(I.EQ.NCORR) GO TO 177
          IL=I+1
          DO 179 L=IL,NCORR
          KK= IDEP(I)
          LL=IDEP(L)
          COR(KK,LL)= CM11(KK,LL)/(SQRT(CM2(KK)*CM2(LL)) )
          COR(LL,KK)= COR(KK,LL)
  179     CONTINUE
  177     CONTINUE
          L = LSAV
          RETURN
          END
```

```
MEMBER NAME  CISTO
            SUBROUTINE CISTO(MCPLO,MIS,MOINT)
      C
      C  SUBROUTINE CISTO CALCULATES CONDITIONAL DISTRIBUTIONS IN JOBI4
      *CALL CCMMF
            DIMENSION MCPLO(6,26)
            DIMENSION MIS(6,12),MOINT(6,6,12,12)
            DO 441 L=1,NCONS
            DIVE = 1./(SCALE* SDZET(L))
            DEVL =(APZETA(L)- AVZET(L)) * DIVE
            HISL =DEVL +7.
            PISL = DEVL+HISL +7.
            DC 450 K=1,4
            IF(L.NE.NCR(K)) GO TO 450
            IF(LCR(K))443,443,444
        443 DEVL =(APZETA(L) -FCR(K)) * DIVE
            HISL = DEVL +1.
            PISL = HISL +DEVL +1.
            GO TO 450
        444 DEVL =(FCR(K) -APZETA(L)) * DIVE
            HISL = 13. - DEVL
            PISL = HISL +13. -DEVL
        450 CONTINUE
            NL=INT(HISL)
            NP =INT(PISL)
            IF(NP.LE.0)NP =1
            IF(NP.GT.26)NP=26
            MCPLO(L,NP) = MCPLO(L,NP) +1
            IF(NL.LT.1) NL=1
            IF(NL.GT.12)NL=12
            MIS(L,NL)= MIS(L,NL) +1
            IF(L.EQ.NCONS) GO TO 441
            LPI =L+1
            DO 442 M=LPI,NCONS
            DIM = 1./(SCALE* SDZET(M))
            DEVM =(APZETA(M)- AVZET(M)) * DIM
            HISM = DEVM +7.
            DC 460 K=1,4
            IF(M.NE.NCR(K)) GO TO 460
            IF(LCR(K))463,463,464
        463 DEVM =(APZETA(M) -FCR(K)) * DIM
            HISM = DEVM +1.
            GO TO 460
        464 DEVM =(FCR(K) -APZETA(M)) * DIM
            HISM = 13. - DEVM
        460 CONTINUE
            NM =INT(HISM)
            IF(NM.LT.1) NM=1
            IF(NM.GT.12)NM=12
            MOINT(L,M,NL,NM) = MOINT(L,M,NL,NM) +1
        442 CONTINUE
        441 CONTINUE
            RETURN
            END
```

```
MEMBER NAME  CMPARA
      SUBROUTINE CMPARA
C
C  SUBROUTINE CMPARA CALCULATES MEAN VALUE AND  HIGHER CENTRAL MOMENTS
C  OF THE PARAMETERS
*CALL COMSP
      LSAV = L
      DO 171 J=1,NPARA
      L=IDIS(J)
      CM1(J) = Z0(J)
      IF(L.GT.8) GO TO 174
      GO TO(174,176,178,178,9180,9182,9184,9186),L
  174 HELPIS = (ADIS(J)-BDIS(J))**2
      CM3(J) =0.
      CM2(J) = HELPIS/12.
      CM4(J) = HELPIS*HELPIS/80.
      GO TO 171
  176 CM2(J)= BDIS(J)* BDIS(J)
      CM3(J)= 0.
      CM4(J)= 3.0*CM2(J)*CM2(J)
      GO TO 171
  178 CM2(J)= BDIS(J)* BDIS(J)
      CM3(J)= 2.*BDIS(J)*CM2(J)
      CM4(J)= 4.5*BDIS(J)*CM3(J)
      IF(L.EQ.4) CM3(J)=-CM3(J)
      GO TO 171
C
C
 9180 AK=1./(.5-.5*ERF((CDIS(J)-ADIS(J))/(SQRT(2.)*BDIS(J))))
      AM=ADIS(J)-CDIS(J)
      AM=-AM
      FACT=BDIS(J)*AK/SQRT(6.2832)*EXP(-(CDIS(J)-ADIS(J))**2/(2.*BDIS(J)
     1**2))
      CM2(J)=BDIS(J)**2+AM*FACT-FACT**2
      CM3(J)=FACT*(AM**2-1.*BDIS(J)**2)-3.*AM*FACT**2+2.*FACT**3
      CM4(J)=3.*BDIS(J)**4+FACT*(AM**3+3.*BDIS(J)**2*AM)-FACT**2*(2.*BDI
     1S(J)**2+4.*AM**2)+6.*AM*FACT**3-3.*FACT**4
      GO TO 171
 9182 BK=1./(.5+.5*ERF((CDIS(J)-ADIS(J))/(SQRT(2.)*BDIS(J))))
      BM=CDIS(J)-ADIS(J)
      FACT=-BDIS(J)*BK/SQRT(6.2832)*EXP(-(CDIS(J)-ADIS(J))**2/(2.*BDIS(J
     1)**2))
      CM2(J)=BDIS(J)**2+BM*FACT-FACT**2
      CM3(J)=FACT*(BM**2-1.*BDIS(J)**2)-3.*BM*FACT**2+2.*FACT**3
      CM4(J)=3.*BDIS(J)**4+FACT*(BM**3+3.*BDIS(J)**2*BM)-FACT**2*(2.*BDI
     1S(J)**2+4.*BM**2)+6.*BM*FACT**3-3.*FACT**4
      GO TO 171
 9184 CM2(J)=DDIS(J)**2
      BEEAY=BDIS(J)-ADIS(J)
      CEEAY=CDIS(J)-ADIS(J)
      GAMNEW=(CEEAY/BEEAY)*((CEEAY*(BDIS(J)-CDIS(J))/DDIS(J)**2)-1.)
      ETANEW=GAMNEW*(BEEAY/CEEAY-1.)
      GAMETA=GAMNEW+ETANEW
      CM3(J)=(BEEAY**3)*2.*GAMNEW*ETANEW*(ETANEW-GAMNEW)/(GAMETA**3*(GAM
     1ETA+1.)*(GAMETA+2.))
      CM4(J)=3.*GAMNEW*ETANEW*BEEAY**4/GAMETA*(((GAMNEW-ETANEW)**2+GAMNE
     1W**2*(1.+ETANEW)+ETANEW**2*(1.+GAMNEW))/(GAMETA**3*(GAMETA+1.)*(GA
     2META+2.)*(GAMETA+3.)))
      GO TO 171
```

```
MEMBER NAME  CMPARA
          9186 CM2(J)=(EXP(2.*ADIS(J)+BDIS(J)**2))*(EXP(BDIS(J)**2)-1.)
               CM3(J)=EXP(3.*ADIS(J))*EXP(1.5*BDIS(J)**2)*(EXP(3.*BDIS(J)**2)-3.*
              1EXP(BDIS(J)**2)+2.)
               CM4(J)=EXP(4.*ADIS(J)+2.*BDIS(J)**2)*(EXP(6.*BDIS(J)**2)-4.*EXP(3.
              1*BDIS(J)**2)+6.*EXP(BDIS(J)**2)-3.)
           171 CONTINUE
               I= LSAV
               RETURN
               END
```

```
MEMBER NAME  COEFSN
            SUBROUTINE COEFSN
      C
      C  SUBROUTINE COEFSN CALCULATES B AND C COEFFICIENTS OF THE MULTIQUADRANT
      C POLYNOMIALS. CALLED BY QUADST ONLY
      C
      *CALL COMMP
            B1=(ZETX-ZETM)/((ZXJ-ZMJ)*(ZXJ-ZXXJ))
            B2=(ZETXX-ZETM)/((ZXXJ-ZMJ)*(ZXXJ-ZXJ))
            BJ=B1*(ZMJ-ZXXJ)+B2*(ZMJ-ZXJ)
            CJ=B1+B2
            SJ=ABS(ZETX-ZETM)+ABS(ZETXX-ZETX)
            BQ(L,IQ,J)=BJ
            CQ(L,IQ,J)=CJ
            SENSQ(L,IQ,J)=SJ
            RETURN
            END
```

```
MEMBER NAME  CCKNOT
            SUBROUTINE COKNOT(NDIST)
      C
      C  SUBROUTINE COKNOT CALCULATES FINAL KNOT POINT COORDINATES Z0,Z1,Z2
      C  WHEN CORRELATED INPUT PARAMETERS
      C  CCKNOT  CALLED BY MAIN,ONLY IF(NCORR.GT.0)
      *CALL CCMMF
            DIMENSION NDIST(12)
            DO 6 I=1,NCORR
            JJ=ILEAD(I)
            KK=IDEP(I)
            AHELP =(FDEP(I)-Z0(KK)) / (FLEAD(I)- Z0(JJ))
            ALFA(JJ,KK) = AHELP
            IF(AHELP) 8,7,7
          7 DZJ1 = Z1(JJ) - Z0(JJ)
            DZJ2 = Z2(JJ) - Z0(JJ)
            GO TO 9
          8 DZJ1 = Z2(JJ) - Z0(JJ)
            DZJ2 = Z1(JJ) - Z0(JJ)
          9 IF(NDIST(KK).EQ.1.AND.NDIST(JJ).EQ.1) GO TO 5
            Z1(KK)= Z0(KK)+ SQRT((Z1(KK)-Z0(KK))**2 +(AHELP*DZJ1)**2)
            Z2(KK)= Z0(KK)- SQRT((Z2(KK)-Z0(KK))**2 +(AHELP*DZJ2)**2)
            GO TO 6
          5 Z1(KK)= Z1(KK) +AHELP* DZJ1
            Z2(KK)= Z2(KK) +AHELP* DZJ2
          6 CONTINUE
            RETURN
            END
```

```
MEMBER NAME  COMMP
        *COMDECK COMMP
              INTEGER WORK,TEST
              REAL NAMEA,NAMEB
              COMMON/INTGR1/LMPAIR,JOBI,L
              COMMON/KNOT/ Z(12),TEST,INDEX,J,K,NPARA
              COMMON/KNOTC/ Z0(12),Z1(12),Z2(12),PROB
              COMMON/KNOT1/ZMJ,ZXJ,ZXXJ,ZMK,ZXK,ZXXK,ZCJ,ZCK,ZETM,ZETX,ZETXX
             1,ZETC,ZETCJ,ZETCK,BJ,CJ,DJK,SJ
              COMMON/TEX/ CONS(6),ZETA0(6),ZETA1(6,12),ZETA2(6,12),ZETA11(6,12,1
             12)
              COMMON/MULTIC/ NQUAD,IQ,NQ,
             1Z3(12),Z4(12),ZETA3(6,12),ZETA4(6,12),
             2ZETA22(6,12,12),ZETA33(6,12,12),ZETA44(6,12,12)
              COMMON/COEFF/B(6,12),C(6,12),D(6,12,12),SENS(6,12),SENSCR(6,12,12)
              COMMON/COEFFQ/BQ(6,4,12),CQ(6,4,12),DQ(6,4,12,12),SENSQ(6,4,12),
             1SENCRQ(6,4,12,12)
              COMMON/HISTOC/ APZETA(6),AVZET(6),SDZET(6),SCALE,NCONS
              COMMON/BIGCOM/ JK(12,12),
             1          ADIS(12),BDIS(12),CDIS(12),DDIS(12),IDIS(12),IPARA(12),
             2          JJK(12),SEMAX(6),JMAX(6),SECMAX(6),KMAX(6),SIMSD(6),
             3          PNAMEA(12),PNAMEB(12),
             4           NCIS(6,12),NCOINT(6,6,12,12),NHIS(6,12),NJOINT(6,6,12,1
             52),CPLOT(9),ZPLOT(9)
              COMMON/PRIMA/ AJCINT(12),ERR(12),NC,ND
              COMMON/CONDIT/ NCR(4),LCR(4),FCR(4)
              COMMON/FLAG/ IFLAG
              COMMON/CORREL/ITYPE(12),ILEAD(12),IDEP(12),FLEAD(12),FDEP(12),
             1NCORR
              COMMON/ALPHA/ ALFA(12,12)
              COMMON/MCMP/CM1(12),CM2(12),CM3(12),CM4(12),CM11(12,12),COR(12,12)
              COMMON/CCNCO/ CORREL(6,6),SIMCOR(6,6)
        *DECK
```

```
MEMBER NAME  COVARI
      SUBROUTINE COVARI(BEE,NY)
C
C  SUBROUTINE COVARI CALCULATES TERMS IN ANALYTICAL CORRELATIONS BETWEEN
C  CONSEQUENSES, CALLED BY MAIN,ONLY IF NCORR.GT.0
*CALL COMMP
      DIMENSION BEE(6,12)
      DO 296 L=1,NCONS
      IF(L.EQ.NCONS) GO TO 296
      LPI=L+1
      DO 297 M=LPI,NCONS
      COSU=0.
      DO 298 J= 1,NY
       IF(J.EQ.NY) GO TO 298
        JPI= J+1
      DO 299 K=JPI,NY
      COSU= COSU +( BEE(L,J)*BEE(M,K) + BEE(L,K)*BEE(M,J) )*CM11(J,K)
  299 CONTINUE
  298 CONTINUE
      CORREL(L,M)= CORREL(L,M) + COSU/(SDZET(L)*SDZET(M) )
  297 CONTINUE
  296 CONTINUE
      RETURN
      END
```

```
MEMBER NAME  HISTO
      SUBROUTINE HISTO(NPLO,NIS,NOINT)
C
C  SUBROUTINE HISTO CALCULATES DISTRIBUTIONS (HISTOGRAMS) OF THE CONSEQUENSES
C  IN JOBI 3 AND 4
*CALL CCMMP
      DIMENSION NPLO(6,26)
      DIMENSION NIS(6,12),NOINT(6,6,12,12)
      DO 421 L=1,NCONS
      DEVL= (APZETA(L)- AVZET(L))/(SCALE*SDZET(L))
      HISL=DEVL +7.
      PISL= DEVL*2. +14.
      NP=INT(PISL)
      IF(NP.LE.0)NP=1
      IF(NP.GT.26)NP=26
      NPLO(L,NP) = NPLO(L,NP)+1
      NL=INT(HISL)
      IF(NL.LT.1) NL=1
      IF(NL.GT.12)NL=12
       NIS(L,NL)=  NIS(L,NL) +1
      IF(L.EQ.NCONS) GO TO 421
      LPI=L+1
      DO 422 M=LPI,NCONS
      DEVM =(APZETA(M)- AVZET(M))/(SCALE*SDZET(M))
      HISM = DEVM +7.
      NM=INT(HISM)
      IF(NM.LT.1) NM=1
      IF(NM.GT.12)NM=12
       NOINT(L,M,NL,NM) =  NOINT(L,M,NL,NM) +1
  422 CONTINUE
  421 CONTINUE
      RETURN
C END HISTOGRAM SUBROUTINE
      END
```

```
MEMBER NAME  INIT
            SUBROUTINE INIT
      C
      C  SUBROUTINE INIT SETS INITIAL VALUE ZEROS
      *CALL COMMP
          3 DO 4 I= 1,12
            ADIS(I)=0.
            BDIS(I)=0.
            CDIS(I)  = 0.
            DDIS(I)  = 0.
            IDIS(I)=0
            IPARA(I)=0
            PNAMEA(I)=0.
            PNAMEB(I)=0.
            Z(I)=0.
            Z1(I)=0.
            Z2(I)=0.
            Z3(I)=0.
            Z4(I)=0.
            Z0(I)=0.
            ITYPE(I)=0
            ILEAD(I)=0
            IDEP(I)  =0
            FLEAD(I)=0.
            FDEP(I)  =0.
            DO 4 L= 1,12
            JK(I,L)  = 0
            ALFA(I,L)=0.
            CM11(I,L)=0.
            CCR(I,L)=0.
          4 CONTINUE
            RETURN
            END
```

```
MEMBER NAME  INITC
          SUBROUTINE INITC
      C
      CSUBROUTINE INITC SETS INITIAL VALUE ZEROS FOR JOBI 2
      *CALL COMMP
        101 DO 104 L=1,6
          ZETA0(L)= 0.
          CONS(L)=0.
          DO 105 J=1,12
          ZETA1(L,J)= 0.
          ZETA2(L,J)= 0.
          ZETA3(L,J)=0.
          ZETA4(L,J)=0.
          SENS(L,J) = 0.
          B(L,J)= 0.
          C(L,J)= 0.
          DO 106 K=1,12
          ZETA11(L,J,K)=0.
          IF(NQ.LE.1) GO TO 103
          ZETA22(L,J,K)=0.
          ZETA33(L,J,K)=0.
          ZETA44(L,J,K)=0.
        103 CONTINUE
          SENSCB(L,J,K)=0.
          D(L,J,K)=0.
        106 CONTINUE
        105 CONTINUE
        104 CONTINUE
          RETURN
          END
```

```
MEMBER NAME  KNCTST
               SUBROUTINE KNOTST
         CC
         C  SUBROUTINE KNOTST CALCULATES   THE BASIC KNOT POINT CO-ORDINATES
         C  Z1, Z0, Z2 , ALSC Z3 AND Z4 FOR MULTIQUADRANT CASES
         CC
         *CALL COMMP
          1501 FORMAT( 30H0 UNKNOWN DISTRIBUTION IDIS = ,I4,20H PARAMETER NUMBER
              1= ,I4,8H NAME = ,2A4)
          1502 FORMAT(20H0 VALUES USED   Z0 =,E14.6, 5H Z1 =,E14.6,5H Z2 =,E14.6)
          1503 FORMAT(46H0PRCB  TOO  LARGE  FOR  EXPONENTIAL  PARAMETER,I4,2A4)
         C
               DO 15 I=1,NPARA
               M=IDIS(I)
               IF(M.LT.1.OR.M.GT.8) GO TO 17
               GO TO (20,30,40,9050,9060,9070,9080,9090),M
         C UNIFORM DISTRIBUTION  IDIS =1
            20 Z1(I)= ADIS(I)- PROB* (ADIS(I)-BDIS(I))
               Z2(I)= BDIS(I)  + PROB*(ADIS(I)-BDIS(I))
               Z0(I)= 0.5*(Z1(I)+Z2(I))
               GO TO 15
         C EXPONENTIAL DISTRIBUTION IDIS =3
            40 IF(PRCB.GT.0.36) GO TO 41
            42 T= ALCG(1./PRCB)
               TT = ALCG(1./(1.-PROB))
               Z0(I)= ADIS(I)+ BDIS(I)
               Z1(I)= ADIS(I)+ BDIS(I)  * T
               Z2(I)= ADIS(I)+ BDIS(I)  * TT
               GO TO 15
            41 WRITE(6,1503)IPARA(I),PNAMEA(I),PNAMEB(I)
               GO TO 42
         C NORMAL DISTRIBUTICN IDIS =2
            30 T = ALCG(1./(PROB*PROB))
               T = SQRT(T)
               XUP = 2.515517 + (.802853 +.010328 * T) * T
               XLOW = 1. + (1.4327880 + (.189269 + .001308* T)*T)  *T
               X = T - XUP/XLOW
               Z0(I)= ADIS(I)
               Z1(I)= ADIS(I)  + BDIS(I)*X
               Z2(I)= ADIS(I)  - BDIS(I)*X
               GO TO 15
         C
         C
         C *** EXPONENTIAL DISTRIBUTION   IDIS=4
          9050 IF(PRCB.GT.0.36) GO TO 9010
          9011 T=ALOG(1./PROB)
               TT=ALCG(1./(1.-PROB))
               Z0(I)=ADIS(I)-BDIS(I)
               Z1(I)=ADIS(I)-BDIS(I)*TT
               Z2(I)=ADIS(I)-BDIS(I)*T
               GO TO 15
          9010 WRITE(6,1503) IPARA(I),PNAMEA(I),PNAMEB(I)
               GO TO 9011
         C *** NORMAL DISTRIBUTION WITH ZLL   IDIS=5
          9060 T=ALOG(1./(PRCB*PROB))
               T=SQRT(T)
               XUP=2.51557+(.802853+.010328*T)*T
               XLCW=1.+(1.432788+(.189269+.001308*T)*T)*T
               X=T-XUP/XLOW
```

```
MEMBER NAME  KNCTST
          AK=1./(.5-.5*ERF((CDIS(I)-ADIS(I))/(SQRT(2.)*BDIS(I))))
          FACT=BDIS(I)*AK/SQRT(6.2832)*EXP(-(CDIS(I)-ADIS(I))**2/(2.*BDIS(I)
         1**2))
          Z0(I)=ADIS(I)+FACT
          Z1(I)=ADIS(I)+BDIS(I)*X
          Z2(I)=ADIS(I)-BDIS(I)*X
          IF(Z2(I).LE.CDIS(I))  Z2(I)=CDIS(I)
          GO TO 15
C *** NORMAL DISTRIBUTION WITH ZUL    IDIS=6
 9070 T=ALOG(1./(PROB*PROB))
          T=SQRT(T)
          XUP=2.51557+(.802853+.010328*T)*T
          XLOW=1.+(1.432788+(.189269+.001308*T)*T)*T
          X=T-XUP/XLOW
          BK=1./(.5+.5*ERF((CDIS(I)-ADIS(I))/(SQRT(2.)*BDIS(I))))
          FACT=-BDIS(I)*BK/SQRT(6.2832)*EXP(-(CDIS(I)-ADIS(I))**2/(2.*BDIS(I
         1)**2))
          Z0(I)=ADIS(I)+FACT
          Z1(I)=ADIS(I)+BDIS(I)*X
          Z2(I)=ADIS(I)-BDIS(I)*X
          IF(Z1(I).GE.CDIS(I))  Z1(I)=CDIS(I)
          GO TO 15
C *** BETA DISTRIBUTION   IDIS=7
CC
C   APPROXIMATIVE FORMULAS USED FOR CALCULATING Z1 AND Z2, VALID FOR SMALL PROB
CC
 9080 Z0(I)=CDIS(I)
          BEEAY=BDIS(I)-ADIS(I)
          CEEAY=CDIS(I)-ADIS(I)
          GAMNEW=(CEEAY/BEEAY)*((CEEAY*(BDIS(I)-CDIS(I))/DDIS(I)**2)-1.)
          ETANEW=GAMNEW*(BEEAY/CEEAY-1.)
          GAMETA=GAMNEW+ETANEW
          IF(GAMNEW.LE.0.) WRITE(6,9501)IPARA(I)
          IF(GAMETA.GT.57.) WRITE(6,9502) IPARA(I)
 9501 FORMAT(31H ****BETA DISTRIBUTED PARAMETER,I4,37H HAS TOO LARGE STA
         1NDARD DEVIATION****//)
 9502 FORMAT(31H ****BETA DISTRIBUTED PARAMETER,I4,37H HAS TOO SMALL STA
         1NDARD DEVIATION****//)
          RATIO=(PROB*GAMMA(GAMNEW)*GAMMA(ETANEW))/GAMMA(GAMETA)
          Z1(I)=BDIS(I)-(RATIO*ETANEW*BEEAY**ETANEW)**(1./ETANEW)
          Z2(I)=ADIS(I)+(RATIO*GAMNEW*BEEAY**GAMNEW)**(1./GAMNEW)
          GO TO 15
C *** LOG NORMAL DISTRIBUTION   IDIS=8
 9090 T=SQRT(ALOG(1./PROB**2))
          XUP=2.515517+(.802853+0.010328*T)*T
          XLOW=1.+(1.432788+(.189269+.001308*T)*T)*T
          X=T-XUP/XLOW
          Z0(I)=EXP(ADIS(I)+.5*BDIS(I)**2)
          Z1(I)=EXP(ADIS(I)+BDIS(I)*X)
          Z2(I)=EXP(ADIS(I)-BDIS(I)*X)
          GO TO 15
C    DISTRIBUTION UNKNOWN , ASSUMED UNIFORM ,ADIS=MEAN, WIDTH=2*BDIS
   17 Z0(I)= ADIS(I)
          Z1(I)= ADIS(I)+BDIS(I)
          Z2(I)= ADIS(I)-BDIS(I)
          WRITE(6,1501) IDIS(I),IPARA(I),PNAMEA(I),PNAMEB(I)
          WRITE(6,1502) Z0(I),Z1(I),Z2(I)
          GO TO 15
```

```
MEMBER NAME  KNOTST
      15 CONTINUE
C  IF CORRELATED INPUT PARAMETERS, CALL CCKNOT
         IF(NCORR.GT.0) CALL CCKNOT(IDIS)
         DO 16 I=1,NPARA
         Z3(I)=Z0(I)+SQRT(2.)*(Z1(I)-Z0(I))*.5
         Z4(I)=Z0(I)+SQRT(2.)*(Z2(I)-Z0(I))*.5
         IF(NQ.EQ.1)  Z3(I)=Z1(I)
         IF(NQ.EQ.1)  Z4(I)=Z2(I)
      16 CONTINUE
         RETURN
         END
```

```
MEMBER NAME  MSHIFT
              SUBROUTINE MSHIFT(ZMEAN)
        C LINEAR EXPECTED VALUE (CONDITIONAL MEAN) SHIFT
        C
        C  SUBROUTINE MSHIFT CALCULATES MEAN VALUE SHIFT FOR CORRELATED INPUT PARAMETERS
        *CALL CCMMF
              DIMENSICN ZMEAN(12)
              DO 312 I=1,NCORR
              IF(IDEP(I).NE.J) GO TO 312
              IL=ILEAD(I)
              SHIFT =(FDEP(I)-ZMEAN(J)) *(Z(IL)-ZMEAN(IL))/(FLEAD(I) -ZMEAN(IL))
              Z(J) = Z(J) + SHIFT
          312 CONTINUE
              RETURN
              END
```

```
MEMBER NAME  PLOTPP
      SUBROUTINE  PLOTPP(NPRINT,T,X)
C
C  SUBROUTINE PLOTPP PLOTS CONSEQUENCES VS  PARAMETERS AND DISTRIBUTIONS
C  OF THE CONSEQUENCES
      DIMENSION T(26),X(26),LINE(120)
      DATA IREAD, IWRITE/5,6/
      DATA MBLANK,MSTAR,MINUS,LTRI/ 4H    ,4H*   ,4H-   ,4HI
      BIG= -1.0E+49
      SMALL=1.0E+49
      DO 40 I=1,NPRINT
      IF(X(I).GT.BIG) BIG= X(I)
      IF( X(I).LT.SMALL) SMALL=X(I)
   40 CONTINUE
      DELT=BIG-SMALL
      TES=ABS(SMALL)/10000.+1.0E-49
      IF(DELT.LT.TES) DELT=TES
      F= 50.0/DELT
      DO 60 I=1, NPRINT
       DO 50 K= 2,51
       LINE(K) = MBLANK
       IF(I.EQ.1) LINE(K) =MINUS
   50 CONTINUE
      LINE(1)= LTRI
      J= (( X(I) -SMALL)*F + 1.501 )
      LINE(J) = MSTAR
      WRITE(IWRITE,603) T(I),X(I),(LINE(L),L=1,51)
   60 CONTINUE
  603 FORMAT(17X,G11.4,2X,G11.4,2X,51A1)
      RETURN
      END
```

```
MEMBER NAME  POLYQ
          SUBROUTINE POLYQ
C
C  SUBROUTINE POLYQ CALCULATES RESPONSE SURFACE CONSEQUENCES IN THE SIMULATION
C
*CALL COMMF
          LSAV=L
          DO 341 L=1,NCONS
          APZETA(L)= ZETAO(L)
          DO 342 J=1,NPARA
          ZZJ=Z(J)-ZO(J)
          DTERM= 0.
          IF(J.EQ.NPARA)GO TO 344
          IQ=1
          JPI=J+1
          DO 343 K= JPI,NPARA
          ZZK=Z(K)-ZO(K)
          IF(ZZK) 802,801,801
      801 CONTINUE
          IF(ZZJ.LT.0.)IQ=2
          GO TO 803
      802 CONTINUE
          IF(ZZJ.LT.0.)IQ=3
          IF(ZZJ.GT.0.)IQ=4
      803 CONTINUE
          DTERM=DTERM+DQ(L,IQ,J,K)*ZZK
      343 CONTINUE
      344 CONTINUE
          BQDUM=BQ(L,1,J)
          CQDUM=CQ(L,1,J)
          IF(ZZJ.LT.0.) BQDUM=BQ(L,3,J)
          IF(ZZJ.LT.0.) CQDUM=CQ(L,3,J)
          ATERM=BQDUM+CQDUM*ZZJ+DTERM
          APZETA(L)=APZETA(L)+ATERM*ZZJ
      342 CONTINUE
      341 CONTINUE
          L=LSAV
          RETURN
          END
```

```
MEMBER NAME  POINT
              SUBROUTINE POINT
        C
        C  SUBROUTINE POINT OUTPUTS KNOT-POINT COORDINATES IN JOBI 1
        C  CALLED BY MAIN, CALLS TEXAS IF TEST =  0
        *CALL COMMP
         1611 FORMAT (5H     ,3I5,(6E16.6))
         1612 FORMAT (3I2,2X,(6F12.6))
              LSAV=I
              WRITE(6,1611) INDEX, J , K ,(Z(L),L=1,NPARA)
              WRITE(7,1612) INDEX, J , K ,(Z(L),L=1,NPARA)
              L=LSAV
              IF(TEST.EQ.1)  CALL  TEXAS
              RETURN
        C END POINT
              END
```

```
MEMBER NAME  PRINTH
          SUBROUTINE PRINTH ( NIS,NOINT,NSIM)
C SUBROUTINE PRINTH
*CALL COMMF
      DIMENSION NIS(6,12),NOINT(6,6,12,12)
      DO 371 L=1,NCONS
      WRITE(6,3003) L,AVZET(L), SDZET(L),SCALE
 3003 FORMAT(14H0  CONSEQUENCE,I4,4X,5HMEAN=,E14.6,3X,19HSTANDARD DEVIAT
     1ION=,E14.6,8H  SCALE=,F6.2/)
      WRITE(6,3004)
 3004 FORMAT(90H CATEGORY   LOWER B      UPPER B      COUNTS       PROBA
     1BILITY      ACCURACY       PERCENT/)
 3005 FORMAT(3H   ,I3,E15.6,E14.6,I8,8X,F10.8,7X,F10.8,3X,F7.3,4H P/C)
      DO 372 NL=1,12
      FNL=FLOAT(NL)
      FSA=FLOAT(NSIM)
      BLOW = AVZET(L) +(FNL-7.)* SCALE* SDZET(L)
C NEW CATEGORY LIMITS FOR CRITERIA FUNCTION
      IF(IFLAG) 470,470,471
  471 DO 480 K=1,4
      IF(L.NE.NCR(K)) GO TO 480
      IF(LCR(K)) 483,483,484
  483 BLOW = FCR(K) + (FNL -1.)* SCALE *SDZET(L)
      GO TO 480
  484 BLOW = FCR(K) + (FNL -13.)*SCALE *SDZET(L)
  480 CONTINUE
  470 BUPP = BLOW + SCALE * SDZET(L)
      CCUNTS = FLOAT( NIS(L,NL))
      ICCUNT=INT(CCUNTS)
      PROBAL = COUNTS / FSA
      ERRCR = ((1.-PROBAL)* PROBAL/FSA)**.5
      IF(PROBAL)375,375,374
  375 PROS=100.
      GO TO 373
  374 PROS =  100.* ERRCR/PROBAL
  373 WRITE(6,3005) NL, BLOW,BUPP ,ICOUNT,PROBAL, ERROR, PRJS
  372 CONTINUE
  371 CONTINUE
 3011 FORMAT(52H1    JOINT  DISTRIBUTIONS OF POLYNOMIAL CONSEQUENCES/)
 3012 FORMAT(20H0 CONSEQUENCE NUMBER,I5,10H  VERTICAL)
 3013 FORMAT(20H  CONSEQUENCE NUMBER,I5,12H  HORIZONTAL/)
 3014 FORMAT(49H0 PROBABILITY   AND ACCURACY (STANDARD DEVIATION)/)
 3015 FORMAT(111H CATEGORY  1        2        3        4        5
     1 6        7        8        9       10       11       12//)
 3016 FORMAT(1H ,I5,12F9.6)
 3017 FORMAT(1H ,I5,12F9.6/)
      WRITE(6,3011)
      NCOI=NCONS-1
      DO 381 L=1,NCOI
      LPI=L+1
      DO 382 M=LPI,NCONS
      WRITE(6,3012) L
      WRITE(6,3013) M
      WRITE(6,3014)
      WRITE(6,3015)
      DO 383 NL=1,12
      DO 384 NM=1,12
      AJOINT(NM) = FLOAT( NOINT(L,M,NL,NM))/FSA
      PROBAL = AJOINT(NM)
```

```
MEMBER NAME  ERINTH
             ERR(NM) = ((1.-PROBAL)* PROBAL/FSA)**.5
         384 CONTINUE
             WRITE(6,3016) NL, AJOINT
             WRITE(6,3017) NL, ERR
         383 CONTINUE
         382 CONTINUE
         381 CONTINUE
       C END OF ERINTH
             RETURN
             END
```

```
MEMBER NAME  QUADST
      SUBROUTINE QUADST
C
C  SUBROUTINE QUADST CALCULATES COEFFICIENTS FOR MULTI-QUADRANT RESPONSE
C  SURFACES, CALLS COEFSN TO HELP IN B AND C COEFFICIENTS
C  QUADST CALLED BY MAIN,ONLY IF NQ.GT.1
C
*CALL COMMF
      NQ=NQUAD
      DO 120 L=1,NCONS
      ZETM=ZETA0(L)
      DO 101 IQ=1,NQ
      IF(NQ.EQ.2) GO TO (601,603),IQ
      GO TO (601,602,603,604),IQ
  601 CONTINUE
      DO 121 J=1,NPARA
      ZMJ=Z0(J)
      ZXJ=Z3(J)
      ZXXJ=Z1(J)
      ZCJ=Z3(J)
      ZETX=ZETA3(L,J)
      ZETXX=ZETA1(L,J)
      ZETCJ=ZETA3(L,J)
      CALL COEFSN
      IF(J.EQ.NPARA) GO TO 128
      JP1=J+1
      DO 122 K=JP1,NPARA
      ZMK=Z0(K)
      ZCK=Z3(K)
      ZETCK=ZETA3(L,K)
      ZETC=ZETA11(L,J,K)
      DIFF=ZETC+ZETM-ZETCJ-ZETCK
      SENCRQ(L,IQ,J,K)=ABS(DIFF)
      DQ(L,IQ,J,K)=DIFF/((ZCJ-ZMJ)*(ZCK-ZMK))
  122 CONTINUE
  121 CONTINUE
  128 CONTINUE
      GO TO 102
  602 CONTINUE
      DO 221 J=1,NPARA
      ZMJ=Z0(J)
      ZXJ=Z4(J)
      ZXXJ=Z2(J)
      ZCJ=Z4(J)
      ZETX=ZETA4(L,J)
      ZETXX=ZETA2(L,J)
      ZETCJ=ZETA4(L,J)
      CALL COEFSN
      IF(J.EQ.NPARA) GO TO 228
      JP1=J+1
      DO 222 K=JP1,NPARA
      ZMK=Z0(K)
      ZCK=Z3(K)
      ZETCK=ZETA3(L,K)
      ZETC=ZETA22(L,J,K)
      DIFF=ZETC+ZETM-ZETCJ-ZETCK
      SENCRQ(L,IQ,J,K)=ABS(DIFF)
      DQ(L,IQ,J,K)=DIFF/((ZCJ-ZMJ)*(ZCK-ZMK))
  222 CONTINUE
```

```
MEMBER NAME  QUADST
           221 CONTINUE
           228 CONTINUE
               GO TO 102
           603 CONTINUE
               DO 321 J=1,NPARA
               ZMJ=Z0(J)
               ZXJ=Z4(J)
               ZXXJ=Z2(J)
               ZCJ=Z4(J)
               ZETX=ZETA4(L,J)
               ZETXX=ZETA2(L,J)
               ZETCJ=ZETA4(L,J)
               CALL COEFSN
               IF(J.EQ.NPARA) GO TO 328
               JP1=J+1
               DO 322 K=JP1,NPARA
               ZMK=Z0(K)
               ZCK=Z4(K)
               ZETCK=ZETA4(L,K)
               ZETC=ZETA33(L,J,K)
               DIFF=ZETC+ZETM-ZETCJ-ZETCK
               SENCRQ(L,IQ,J,K)=ABS(DIFF)
               DQ(L,IQ,J,K)=DIFF/((ZCJ-ZMJ)*(ZCK-ZMK))
           322 CONTINUE
           321 CONTINUE
           328 CONTINUE
               GO TO 102
           604 CONTINUE
               DO 421 J=1,NPARA
               ZMJ=Z0(J)
               ZXJ=Z3(J)
               ZXXJ=Z1(J)
               ZCJ=Z3(J)
               ZETX=ZETA3(L,J)
               ZETXX=ZETA1(L,J)
               ZETCJ=ZETA3(L,J)
               CALL COEFSN
               IF(J.EQ.NPARA) GO TO 428
               JP1=J+1
               DO 422 K=JP1,NPARA
               ZMK=Z0(K)
               ZCK=Z4(K)
               ZETCK=ZETA4(L,K)
               ZETC=ZETA44(L,J,K)
               DIFF=ZETC+ZETM-ZETCJ-ZETCK
               SENCRQ(L,IQ,J,K)=ABS(DIFF)
               DQ(L,IQ,J,K)=DIFF/((ZCJ-ZMJ)*(ZCK-ZMK))
           422 CONTINUE
           421 CONTINUE
           428 CONTINUE
           102 CONTINUE
           101 CONTINUE
           120 CONTINUE
               RETURN
               END
```

```
MEMBER NAME  TEXAS
           SUBROUTINE  TEXAS
      C SUBROUTINE TEXAS FOR TESTING ONLY (TEST.GT.0)
      C TCF/EUBFNB-1254
      *CALL CCMBP
           X1= Z(1)-500.
           X2= Z(2)-1.368
           X3= Z(3)-27.6
           X4= Z(4)-1760.
           X5= Z(5)-1.
           X6= Z(6)+5.
           CONS(1)=2676. +2.5089 *X1 -5703.5 *X2 -27.273 *X3 +1.1287 *X4
          1 -495.00*X5 -32.391 *X6 -1.9323 *X6 *X6
           CONS(2)=4324. +2.5756 *X1 -2633.2 *X2 -21.455 *X3 +1.0810 *X4
          1 -273.00*X5 -(26.443 + 2.0986 *X6)*X6
           CONS(3)=3814. +0.66222*X1 -1919.6 *X2 -7.2727 *X3 +0.34442*X4
          1 -166.5C*X5 -(10.4276+0.55368 *X6)*X6
           CONS(4)=5823. +2.0311 *X1 -1959.8 *X2 -4.5455 *X3 +0.99574*X4
          1 -423.0 *X5 -(29.415 +1.62636 *X6)*X6
           CCNS(1)=Z(1)
           CCNS(2)=Z(2)
           CONS(3)=Z(3)
           CONS(4)=Z(4)
           CONS(5)=0.
           CONS(6)=0.
           ISAV=I
           DC 71  L=1,6
           IF(INDEX.EQ.0)  ZETA0(L)=CONS(L)
           IF(INDEX.EQ.1)  ZETA1(L,J)=CONS(L)
           IF(INDEX.EQ.2)  ZETA2(L,J)=CONS(L)
           IF(INDEX.EQ.3)  ZETA3(L,J)=CONS(L)
           IF(INDEX.EQ.4)  ZETA4(L,J)=CONS(L)
           IF(INDEX.EQ.11)  ZETA11(L,J,K)=CONS(L)
           IF(INDEX.EQ.22)  ZETA22(L,J,K)=CONS(L)
           IF(INDEX.EQ.33)  ZETA33(L,J,K)=CONS(L)
           IF(INDEX.EQ.44)  ZETA44(L,J,K)=CONS(L)
        71 CONTINUE
           I=ISAV
           RETURN
           END


MEMBER NAME  VARI
           SUBROUTINE VARI(BEE,NY)
      C
      C  SUBRCUTINE VARI CALCULATES TERMS IN ANALYTICAL VARIANCES OF THE CONSEQUENSES
      C  IF CORRELATED INPUT PARAMETERS PRESENT
      C  CALLED BY MAIN, ONLY IF NCORR.GT.0
      *CALL COMMF
           DIMENSICN BEE(6,12)
           DO 196 L=1,NCCNS
           VAR =0.
           DC 197 J=1,NY
           IF(J.EQ.NY) GC TO 197
           JPI = J+1
           DO 198 K= JPI,NY
           VAR = VAR+ 2.*BEE(L,K)*CM11(J,K)*BEE(L,J)
       198 CCNTINUE
       197 CCNTINUE
           SDZET(L)= SQRT(SDZET(L)**2 + VAR)
       196 CCNTINUE
           RETURN
           END
```

APPENDIX B

Sample Input/Output

This sample problem performs Task 4 (JOBI = 4) for a problem of four input parameters and six consequence variables. The multiquadrant knot-point selection scheme is in use (NQUAD = 4).

The first page is the listing of the input cards for Task 4. (For Task 1, only the first five of these input cards are needed.) In the output listing that follows, the consequence variables are power, energy, reactivity, core void fraction, molten cladding fraction, and molten fuel fraction at a specified time during a postulated accident in an LMFBR. Chapter III contains a physical description of the problem.

The coefficients of the response surface polynomials are reported for each quadrant indicated by IQ = 1, ..., 4. Four quadrants are associated with each pair (J, K) of parameters Z_j and Z_k, respectively with the convention $K > J$. Quadrants 1 and 4 have identical B and C coefficients, as do quadrants 2 and 3; however, the cross-term coefficients D(IQ, J, K) are different for every quadrant.

With the aid of definitions given in Chapter II and comments found in the output itself, the rest of the output should be self-explanatory. Helpful comments may also be found in the program listing.

The moments of the response-surface consequences on p. 118 are given for both the complete response surfaces (quadratic model) and for linearized first-order surfaces (linearized model).

The probability distributions starting on p. 119 are presented as histogram tables with 12 categories (intervals). Category 1 includes all cases below the lower limit; category 12 includes all cases above the upper limit.

At the end, the distributions are plotted in 26 categories, each one-half of the above 12 categories, except for the end categories that cover the lower and upper tails.

```
4 0 4 .0228        6    50000 0.500  34060.5      0      4
1 EUSNOF 1           1.0          0.0
2 FUELCP 2           1.0          0.12
3 DOPPLR 2           1.0          0.08
4 VCIDWT 2           1.0          0.10
C 0 0       15.906427    17.272975    0.876856     0.560265     0.137529     0.086247
1 1 0       15.906427    17.272975    0.876856     0.560265     0.137529     0.086247
2 1 C       15.906427    17.272975    0.876856     0.560265     0.137529     0.086247
3 1 0       15.906427    17.272975    0.876856     0.560265     0.137529     0.086247
4 1 C       15.906427    17.272975    0.876856     0.560265     0.137529     0.086247
1 2 0       16.812307    18.436539    0.864460     0.563331     0.153846     0.093240
2 2 0       14.047668    16.235075    0.877437     0.554361     0.123543     0.086247
3 2 C       16.345976    18.134704    0.863420     0.567687     0.153846     0.093240
4 2 C       14.303260    16.581395    0.872035     0.559273     0.137529     0.086247
1 3 C       11.978627    17.048791    0.838756     0.567028     0.146853     0.034965
2 3 0       24.464360    17.698196    0.910999     0.555113     0.123543     0.195804
3 3 0       12.031469    17.121737    0.847327     0.565418     0.146853     0.039627
4 3 C       21.333607    17.550414    0.900701     0.556884     0.137529     0.137529
1 4 0       48.451743    19.152864    0.953858     0.549799     0.310023     0.575758
2 4 0        5.748944    16.375703    0.730859     0.574757     0.137529     0.013986
3 4 0       40.059809    18.488626    0.942758     0.551450     0.223776     0.379953
4 4 C        7.511887    16.577264    0.780680     0.569323     0.137529     0.025641
11 1 2      16.345976    18.134704    0.863420     0.567687     0.153846     0.093240
11 1 3      12.031468    17.121737    0.847827     0.565418     0.146853     0.039627
11 1 4      40.059809    18.488626    0.942758     0.551450     0.223776     0.379953
11 2 3      12.953319    17.799639    0.849465     0.568062     0.153846     0.041958
11 2 4      29.945854    19.535676    0.919915     0.557717     0.156177     0.468531
11 3 4      21.168293    18.027353    0.915634     0.557005     0.151515     0.261072
22 1 2      16.345976    18.134704    0.863420     0.567687     0.153846     0.093240
22 1 3      12.031468    17.121737    0.847827     0.565418     0.146853     0.039627
22 1 4      40.059809    18.488626    0.942758     0.551450     0.223776     0.379953
22 2 3      11.172988    16.422665    0.845639     0.562453     0.137529     0.041958
22 2 4      40.006802    17.617068    0.947300     0.547357     0.205128     0.354312
22 3 4      40.172529    18.646032    0.940345     0.543854     0.209790     0.449883
33 1 2      14.303260    16.581395    0.872035     0.559273     0.137529     0.086247
33 1 3      21.333607    17.550414    0.900701     0.556884     0.137529     0.137529
33 1 4       7.511887    16.577264    0.780680     0.569323     0.137529     0.025641
33 2 3      20.154998    16.792470    0.902915     0.554580     0.132867     0.125874
33 2 4       6.648851    15.986846    0.775907     0.564344     0.128205     0.025641
33 3 4       9.199480    16.683674    0.810701     0.565861     0.128205     0.034965
44 1 2      14.303260    16.581395    0.872035     0.559273     0.137529     0.086247
44 1 3      21.333607    17.550414    0.900701     0.556864     0.137529     0.137529
44 1 4       7.511887    16.577264    0.780680     0.569323     0.137529     0.025641
44 2 3      24.373725    18.329603    0.909049     0.557313     0.142191     0.123543
44 2 4       7.749342    17.219901    0.773948     0.577227     0.149184     0.025641
44 3 4       6.263566    16.527767    0.747396     0.576529     0.149184     0.013986
-1
 20000      0    .01    1 0        25.0
```

INPUT DATA - WORK406025   JOB 4

NUMBER OF PARAMETERS = 4

PAIRS UNLIMITED

PROBABILITY RANGE 0.02280000

NUMBER OF CONSEQUENCES = 6

NUMBER OF SIMULATION CYCLES = 50000
CATEGORY WIDTH = 0.50 STANDARD DEVIATIONS

MULTI QUADRANT RESPONSE SURFACE (NQUAD=4)

INDEPENDENT INPUT PARAMETERS

NUMBER	NAME	DISTRIBUTION	PARAMETERS				PAIRS IF LIMITED NUMBER											
1	BURNUP	1	1.0000	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2	FUELCP	2	1.0000	0.12000	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0
3	COPFLR	2	1.0000	0.80000E-01	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0
4	VOIDWT	2	1.0000	0.10000E 00	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0

DISTRIBUTION	FIRST PARAMETER	SECOND PARAMETER	THIRD PARAMETER	FOURTH PARAMETER
1=UNIFORM	UPPER LIMIT	LOWER LIMIT	N/A	N/A
2=NORMAL	MEAN VALUE	STANDARD DEVIATION	N/A	N/A
3=EXPONENTIAL	LOWER LIMIT	SCALE CONSTANT	N/A	N/A
4=EXPONENTIAL	UPPER LIMIT	SCALE CONSTANT	N/A	N/A
5=NORMAL	MEAN VALUE	STANDARD DEVIATION	LOWER LIMIT	N/A
6=NORMAL	MEAN VALUE	STANDARD DEVIATION	UPPER LIMIT	N/A
7=BETA	LOWER LIMIT	UPPER LIMIT	MEAN	STANDARD DEVIATION
8=LOG NORMAL	MEAN VALUE	STANDARD DEVIATION	N/A	N/A

FOR DISTRIBUTIONS 5 AND 6, THE VALUES FOR THE MEAN AND STANDARD DEVIATION ARE THOSE FOR THE UNTRUNCATED NORMAL DISTRIBUTIONS.

FOR DISTRIBUTION 8, THE VALUES FOR MEAN AND STANDARD DEVIATION ARE THOSE OF THE LOGARITHM OF THE PARAMETER.

PARAMETER VALUES SELECTED

NUMBER	NAME	Z2	Z4	Z0	Z3	Z1
1	BURNUP	0.228000E-01	0.162569E 00	0.500000E 00	0.837431E 00	0.977200E 00
2	FORICP	0.760055E 00	0.830336E 00	0.100000E 01	0.116966E 01	0.123994E 01
3	DCPFLR	0.840035E 00	0.886891E 00	0.100000E 01	0.111311E 01	0.115996E 01
4	VCIDWT	0.800049E 00	0.858613E 00	0.100000E 01	0.114139E 01	0.119995E 01

INPUT CONSEQUENCES IN KNOT POINTS

INDEX	J	K	6 -CONSEQUENCES					
0	0	0	0.159064E 02	0.172730E 02	0.876856E 00	0.560265E 00	0.137529E 00	0.862470E-01
1	1	0	0.159064E 02	0.172730E 02	0.876856E 00	0.560265E 00	0.137529E 00	0.862470E-01
2	1	0	0.159064E 02	0.172730E 02	0.876856E 00	0.560265E 00	0.137529E 00	0.862470E-01
3	1	0	0.159064E 02	0.172730E 02	0.876856E 00	0.560265E 00	0.137529E 00	0.862470E-01
4	1	0	0.159064E 02	0.172730E 02	0.876856E 00	0.560265E 00	0.137529E 00	0.862470E-01
1	2	0	0.168123E 02	0.184365E 02	0.864460E 00	0.568331E 00	0.153846E 00	0.932400E-01
2	2	0	0.140477E 02	0.162351E 02	0.877457E 00	0.554361E 00	0.123543E 00	0.862470E-01
3	2	0	0.163460E 02	0.181347E 02	0.863420E 00	0.567687E 00	0.153846E 00	0.932400E-01
4	2	0	0.143033E 02	0.165814E 02	0.872035E 00	0.559273E 00	0.137529E 00	0.862470E-01
1	3	0	0.110786E 02	0.170488E 02	0.838756E 00	0.567028E 00	0.146853E 00	0.349650E-01
2	3	0	0.244644E 02	0.176982E 02	0.910999E 00	0.555113E 00	0.123543E 00	0.195804E 00
3	3	0	0.120315E 02	0.171217E 02	0.847827E 00	0.565418E 00	0.146853E 00	0.396270E-01
4	3	0	0.213336E 02	0.175504E 02	0.900701E 00	0.556884E 00	0.137529E 00	0.137529E 00
1	4	0	0.484517E 02	0.191529E 02	0.953858E 00	0.549799E 00	0.310023E 00	0.575758E 00
2	4	0	0.574894E 01	0.163757E 02	0.730859E 00	0.574757E 00	0.137529E 00	0.139860E-01
3	4	0	0.400598E 02	0.184886E 02	0.942758E 00	0.551450E 00	0.223776E 00	0.379953E 00
4	4	0	0.751189E 01	0.165773E 02	0.780680E 00	0.569323E 00	0.137529E 00	0.256410E-01
11	1	2	0.163460E 02	0.181347E 02	0.863420E 00	0.567687E 00	0.153846E 00	0.932400E-01
11	1	3	0.120315E 02	0.171217E 02	0.847827E 00	0.565418E 00	0.146853E 00	0.396270E-01
11	1	4	0.400598E 02	0.184886E 02	0.942758E 00	0.551450E 00	0.223776E 00	0.379953E 00
11	2	3	0.129533E 02	0.177996E 02	0.849465E 00	0.568062E 00	0.153846E 00	0.419580E-01
11	2	4	0.299458E 02	0.195357E 02	0.919915E 00	0.557717E 00	0.156177E 00	0.468531E 00
11	3	4	0.211683E 02	0.180273E 02	0.915634E 00	0.557005E 00	0.151515E 00	0.261072E 00
22	1	2	0.163460E 02	0.181347E 02	0.863420E 00	0.567687E 00	0.153846E 00	0.932400E-01
22	1	3	0.120315E 02	0.171217E 02	0.847827E 00	0.565418E 00	0.146853E 00	0.396270E-01
22	1	4	0.400598E 02	0.184886E 02	0.942758E 00	0.551450E 00	0.223776E 00	0.379953E 00
22	2	3	0.111730E 02	0.164227E 02	0.845639E 00	0.562453E 00	0.137529E 00	0.419580E-01
22	2	4	0.400068E 02	0.176171E 02	0.947300E 00	0.547357E 00	0.205128E 00	0.354312E 00
22	3	4	0.401725E 02	0.186460E 02	0.940345E 00	0.543854E 00	0.209790E 00	0.449883E 00
33	1	2	0.143033E 02	0.165814E 02	0.872035E 00	0.559273E 00	0.137529E 00	0.862470E-01
33	1	3	0.213336E 02	0.175504E 02	0.900701E 00	0.556884E 00	0.137529E 00	0.137529E 00
33	1	4	0.751189E 01	0.165773E 02	0.780680E 00	0.569323E 00	0.137529E 00	0.256410E-01
33	2	3	0.201550E 02	0.167925E 02	0.902915E 00	0.554080E 00	0.132867E 00	0.125874E 00
33	2	4	0.684885E 01	0.159868E 02	0.775907E 00	0.564344E 00	0.128205E 00	0.256410E-01
33	3	4	0.919948E 01	0.166837E 02	0.810701E 00	0.565861E 00	0.128205E 00	0.349650E-01
44	1	2	0.143033E 02	0.165814E 02	0.872035E 00	0.559273E 00	0.137529E 00	0.862470E-01
44	1	3	0.213336E 02	0.175504E 02	0.900701E 00	0.556884E 00	0.137529E 00	0.137529E 00
44	1	4	0.751189E 01	0.165773E 02	0.780680E 00	0.569323E 00	0.137529E 00	0.256410E-01
44	2	3	0.243737E 02	0.183296E 02	0.909049E 00	0.557313E 00	0.142191E 00	0.123543E 00
44	2	4	0.774934E 01	0.172199E 02	0.773948E 00	0.577227E 00	0.149184E 00	0.256410E-01
44	3	4	0.626357E 01	0.165278E 02	0.747396E 00	0.576529E 00	0.149184E 00	0.139860E-01
-1	0	0	0.0	0.0	0.0	0.0	0.0	0.0

NEGATIVE INDEX IS FOR EOF ONLY

```
THE COEFFICIENTS OF THE POLYNOMIALS

   A
 + B(J) * (Z(J)-ZO(J))                  , SUM J
 + C(J) * (Z(J)-ZO(J))**2               , SUM J
 + D(J,K) * (Z(J)-ZO(J)) * (Z(K)-ZO(K)) , SUM J,K  (K.GT.J)

IN MULTIQUADRANT CASE (NQUAD=4) IQ INDICATES THE QUADRANT IN Z(J)/Z(K) -PLANE



          CONSEQUENCE   1

   A =    15.9064


  B(J)   =   0.0             5.76106      -41.8406        106.784
IQ= 1
BQ(IQ,J)=    0.0            -0.269656     -44.1027        190.305

  C(J)   =   0.0            -8.27559       72.8897        279.987
IQ= 1
CQ(IQ,J)=    0.0            16.8586        87.0308       -137.726

  D( 1,K) =  -0.266530E-03  -0.324835E-03  -0.319837E-03
IQ= 1
DQ(IQ, 1,K)=  -0.266530E-03  -0.324835E-03  -0.319837E-03

  D( 2,K) =    25.1329       -439.948
IQ= 1
DQ(IQ, 2,K)=    25.1329       -439.948

  D( 3,K) =   -939.006
IQ= 1
DQ(IQ, 3,K)=   -939.006

  B(J)   =   0.0             5.76106      -41.8406        106.784
IQ= 2
BQ(IQ,J)=    0.0            13.5589       -34.6590        80.0701

  C(J)   =   0.0            -8.27559       72.8897        279.987
IQ= 2
CQ(IQ,J)=    0.0            24.2232       117.786         146.387

  D( 1,K) =  -0.266530E-03  -0.324835E-03  -0.319837E-03
IQ= 2
DQ(IQ, 1,K)=   0.266530E-03   0.324835E-03   0.319837E-03

  D( 2,K) =    25.1329       -439.948
IQ= 2
DQ(IQ, 2,K)=   -38.8047       -64.6212

  D( 3,K) =   -939.006
IQ= 2
DQ(IQ, 3,K)=    332.319

  B(J)   =   0.0             5.76106      -41.8406        106.784
IQ= 3
```

```
BC(IC,J)=   C.0            13.5589      -34.6590       60.0701

  C(J)   =  0.0           -8.27559       72.6897      279.387
IC= 3
CC(IC,J)=   0.0            24.2232      117.786       146.387

  D( 1,K) =  -0.266530E-03  -0.324835E-03  -0.319837E-03
IC= 3
DC(IQ, 1,K)=   0.0          -0.399794E-03  -0.179907E-03

  D( 2,K) =    25.1329       -439.948
IC= 3
DC(IC, 2,K)=    22.1216        39.1908

  D( 3,K) =   -939.006
IC= 3
DC(IQ, 3,K)=   -233.635

  B(J)   =  0.0            5.76106      -41.8406      106.784
IC= 4
BC(IQ,J)=   0.0           -0.269656     -44.1027      190.305

  C(J)   =  0.0           -8.27559       72.6897      279.987
IC= 4
CC(IQ,J)=   0.0            16.8586       87.0306     -137.726

  D( 1,K) =  -0.266530E-03  -0.324835E-03  -0.319837E-03
IC= 4
DC(IC, 1,K)=   0.0           0.399794E-03   0.179907E-03

  D( 2,K) =    25.1329       -439.948
IC= 4
DC(IC, 2,K)=   -135.513         8.42447

  D( 3,K) =   -539.006
IC= 4
DC(IC, 3,K)=   -164.246
```

```
          CONSEQUENCE   2

   A =    17.2730


  B(J)   =   0.0              4.58754       -2.02987       6.94462
IC= 1
BC(IC,J)=    0.0              5.63333       -1.18144       6.65778

  C(J)   =   0.0              1.09146        3.92838      12.2691
IC= 1
CC(IC,J)=    0.0             -3.26709       -1.37561      13.7237

  D( 1,K) =   0.0               0.0            0.0
IC= 1
DC(IC, 1,K)=   0.0               0.0            0.0

  D( 2,K) =   -9.57889          7.72607
IC= 1
DC(IC, 2,K)=   -9.57889          7.72607

  D( 3,K) =   -19.3874
IC= 1
DC(IC, 3,K)=   -19.3874

  B(J)   =   0.0              4.58754       -2.02987       6.94462
IC= 2
BC(IC,J)=    0.0              3.47376       -1.95681       5.96645

  C(J)   =   0.0              1.09146        3.92838      12.2891
IC= 2
CC(IC,J)=    0.0             -3.55045        4.38507       7.39700

  D( 1,K) =   0.0               0.0            0.0
IC= 2
DC(IC, 1,K)=   0.0               0.0            0.0

  D( 2,K) =   -9.57889          7.72607
IC= 2
DC(IC, 2,K)=   0.351201          7.50214

  D( 3,K) =   -19.3874
IC= 2
DC(IC, 3,K)=    7.50532

  B(J)   =   0.0              4.58754       -2.02987       6.94462
IC= 3
BC(IC,J)=    0.0              3.47376       -1.95681       5.96645

  C(J)   =   0.0              1.09146        3.92838      12.2891
IC= 3
CC(IC,J)=    0.0             -3.55045        4.38507       7.39700

  D( 1,K) =   0.0               0.0            0.0
IC= 3
DC(IC, 1,K)=   0.0               0.0            0.0
```

```
  D( 2,K) =   -9.57889        7.72607
IC= 3
DC(IQ, 2,K)=   -3.45797        4.21667

  D( 3,K) =   -19.3874
IC= 3
DC(IQ, 3,K)=   -10.6540

  B(J)  =   0.0             4.58754      -2.02987       6.94462
IC= 4
BC(IQ,J)=   0.0             5.63333      -1.18144       6.65778

  C(J)  =   0.0             1.09146       3.92838      12.2691
IC= 4
CC(IQ,J)=   0.0            -3.26709      -1.37561      13.7237

  D( 1,K) =   0.0             0.0            0.0
IC= 4
DC(IQ, 1,K)=   0.0             0.0            0.0

  D( 2,K) =   -9.57889        7.72607
IC= 4
DC(IQ, 2,K)=    4.30081        9.13308

  D( 3,K) =   -19.3874
IC= 4
DC(IQ, 3,K)=   -6.36131
```

```
          CCBSEQUENCE   3

     A =   0.876856


  B(J)   =   0.0          -0.270837E-01  -0.225815      0.557634
IC= 1
BC(IQ,J)=    0.0          -0.145654      -0.301222      0.661684

  C(J)   =   0.0          -0.102438      -0.773242E-01  -0.862858
IC= 1
CC(IQ,J)=    0.0           0.391727       0.394085      -1.38324

  D( 1,K) =  -0.937020E-05  -0.312341E-05  -0.999490E-05
IC= 1
DC(IQ, 1,K)=  -0.937020E-05  -0.312341E-05  -0.999490E-05

  D( 2,K) =   0.785464       -0.392188
IC= 1
DC(IQ, 2,K)=   0.785464       -0.392188

  D( 3,K) =   0.115068
IC= 1
DC(IQ, 3,K)=   0.115068

  B(J)   =   0.0          -0.270837E-01  -0.225815      0.557634
IC= 2
BC(IQ,J)=    0.0           0.103062      -0.204460      0.559692

  C(J)   =   0.0          -0.102438      -0.773242E-01  -0.862858
IC= 2
CC(IQ,J)=    0.0           0.439968       0.561733E-01  -0.852564

  D( 1,K) =  -0.937020E-05  -0.312341E-05  -0.999490E-05
IC= 2
DC(IQ, 1,K)=   0.937021E-05   0.312341E-05   0.999490E-05

  D( 2,K) =   0.785464       -0.392188
IC= 2
DC(IQ, 2,K)=  -0.137162       -0.390313

  D( 3,K) =   0.115068
IC= 2
DC(IQ, 3,K)=    1.64196

  B(J)   =   0.0          -0.270837E-01  -0.225815      0.557634
IC= 3
BC(IQ,J)=    0.0           0.103062      -0.204460      0.559692

  C(J)   =   0.0          -0.102438      -0.773242E-01  -0.862858
IC= 3
CC(IQ,J)=    0.0           0.439966       0.561733E-01  -0.852564

  D( 1,K) =  -0.937020E-05  -0.312341E-05  -0.999490E-05
IC= 3
DC(IQ, 1,K)=  -0.104113E-05  -0.140553E-04  -0.749614E-05
```

```
  D( 2,K) =   0.785464      -0.392188
IC= 3
DC(IC, 2,K)=   0.366581       0.198034E-02

  D( 3,K) =   0.115068
IC= 3
DC(IC, 3,K)=   0.286148

  B(J)   =   0.0           -0.270837E-01  -0.225815      0.557634
IC= 4
BC(IC,J)=   0.0           -0.145654      -0.301222      0.661684

  C(J)   =   0.0           -0.102438      -0.773242E-01  -0.862858
IC= 4
CC(IQ,J)=   0.0            0.391727       0.394065      -1.38324

  D( 1,K) =  -0.937020E-05  -0.312341E-05  -0.999490E-05
IC= 4
DC(IQ, 1,K)=   0.104113E-05   0.140553E-04   0.749614E-05

  D( 2,K) =   0.785464      -0.392188
IC= 4
DC(IC, 2,K)=   -1.13514      -0.279458

  D( 3,K) =   0.115068
IC= 4
DC(IC, 3,K)=   0.266103
```

```
          CONSEQUENCE   4

   A =   0.560265


  B(J)   =   0.0            0.291113E-01   0.372436E-01  -0.624104E-01
IC= 1
BC(IQ,J)=    0.0            0.681990E-01   0.534730E-01  -0.864989E-01

  C(J)   =   0.0            0.187771E-01   0.314814E-01   0.503500E-01
IC= 1
CC(IQ,J)=    0.0           -0.144129      -0.699775E-01   0.170822

  D( 1,K) =  -0.520567E-05  -0.156171E-05  -0.112443E-04
IC= 1
DC(IQ, 1,K)=  -0.520567E-05  -0.156171E-05  -0.112443E-04

  D( 2,K) =  -0.249005      -0.481498E-01
IC= 1
DC(IQ, 2,K)=  -0.249005      -0.481498E-01

  D( 3,K) =   0.251136E-01
IC= 1
DC(IQ, 3,K)=   0.251136E-01

  B(J)   =   0.0            0.291113E-01   0.372436E-01  -0.624104E-01
IC= 2
BC(IQ,J)=    0.0           -0.394414E-01   0.242979E-01  -0.437558E-01

  C(J)   =   0.0            0.187771E-01   0.314814E-01   0.503500E-01
IC= 2
CC(IQ,J)=    0.0           -0.266929      -0.494489E-01   0.143645

  D( 1,K) =  -0.520567E-05  -0.156171E-05  -0.112443E-04
IC= 2
DC(IQ, 1,K)=   0.520567E-05   0.156171E-05   0.112443E-04

  D( 2,K) =  -0.249005      -0.481498E-01
IC= 2
DC(IQ, 2,K)=   0.102813       0.129302

  D( 3,K) =   0.251136E-01
IC= 2
DC(IQ, 3,K)=   0.263605

  B(J)   =   0.0            0.291113E-01   0.372436E-01  -0.624104E-01
IC= 3
BC(IQ,J)=    0.0           -0.394414E-01   0.242979E-01  -0.437558E-01

  C(J)   =   0.0            0.187771E-01   0.314814E-01   0.503500E-01
IC= 3
CC(IQ,J)=    0.0           -0.266929      -0.494489E-01   0.143645

  D( 1,K) =  -0.520567E-05  -0.156171E-05  -0.112443E-04
IC= 3
DC(IQ, 1,K)=  -0.937017E-05  -0.140553E-04  -0.149923E-04
```

```
  D( 2,K) =  -0.249005       -0.481498E-01
IC= 3
DC(IC, 2,K)=  -0.944389E-01  -0.166242

  D( 3,K) =   0.251136E-01
IC= 3
DC(IC, 3,K)=  -0.510242E-02

  B(J)   =   0.0            0.291113E-01   0.372436E-01  -0.624104E-01
IC= 4
BC(IC,J)=   0.0            0.681990E-01   0.534730E-01  -0.864989E-01

  C(J)   =   0.0            0.187771E-01   0.314814E-01   0.503500E-01
IC= 4
CC(IC,J)=   0.0           -0.144129      -0.699775E-01   0.170822

  D( 1,K) =  -0.520567E-05  -0.156171E-05  -0.112443E-04
IC= 4
DC(IQ, 1,K)=   0.937017E-05   0.140553E-04   0.149923E-04

  D( 2,K) =  -0.249005       -0.481498E-01
IC= 4
DC(IQ, 2,K)=   0.364420       -0.200644E-01

  D( 3,K) =   0.251136E-01
IC= 4
DC(IC, 3,K)=  -0.128325
```

```
            CONSEQUENCE   5

     A =    0.137529


  B(J)    =    0.0              0.631468E-01   0.728616E-01   0.431343
IC= 1
BC(IC,J)=    0.0              0.164177       0.140724       0.476837E-05

  C(J)    =    0.0              0.202448E-01  -0.910987E-01    2.15724
IC= 1
CC(IC,J)=    0.0             -0.400819      -0.515340       4.31447

  D( 1,K) =    0.0              0.0            0.0
IC= 1
DC(IC, 1,K)=    0.0            0.0            0.0

  D( 2,K) =  -0.485869       -3.49824
IC= 1
DC(IC, 2,K)=  -0.485869       -3.49824

  D( 3,K) =   -5.10162
IC= 1
DC(IC, 3,K)=   -5.10162

  B(J)    =    0.0              0.631468E-01   0.728616E-01   0.431343
IC= 2
BC(IC,J)=    0.0             -0.140723      -0.211084       0.0

  C(J)    =    0.0              0.202448E-01  -0.910987E-01    2.15724
IC= 2
CC(IC,J)=    0.0             -0.829419      -1.86619        0.0

  D( 1,K) =    0.0              0.0            0.0
IC= 2
DC(IC, 1,K)=    0.0            0.0            0.0

  D( 2,K) =  -0.485869       -3.49824
IC= 2
DC(IC, 2,K)=    0.485867       0.777386

  D( 3,K) =   -5.10162
IC= 2
DC(IC, 3,K)=    0.674557

  B(J)    =    0.0              0.631468E-01   0.728616E-01   0.431343
IC= 3
BC(IC,J)=    0.0             -0.140723      -0.211084       0.0

  C(J)    =    0.0              0.202448E-01  -0.910987E-01    2.15724
IC= 3
CC(IC,J)=    0.0             -0.829419      -1.86619        0.0

  D( 1,K) =    0.0              0.0            0.0
IC= 3
DC(IC, 1,K)=    0.0            0.0            0.0
```

```
  D( 2,K) =  -0.465869        -3.49824
IC= 3
DC(IC, 2,K)=  -0.142596        -0.386691

  D( 3,K) =   -5.10162
IC= 3
DC(IC, 3,K)=  -0.563037

  B(J)   =   0.0            0.631468E-01   0.728616E-01   0.431343
IC= 4
BC(IC,J)=   0.0            0.164177       0.140724       0.476837E-05

  C(J)   =   0.0            0.202448E-01  -0.910987E-01    2.15724
IC= 4
CC(IC,J)=   0.0           -0.400819      -0.515340        4.31447

  D( 1,K) =   0.0            0.0            0.0
IC= 4
DC(IC, 1,K)=   0.0            0.0            0.0

  D( 2,K) =  -0.465869        -3.49824
IC= 4
DC(IC, 2,K)=   0.607330        0.194345

  D( 3,K) =   -5.10162
IC= 4
DC(IC, 3,K)=  -0.145761
```

```
          CONSEQUENCE    6

    A =   0.862470E-01


  B(J)   =    0.0              0.145724E-01  -0.502745        1.40478
IC= 1
BC(IC,J)=    0.0              0.703616E-01  -0.633255        1.18207

  C(J)   =    0.0              0.607331E-01    1.13874        5.21821
IC= 1
CC(IC,J)=    0.0             -0.171780        1.95464        6.33203

  D( 1,K) =    0.0              -0.107367E-05    0.0
IC= 1
DC(IC, 1,K)=    0.0              -0.107367E-05    0.0

  D( 2,K) =  -0.242935          3.40107
IC= 1
DC(IC, 2,K)=  -0.242935          3.40107

  D( 3,K) =    -4.51858
IC= 1
DC(IC, 3,K)=    -4.51858

  B(J)   =    0.0              0.145724E-01  -0.502745        1.40478
IC= 2
BC(IC,J)=    0.0              0.0             0.105540       0.591035

  C(J)   =    0.0              0.607331E-01    1.13874        5.21821
IC= 2
CC(IC,J)=    0.0              0.0             4.94145        1.14849

  D( 1,K) =    0.0              -0.107367E-05    0.0
IC= 2
DC(IC, 1,K)=    0.0               0.107367E-05    0.0

  D( 2,K) =  -0.242935          3.40107
IC= 2
DC(IC, 2,K)=  -0.121465          1.06890

  D( 3,K) =    -4.51858
IC= 2
DC(IC, 3,K)=    -1.16608

  B(J)   =    0.0              0.145724E-01  -0.502745        1.40476
IC= 3
BC(IC,J)=    0.0              0.0             0.105540       0.591035

  C(J)   =    0.0              0.607331E-01    1.13874        5.21821
IC= 3
CC(IC,J)=    0.0              0.0             4.94145        1.14849

  D( 1,K) =    0.0              -0.107367E-05    0.0
IC= 3
DC(IC, 1,K)=    0.0               0.0             -0.702763E-06
```

```
  D( 2,K) =  -0.242935         3.40107
IC= 3
DC(IC, 2,K)=  -0.607328       -0.139767E-05

  D( 3,K) =   -4.51856
IC= 3
DC(IQ, 3,K)=   -2.62366

  B(J)   =   0.0              0.145724E-01  -0.502745        1.40478
IC= 4
BC(IQ,J)=    0.0              0.703616E-01  -0.633255        1.18207

  C(J)   =   0.0              0.607331E-01    1.13874        5.21821
IC= 4
CC(IC,J)=    0.0             -0.171780        1.95464        6.33203

  D( 1,K) =   0.0             -0.107367E-05   0.0
IC= 4
DC(IQ, 1,K)=   0.0             0.0             0.702763E-06

  D( 2,K) =  -0.242935         3.40107
IC= 4
DC(IC, 2,K)=    1.09319        0.291520

  D( 3,K) =   -4.51856
IC= 4
DC(IC, 3,K)=   -2.18646
```

SENSITIVITIES

CONSEQUENCE 1		CONSEQUENCE 2		CONSEQUENCE 3		CONSEQUENCE 4		CONSEQUENCE 5		CONSEQUENCE 6	
PARA	SENSITIVITY	PARA	SENSITIVITY	PARA	SENSITIVITY	PARA	SENSITIVITY	PARA	SENSITIVITY	PARA	SENSITIVITY
4	0.427028E 02	4	0.277716E 01	4	0.222999E 00	4	0.249580E-01	4	0.172494E 00	4	0.561772E 00
3	0.133857E 02	2	0.220148E 01	3	0.722430E-01	2	0.139700E-01	2	0.303030E-01	3	0.160839E 00
2	0.276463E 01	3	0.645399E 00	2	0.129970E-01	3	0.119150E-01	3	0.233100E-01	2	0.699300E-02
1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0

CROSS-TERM SENSITIVITIES

CONSEQUENCES 1 PAIR	SENSITIVITY	2 PAIR	SENSITIVITY	3 PAIR	SENSITIVITY	4 PAIR	SENSITIVITY	5 PAIR	SENSITIVITY	6 PAIR	SENSITIVITY
3 4	0.150166E 02	3 4	0.310043E 00	2 3	0.150734E-01	2 3	0.477850E-02	2 4	0.839160E-01	2 4	0.815850E-01
2 4	0.105535E 02	2 4	0.185333E 00	2 4	0.940782E-02	2 4	0.115502E-02	3 4	0.815850E-01	3 4	0.722610E-01
2 3	0.482311E 00	2 3	0.183823E 00	3 4	0.190413E-02	3 4	0.401616E-03	2 3	0.932401E-02	2 3	0.466202E-02
1 4	0.152566E-04	1 4	0.0	1 2	0.536442E-06	1 4	0.536442E-06	1 4	0.0	1 3	0.409782E-07
1 2	0.152588E-04	1 3	0.0	1 4	0.476837E-06	1 2	0.298023E-06	1 3	0.0	1 4	0.0
1 3	0.123976E-04	1 2	0.0	1 3	0.119209E-06	1 3	0.596046E-07	1 2	0.0	1 2	0.0

CONSEQUENCES VS PARAMETERS

NINE EQUALLY SPACED VALUES FROM Z2(J) THROUGH Z1(J)

CONSEQUENCE 1

1 RESBUF	0.2280E-01	0.1421	0.2614	0.3807	0.5000	0.6193	0.7386	0.8579	0.9772
CONSEQUENCE 1	15.91	15.91	15.91	15.91	15.91	15.91	15.91	15.91	15.91

CONSEQUENCE VERSUS PARAMETER SKETCH

```
PARAMETER    CONSEQUENCE                  SKETCH

0.2280E-01     15.91      *--------------------------------------------------
0.1421         15.91      *
0.2614         15.91      *
0.3807         15.91      *
0.5000         15.91      *
0.6193         15.91      *
0.7386         15.91      *
0.8579         15.91      *
0.9772         15.91      *
```

2 BUBLCE	0.7601	0.8200	0.8800	0.9400	1.000	1.060	1.120	1.180	1.240
CONSEQUENCE 1	14.05	14.60	15.10	15.53	15.91	16.22	16.48	16.68	16.81

CONSEQUENCE VERSUS PARAMETER SKETCH

```
PARAMETER    CONSEQUENCE                  SKETCH

0.7601         14.05      *--------------------------------------------------
0.8200         14.60      I         *
0.8800         15.10      I                  *
0.9400         15.53      I                          *
1.000          15.91      I                                 *
1.060          16.22      I                                      *
1.120          16.48      I                                           *
1.180          16.68      I                                               *
1.240          16.81      I                                                 *
```

3 ECPPLS	0.8400	0.8800	0.9200	0.9600	1.000	1.040	1.080	1.120	1.160
CONSEQUENCE 1	24.46	21.98	19.72	17.70	15.91	14.35	13.03	11.94	11.08

CONSEQUENCE VERSUS PARAMETER SKETCH

```
PARAMETER    CONSEQUENCE                  SKETCH

0.8400         24.46      I-------------------------------------------------*
0.8800         21.98      I                                        *
0.9200         19.72      I                               *
0.9600         17.70      I                        *
1.000          15.91      I                 *
1.040          14.35      I           *
1.080          13.03      I      *
1.120          11.94      I  *
1.160          11.08      *
```

```
4  WEIGHT      0.8000     0.8500     0.9000     0.9500     1.000      1.050      1.100      1.150      1.200
CONSEQUENCE  1  5.749      6.189      8.029      11.27      15.91      21.94      29.38      38.22      48.45

          CONSEQUENCE VERSUS PARAMETER SKETCH

             PARAMETER   CONSEQUENCE                     SKETCH

             0.8000         5.749     *-------------------------------------------------
             0.8500         6.189     I*
             0.9000         8.029     I  *
             0.9500         11.27     I     *
             1.000          15.91     I           *
             1.050          21.94     I                  *
             1.100          29.38     I                           *
             1.150          38.22     I                                     *
             1.200          48.45     I                                                 *

                         CONSEQUENCE   2

1  ENGNOF      0.2280E-01 0.1421     0.2614     0.3807     0.5000     0.6193     0.7386     0.8579     0.9772
CONSEQUENCE  2  17.27      17.27      17.27      17.27      17.27      17.27      17.27      17.27      17.27

          CONSEQUENCE VERSUS PARAMETER SKETCH

             PARAMETER   CONSEQUENCE                     SKETCH

             0.2280E-01     17.27     *-------------------------------------------------
             0.1421         17.27     *
             0.2614         17.27     *
             0.3807         17.27     *
             0.5000         17.27     *
             0.6193         17.27     *
             0.7386         17.27     *
             0.8579         17.27     *
             0.9772         17.27     *

2  FUELCF      0.7601     0.8200     0.8800     0.9400     1.000      1.060      1.120      1.180      1.240
CONSEQUENCE  2  16.24      16.48      16.74      17.00      17.27      17.55      17.84      18.13      18.44

          CONSEQUENCE VERSUS PARAMETER SKETCH

             PARAMETER   CONSEQUENCE                     SKETCH

             0.7601         16.24     *-------------------------------------------------
             0.8200         16.48     I     *
             0.8800         16.74     I          *
             0.9400         17.00     I                *
             1.000          17.27     I                       *
             1.060          17.55     I                             *
             1.120          17.84     I                                   *
             1.180          18.13     I                                          *
             1.240          18.44     I                                                 *

3  DCFELS      0.8400     0.8800     0.9200     0.9600     1.000      1.040      1.080      1.120      1.160
CONSEQUENCE  2  17.70      17.57      17.46      17.36      17.27      17.20      17.14      17.09      17.05

          CONSEQUENCE VERSUS PARAMETER SKETCH
```

```
          PARAMETER    CONSEQUENCE                      SKETCH

          0.8400         17.70      I-------------------------------------------------*
          0.8800         17.57      I                                       *
          0.9200         17.46      I                               *
          0.9600         17.36      I                       *
           1.000         17.27      I                *
           1.040         17.20      I          *
           1.080         17.14      I      *
           1.120         17.09      I  *
           1.160         17.05      *

   4  VCIDNT    0.8000      0.8500     0.9000     0.9500     1.000      1.050      1.100      1.150      1.200
 CONSEQUENCE  2  16.38       16.51      16.70      16.96      17.27      17.65      18.09      18.59      19.15


       CONSEQUENCE VERSUS PARAMETER SKETCH

          PARAMETER    CONSEQUENCE                      SKETCH

          0.8000         16.38      *--------------------------------------------------
          0.8500         16.51      I *
          0.9000         16.70      I     *
          0.9500         16.96      I         *
           1.000         17.27      I               *
           1.050         17.65      I                      *
           1.100         18.09      I                              *
           1.150         18.59      I                                       *
           1.200         19.15      I                                                 *

                       CONSEQUENCE   3

   1  ECNNUF    0.2280E-01 0.1421     0.2614     0.3807     0.5000     0.6193     0.7386     0.8579     0.9772
 CONSEQUENCE  3 0.8769     0.8769     0.8769     0.8769     0.8769     0.8769     0.8769     0.8769     0.8769


       CONSEQUENCE VERSUS PARAMETER SKETCH

          PARAMETER    CONSEQUENCE                      SKETCH

          0.2280E-01     0.8769     *--------------------------------------------------
          0.1421         0.8769     *
          0.2614         0.8769     *
          0.3807         0.8769     *
          0.5000         0.8769     *
          0.6193         0.8769     *
          0.7386         0.8769     *
          0.8579         0.8769     *
          0.9772         0.8769     *

   2  FUELCF    0.7601      0.8200     0.8800     0.9400     1.000      1.060      1.120      1.180      1.240
 CONSEQUENCE  3 0.8775      0.8784     0.8786     0.8781     0.8769     0.8749     0.8721     0.8687     0.8645


       CONSEQUENCE VERSUS PARAMETER SKETCH

          PARAMETER    CONSEQUENCE                      SKETCH

          0.7601         0.8775     I---------------------------------------------*----
          0.8200         0.8784     I                                                *
```

```
         0.8800      0.8786      I                                                 *
         0.9400      0.8781      I                                               *
          1.000      0.8769      I                                           *
          1.060      0.8749      I                                    *
          1.120      0.8721      I                          *
          1.180      0.8687      I              *
          1.240      0.8645      *

 3 CCEPLS        0.8400      0.8800      0.9200      0.9600      1.000       1.040       1.080       1.120       1.160
CONSEQUENCE   3  0.9110      0.9028      0.8944      0.8858      0.8769      0.8677      0.8583      0.8487      0.8388

      CONSEQUENCE VERSUS PARAMETER SKETCH

          PARAMETER   CONSEQUENCE                  SKETCH

         0.8400      0.9110      I-------------------------------------------------*
         0.8800      0.9028      I                                           *
         0.9200      0.8944      I                                      *
         0.9600      0.8858      I                                *
          1.000      0.8769      I                         *
          1.040      0.8677      I                   *
          1.080      0.8583      I             *
          1.120      0.8487      I      *
          1.160      0.8388      *

 4 WEIGHT        0.8000      0.8500      0.9000      0.9500      1.000       1.050       1.100       1.150       1.200
CONSEQUENCE   3  0.7309      0.7738      0.8125      0.8468      0.8769      0.9026      0.9240      0.9411      0.9539

      CONSEQUENCE VERSUS PARAMETER SKETCH

          PARAMETER   CONSEQUENCE                  SKETCH

         0.8000      0.7309      *--------------------------------------------------
         0.8500      0.7738      I         *
         0.9000      0.8125      I                 *
         0.9500      0.8468      I                         *
          1.000      0.8769      I                                *
          1.050      0.9026      I                                      *
          1.100      0.9240      I                                          *
          1.150      0.9411      I                                              *
          1.200      0.9539      I                                                 *

                     CONSEQUENCE   4

 1 RUNNOF        0.2280E-01 0.1421   0.2614      0.3807      0.5000      0.6193      0.7386      0.8579      0.9772
CONSEQUENCE   4  0.5603      0.5603      0.5603      0.5603      0.5603      0.5603      0.5603      0.5603      0.5603

      CONSEQUENCE VERSUS PARAMETER SKETCH

          PARAMETER   CONSEQUENCE                  SKETCH

         0.2280E-01  0.5603      *--------------------------------------------------
         0.1421      0.5603      *
         0.2614      0.5603      *
         0.3807      0.5603      *
         0.5000      0.5603      *
         0.6193      0.5603      *
         0.7386      0.5603      *
```

```
                0.8579        0.5603      *
                0.9772        0.5603      *

       2 PUBLCE   0.7601     0.8200     0.8800     0.9400     1.000      1.060      1.120      1.180      1.240
    CONSEQUENCE 4 0.5544     0.5556     0.5570     0.5586     0.5603     0.5621     0.5640     0.5661     0.5683

           CONSEQUENCE VERSUS PARAMETER SKETCH

              PARAMETER   CONSEQUENCE                     SKETCH

                0.7601     0.5544     *---------------------------------------------------
                0.8200     0.5556     I    *
                0.8600     0.5570     I         *
                0.9400     0.5586     I              *
                1.000      0.5603     I                    *
                1.060      0.5621     I                           *
                1.120      0.5640     I                                  *
                1.180      0.5661     I                                         *
                1.240      0.5683     I                                                *

       3 DCPPLS   0.8400     0.8800     0.9200     0.9600     1.000      1.040      1.080      1.120      1.160
    CONSEQUENCE 4 0.5551     0.5562     0.5575     0.5588     0.5603     0.5618     0.5634     0.5652     0.5670

           CONSEQUENCE VERSUS PARAMETER SKETCH

              PARAMETER   CONSEQUENCE                     SKETCH

                0.8400     0.5551     *---------------------------------------------------
                0.8800     0.5562     I    *
                0.9200     0.5575     I         *
                0.9600     0.5588     I               *
                1.000      0.5603     I                     *
                1.040      0.5618     I                           *
                1.080      0.5634     I                                  *
                1.120      0.5652     I                                         *
                1.160      0.5670     I                                                *

       4 WEIGHT   0.8000     0.8500     0.9000     0.9500     1.000      1.050      1.100      1.150      1.200
    CONSEQUENCE 4 0.5748     0.5708     0.5670     0.5635     0.5603     0.5573     0.5545     0.5520     0.5498

           CONSEQUENCE VERSUS PARAMETER SKETCH

              PARAMETER   CONSEQUENCE                     SKETCH

                0.8000     0.5748     I--------------------------------------------------*
                0.8500     0.5708     I                                         *
                0.9000     0.5670     I                                 *
                0.9500     0.5635     I                          *
                1.000      0.5603     I                    *
                1.050      0.5573     I              *
                1.100      0.5545     I        *
                1.150      0.5520     I   *
                1.200      0.5498     *

                          CONSEQUENCE   5

       1 EORNOF   0.2268CE-01 0.1421  0.2614     0.3807     0.5000     0.6193     0.7386     0.8579     0.9772
    CONSEQUENCE 5 0.1375     0.1375     0.1375     0.1375     0.1375     0.1375     0.1375     0.1375     0.1375
```

```
          CONSEQUENCE VERSUS PARAMETER SKETCH

              PARAMETER    CONSEQUENCE                      SKETCH

             0.2280E-01    0.1375       *--------------------------------------------------
             0.1421        0.1375       *
             0.2614        0.1375       *
             0.3807        0.1375       *
             0.5000        0.1375       *
             0.6193        0.1375       *
             0.7386        0.1375       *
             0.8579        0.1375       *
             0.9772        0.1375       *

     2  PORICE       0.7601      0.8200      0.8800      0.9400      1.000       1.060       1.120       1.180       1.240
CONSEQUENCE     5    0.1235      0.1268      0.1302      0.1338      0.1375      0.1414      0.1454      0.1495      0.1538

          CONSEQUENCE VERSUS PARAMETER SKETCH

              PARAMETER    CONSEQUENCE                      SKETCH

             0.7601        0.1235       *--------------------------------------------------
             0.8200        0.1268       I    *
             0.8800        0.1302       I          *
             0.9400        0.1338       I                *
             1.000         0.1375       I                      *
             1.060         0.1414       I                            *
             1.120         0.1454       I                                   *
             1.180         0.1495       I                                          *
             1.240         0.1538       I                                                 *

     3  COPPER       0.8400      0.8800      0.9200      0.9600      1.000       1.040       1.080       1.120       1.160
CONSEQUENCE     5    0.1235      0.1275      0.1311      0.1345      0.1375      0.1403      0.1428      0.1450      0.1469

          CONSEQUENCE VERSUS PARAMETER SKETCH

              PARAMETER    CONSEQUENCE                      SKETCH

             0.8400        0.1235       *--------------------------------------------------
             0.8800        0.1275       I       *
             0.9200        0.1311       I               *
             0.9600        0.1345       I                      *
             1.000         0.1375       I                             *
             1.040         0.1403       I                                   *
             1.080         0.1428       I                                        *
             1.120         0.1450       I                                             *
             1.160         0.1469       I                                                 *

     4  VOIDWT       0.8000      0.8500      0.9000      0.9500      1.000       1.050       1.100       1.150       1.200
CONSEQUENCE     5    0.1375      0.1214      0.1160      0.1214      0.1375      0.1645      0.2022      0.2507      0.3100

          CONSEQUENCE VERSUS PARAMETER SKETCH

              PARAMETER    CONSEQUENCE                      SKETCH

             0.8000        0.1375       I-----*--------------------------------------------
             0.8500        0.1214       I*
```

```
                    0.9000       0.1160    *
                    0.9500       0.1214    I*
                     1.000       0.1375    I     *
                     1.050       0.1645    I            *
                     1.100       0.2042    I                     *
                     1.150       0.2507    I                                  *
                     1.200       0.3100    I                                                 *

                                 CONSEQUENCE   6

     1  REVNUE    0.2280E-01 0.1421     0.2614     0.3807     0.5000     0.6193     0.7386     0.8579     0.9772
CONSEQUENCE    6  0.8625E-01 0.8625E-01 0.8625E-01 0.8625E-01 0.8625E-01 0.8625E-01 0.8625E-01 0.8625E-01 0.8625E-01

              CONSEQUENCE VERSUS PARAMETER SKETCH

                   PARAMETER   CONSEQUENCE                      SKETCH

                  0.2280E-01   0.8625E-01  *-------------------------------------------------
                  0.1421       0.8625E-01  *
                  0.2614       0.8625E-01  *
                  0.3807       0.8625E-01  *
                  0.5000       0.8625E-01  *
                  0.6193       0.8625E-01  *
                  0.7386       0.8625E-01  *
                  0.8579       0.8625E-01  *
                  0.9772       0.8625E-01  *

     2  FUELCF    0.7601     0.8200     0.8800     0.9400     1.000      1.060      1.120      1.180      1.240
CONSEQUENCE    6  0.8625E-01 0.8559E-01 0.8537E-01 0.8559E-01 0.8625E-01 0.8734E-01 0.8887E-01 0.9084E-01 0.9324E-01

              CONSEQUENCE VERSUS PARAMETER SKETCH

                   PARAMETER   CONSEQUENCE                      SKETCH

                  0.7601       0.8625E-01  I-----*-------------------------------------------
                  0.8200       0.8559E-01  I*
                  0.8800       0.8537E-01  *
                  0.9400       0.8559E-01  I*
                   1.000       0.8625E-01  I     *
                   1.060       0.8734E-01  I            *
                   1.120       0.8887E-01  I                     *
                   1.180       0.9084E-01  I                                  *
                   1.240       0.9324E-01  I                                                 *

     3  DCEFIB    0.8400     0.8800     0.9200     0.9600     1.000      1.040      1.080      1.120      1.160
CONSEQUENCE    6  0.1958     0.1630     0.1337     0.1082     0.8625E-01 0.6796E-01 0.5332E-01 0.4232E-01 0.3497E-01

              CONSEQUENCE VERSUS PARAMETER SKETCH

                   PARAMETER   CONSEQUENCE                      SKETCH

                  0.8400       0.1958      I-------------------------------------------------*
                  0.8800       0.1630      I                                       *
                  0.9200       0.1337      I                              *
                  0.9600       0.1082      I                      *
                   1.000       0.8625E-01  I               *
                   1.040       0.6796E-01  I         *
                   1.080       0.5332E-01  I     *
```

```
               1.120        0.4232E-01  I *
               1.160        0.3497E-01  *

   4  VOIDNT        0.8000      0.8500      0.9000      0.9500      1.000       1.050       1.100       1.150       1.200
CONSEQUENCE   6  0.1399E-01-0.7066E-02-0.2040E-02 0.2906E-01 0.8625E-01 0.1695     0.2788      0.4143      0.5758


           CONSEQUENCE VERSUS PARAMETER SKETCH

               PARAMETER   CONSEQUENCE                      SKETCH

               0.8000       0.1399E-01  I-*-----------------------------------------------
               0.8500      -0.7066E-02  *
               0.9000      -0.2040E-02  *
               0.9500       0.2906E-01  I *
               1.000        0.8625E-01  I      *
               1.050        0.1695      I             *
               1.100        0.2788      I                       *
               1.150        0.4143      I                                  *
               1.200        0.5758      I                                                *
```

MOMENTS OF THE PARAMETERS

PARAMETER		MEAN	CM2	CM3	CM4
1	EOBROF	0.500000	0.833333E-01	0.0	0.125000E-01
2	PURICE	1.00000	0.144000E-01	0.0	0.622079E-03
3	CCEFLB	1.00000	0.640000E-02	0.0	0.122860E-03
4	WEIGHT	1.00000	0.999999E-02	0.0	0.299999E-03

ANALYTICAL CROSS CENTRAL MOMENTS OF THE PARAMETER PAIRS

PARA 1	PARA 2	CM11	CORREL COEFF	CM21	CM12	CM31	CM22	CM13
1	2	0.0	0.0					
1	3	0.0	0.0					
1	4	0.0	0.0					
2	3	0.0	0.0					
2	4	0.0	0.0					
3	4	0.0	0.0					

MOMENTS OF THE ANALYTICAL RESPONSE SURFACE CONSEQUENCES

	QUADRATIC MODEL		LINEARIZED MODEL	
CONSEQ	MEAN VALUE	STANDARD DEV	MEAN VALUE	STAN DEV
1	0.190536E 02	0.150403E 02	0.159064E 02	0.112120E 02
2	0.174367E 02	0.940624E 00	0.172730E 02	0.900946E 00
3	0.866257E 00	0.606641E-01	0.876856E 00	0.587066E-01
4	0.561240E 00	0.817644E-02	0.560265E 00	0.774799E-02
5	0.158810E 00	0.795816E-01	0.137529E 00	0.441810E-01
6	0.146591E 00	0.172876E 00	0.862470E-01	0.146132E 00

CONS1	CONS2	CORREL COEFF	LIN CORREL COEFF
1	2	0.68572535	0.82561195
1	3	0.68474215	0.99310780
1	4	-.57160908	-.85416728
1	5	0.91366893	0.90102655
1	6	0.76543438	0.99845344
2	3	0.63791120	0.75380713
2	4	-.34032530	-.41471070
2	5	0.55211133	0.83357179
2	6	0.78638124	0.79790741
3	4	-.88303590	-.90841377
3	5	0.41972876	0.87726784
3	6	0.70561045	0.99714011
4	5	-.27126813	-.65835512
4	6	-.67899209	-.87477785
5	6	0.57091749	0.90427605

END OF MOMENT OUTPUT IN JOB 2

**DISTRIBUTIONS OF THE RESPONSE SURFACE CONSEQUENCES, * NOS* 4060.5

CATEGORIES DEFINED BY ANALYTICAL MOMENTS

NOSF ACCESS NUMBER OF SAMPLES = 50000

CONSEQUENCE	SAMPLE MEAN VALUE	SAMPLE STANDARD DEVIATION	SCM3	SCM4
1	16.7088	10.6321	1225.92	45354.5
2	17.4171	0.881619	0.500396	2.47630
3	0.864514	0.589928E-01	-0.184533E-03	0.479123E-04
4	0.560526	0.893697E-02	-0.151924E-06	0.292512E-07
5	0.151662	0.416306E-01	0.257882E-03	0.837809E-04
6	0.140590	0.150833	0.765653E-02	0.527093E-02

NUMBER OF SIMULATION CYCLES = 50000

CONSEQUENCE 1 MEAN= 0.190536E 02 STANDARD DEVIATION= 0.153403E 02 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	-0.260674E 02	-0.185473E 02	2	0.00004000	0.00002828	70.709 P/C
2	-0.185473E 02	-0.110271E 02	2	0.00004000	0.00002828	70.709 P/C
3	-0.110271E 02	-0.350651E 01	10	0.00020000	0.00006324	31.620 P/C
4	-0.350651E 01	0.401326E 01	118	0.00236000	0.00021700	9.195 P/C
5	0.401326E 01	0.115334E 02	15030	0.30059999	0.00205056	0.682 P/C
6	0.115334E 02	0.190536E 02	15460	0.30919999	0.00206686	0.668 P/C
7	0.190536E 02	0.265737E 02	8447	0.16893955	0.00167570	0.992 P/C
8	0.265737E 02	0.340939E 02	5634	0.11267996	0.00141409	1.255 P/C
9	0.340939E 02	0.416141E 02	3272	0.06544000	0.00110596	1.690 P/C
10	0.416141E 02	0.491342E 02	1507	0.03014000	0.00076461	2.537 P/C
11	0.491342E 02	0.566544E 02	443	0.00886000	0.00041908	4.730 P/C
12	0.566544E 02	0.641746E 02	75	0.00150000	0.00017308	11.538 P/C

CONSEQUENCE 2 MEAN= 0.174367E 02 STANDARD DEVIATION= 0.940624E 00 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	0.146148E 02	0.150851E 02	21	0.00042000	0.00009163	21.817 P/C
2	0.150851E 02	0.155554E 02	200	0.00400000	0.00028228	7.057 P/C
3	0.155554E 02	0.160257E 02	1295	0.02590000	0.00071034	2.743 P/C
4	0.160257E 02	0.164960E 02	5001	0.10001999	0.00134176	1.341 P/C
5	0.164961E 02	0.169664E 02	9904	0.19807994	0.00178238	0.900 P/C
6	0.169664E 02	0.174367E 02	11393	0.22785997	0.00187585	0.823 P/C
7	0.174367E 02	0.179070E 02	9470	0.18939996	0.00175230	0.925 P/C
8	0.179070E 02	0.183773E 02	6025	0.12049997	0.00145588	1.208 P/C
9	0.183773E 02	0.188476E 02	3409	0.06817997	0.00112722	1.653 P/C
10	0.188476E 02	0.193179E 02	1777	0.03554000	0.00082797	2.330 P/C
11	0.193179E 02	0.197882E 02	836	0.01672000	0.00057342	3.430 P/C
12	0.197882E 02	0.202585E 02	669	0.01338000	0.00051383	3.840 P/C

CONSEQUENCE 3 MEAN= 0.864257E 00 STANDARD DEVIATION= 0.606641E-01 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	0.684265E 00	0.714557E 00	943	0.01886000	0.00060635	3.226 P/C
2	0.714557E 00	0.744529E 00	1063	0.02126000	0.00064510	3.034 P/C
3	0.744529E 00	0.775261E 00	2072	0.04144000	0.00089132	2.151 P/C
4	0.775261E 00	0.805553E 00	3659	0.07317996	0.00116469	1.592 P/C

5	0.805593E 00	0.835925E 00	6210	0.12419999	0.00147495	1.166 P/C
6	0.835925E 00	0.866257E 00	8717	0.17433994	0.00169689	0.973 P/C
7	0.866257E 00	0.896589E 00	10093	0.20185995	0.00179506	0.889 P/C
8	0.896589E 00	0.926921E 00	10590	0.21179998	0.00182724	0.863 P/C
9	0.926921E 00	0.957253E 00	6308	0.12615997	0.00148488	1.177 P/C
10	0.957253E 00	0.987585E 00	316	0.00632000	0.00035440	5.606 P/C
11	0.987585E 00	0.101792E 01	24	0.00048000	0.00009796	20.408 P/C
12	0.101792E 01	0.104825E 01	3	0.00006000	0.00003464	57.733 P/C

CONSEQUENCE 4 MEAN= 0.561240E 00 STANDARD DEVIATION= 0.817644E-02 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	0.536711E 00	0.540799E 00	964	0.01928000	0.00061495	3.190 P/C
2	0.540799E 00	0.544887E 00	1073	0.02146000	0.00064807	3.020 P/C
3	0.544887E 00	0.548976E 00	2122	0.04244000	0.00090154	2.124 P/C
4	0.548976E 00	0.553064E 00	4058	0.08115995	0.00122125	1.505 P/C
5	0.553064E 00	0.557152E 00	7115	0.14229995	0.00156237	1.098 P/C
6	0.557152E 00	0.561240E 00	9970	0.19939995	0.00178684	0.896 P/C
7	0.561240E 00	0.565328E 00	10060	0.20119995	0.00179287	0.891 P/C
8	0.565328E 00	0.569417E 00	7265	0.14529997	0.00157599	1.085 P/C
9	0.569417E 00	0.573505E 00	3966	0.07931995	0.00120854	1.524 P/C
10	0.573505E 00	0.577593E 00	1877	0.03754000	0.00085007	2.264 P/C
11	0.577593E 00	0.581681E 00	855	0.01710000	0.00057979	3.391 P/C
12	0.581681E 00	0.585769E 00	675	0.01350000	0.00051610	3.823 P/C

CONSEQUENCE 5 MEAN= 0.158810E 00 STANDARD DEVIATION= 0.795616E-01 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	-0.759349E-01	-0.401441E-01	9	0.00018000	0.00005999	33.330 P/C
2	-0.401441E-01	-0.353307E-03	19	0.00038000	0.00008716	22.937 P/C
3	-0.353307E-03	0.394374E-01	92	0.00184000	0.00019166	10.416 P/C
4	0.394375E-01	0.792282E-01	511	0.01022000	0.00044979	4.401 P/C
5	0.792282E-01	0.119019E 00	3399	0.06797999	0.00112569	1.656 P/C
6	0.119019E 00	0.158810E 00	37186	0.74372000	0.00195244	0.263 P/C
7	0.158810E 00	0.198601E 00	4923	0.09845996	0.00133241	1.353 P/C
8	0.198601E 00	0.238391E 00	1896	0.03792000	0.00085419	2.253 P/C
9	0.238391E 00	0.278182E 00	905	0.01810000	0.00059619	3.294 P/C
10	0.278182E 00	0.317973E 00	464	0.00928000	0.00042881	4.621 P/C
11	0.317973E 00	0.357764E 00	275	0.00550000	0.00033075	6.014 P/C
12	0.357764E 00	0.397554E 00	321	0.00642000	0.00035718	5.564 P/C

CONSEQUENCE 6 MEAN= 0.146591E 00 STANDARD DEVIATION= 0.172876E 00 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	-0.372038E 00	-0.285599E 00	0	0.0	0.0	100.000 P/C
2	-0.285599E 00	-0.199161E 00	0	0.0	0.0	100.000 P/C
3	-0.199161E 00	-0.112723E 00	0	0.0	0.0	100.000 P/C
4	-0.112723E 00	-0.262849E-01	84	0.00168000	0.00018315	10.902 P/C
5	-0.262849E-01	0.601533E-01	18904	0.37807995	0.00216857	0.574 P/C
6	0.601533E-01	0.146591E 00	14533	0.29065996	0.00203065	0.699 P/C
7	0.146591E 00	0.233030E 00	6950	0.13900000	0.00154712	1.113 P/C
8	0.233030E 00	0.319468E 00	3931	0.07861996	0.00120367	1.531 P/C
9	0.319468E 00	0.405906E 00	2323	0.04646000	0.00094125	2.026 P/C
10	0.405906E 00	0.492344E 00	1398	0.02796000	0.00073727	2.637 P/C
11	0.492344E 00	0.578782E 00	762	0.01524000	0.00054786	3.595 P/C
12	0.578782E 00	0.665221E 00	1115	0.02230000	0.00066034	2.961 P/C

JOINT DISTRIBUTIONS OF POLYNOMIAL CONSEQUENCES

CONSEQUENCE NUMBER 1 VERTICAL
CONSEQUENCE NUMBER 2 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.0	0.0	0.000020
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.0	0.0	0.000020
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000040
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000028
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000060	0.000060	0.000040	0.000020
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000035	0.000035	0.000028	0.000020
4	0.0	0.000020	0.000420	0.000820	0.000040	0.000140	0.000140	0.000300	0.000220	0.000080	0.000120	0.000060
4	0.0	0.000020	0.000092	0.000128	0.000028	0.000053	0.000053	0.000077	0.000066	0.000040	0.000049	0.000035
5	0.000360	0.003160	0.021560	0.078780	0.117160	0.061980	0.013540	0.001740	0.001180	0.000640	0.000320	0.000180
5	0.000085	0.000251	0.000650	0.001205	0.001438	0.001078	0.000517	0.000186	0.000154	0.000113	0.000080	0.000060
6	0.000060	0.000660	0.003120	0.016620	0.062600	0.108240	0.076420	0.029240	0.007960	0.002560	0.001020	0.000700
6	0.000035	0.000115	0.000249	0.000572	0.001083	0.001389	0.001188	0.000753	0.000397	0.000226	0.000143	0.000118
7	0.0	0.000080	0.000620	0.002740	0.013120	0.040660	0.056100	0.034880	0.013680	0.004480	0.001580	0.001000
7	0.0	0.000040	0.000111	0.000234	0.000509	0.000883	0.001029	0.000821	0.000519	0.000299	0.000178	0.000141
8	0.0	0.000080	0.000100	0.000820	0.004080	0.012880	0.033080	0.032640	0.020180	0.006740	0.001280	0.000800
8	0.0	0.000040	0.000045	0.000128	0.000285	0.000504	0.000800	0.000795	0.000629	0.000366	0.000160	0.000126
9	0.0	0.0	0.000060	0.000200	0.000960	0.003260	0.008800	0.017340	0.017420	0.011380	0.004860	0.001160
9	0.0	0.0	0.000035	0.000063	0.000138	0.000255	0.000418	0.000584	0.000585	0.000474	0.000311	0.000152
10	0.0	0.0	0.000020	0.000040	0.000100	0.000600	0.001200	0.003960	0.006740	0.008160	0.005540	0.003780
10	0.0	0.0	0.000020	0.000028	0.000045	0.000110	0.000155	0.000281	0.000366	0.000402	0.000332	0.000274
11	0.0	0.0	0.0	0.0	0.000020	0.000060	0.000100	0.000360	0.000660	0.001340	0.001820	0.004480
11	0.0	0.0	0.0	0.0	0.000020	0.000040	0.000045	0.000085	0.000115	0.000164	0.000191	0.000299
12	0.0	0.0	0.0	0.0	0.0	0.000020	0.000020	0.000020	0.000060	0.000100	0.000140	0.001140
12	0.0	0.0	0.0	0.0	0.0	0.000020	0.000020	0.000020	0.000035	0.000045	0.000053	0.000151

CONSEQUENCE NUMBER 1 VERTICAL
CONSEQUENCE NUMBER 3 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000040	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000028	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000020	0.0	0.0	0.0

2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000020	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000200	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000063	0.0	0.0	0.0	0.0
4	0.001120	0.000120	0.0	0.0	0.0	0.0	0.000220	0.000880	0.000020	0.0	0.0	0.0
4	0.000150	0.000049	0.0	0.0	0.0	0.0	0.000066	0.000133	0.000020	0.0	0.0	0.0
5	0.017740	0.021140	0.041440	0.073180	0.113820	0.025940	0.004120	0.003120	0.000100	0.0	0.0	0.0
5	0.000590	0.000643	0.000891	0.001165	0.001420	0.000711	0.000286	0.000249	0.000045	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.010360	0.148440	0.136300	0.013720	0.000280	0.000060	0.000020	0.0
6	0.0	0.0	0.0	0.0	0.000453	0.001590	0.001534	0.000520	0.000075	0.000035	0.000020	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.061000	0.105580	0.002340	0.000020	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.001070	0.001374	0.000216	0.000020	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.000100	0.081000	0.031160	0.000420	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.000045	0.001220	0.000777	0.000092	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.006300	0.057380	0.001660	0.000100	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000354	0.001040	0.000182	0.000045	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000200	0.027140	0.002580	0.000220	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000063	0.000727	0.000227	0.000066	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.000040	0.000320	0.006940	0.001420	0.000100	0.000040
11	0.0	0.0	0.0	0.0	0.0	0.0	0.000028	0.000080	0.000371	0.000168	0.000045	0.000028
12	0.0	0.0	0.0	0.0	0.0	0.0	0.000080	0.000420	0.000780	0.000160	0.000040	0.000020
12	0.0	0.0	0.0	0.0	0.0	0.0	0.000040	0.000092	0.000125	0.000057	0.000028	0.000020

CONSEQUENCE NUMBER 1 VERTICAL
CONSEQUENCE NUMBER 4 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.000020	0.0	0.000020	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.000020	0.0	0.000020	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.000020	0.000020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.000020	0.000020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.000040	0.000080	0.000080	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.000028	0.000040	0.000040	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.000020	0.000020	0.000340	0.000620	0.000140	0.0	0.000080	0.000340	0.000400	0.000400
4	0.0	0.0	0.000020	0.000020	0.000082	0.000111	0.000053	0.0	0.000040	0.000082	0.000089	0.000089
5	0.000380	0.000600	0.001120	0.002300	0.005960	0.015660	0.047680	0.080080	0.071820	0.037200	0.016700	0.013100
5	0.000087	0.000110	0.000150	0.000214	0.000344	0.000555	0.000953	0.001267	0.001155	0.000846	0.000573	0.000508
6	0.001040	0.001080	0.001740	0.005000	0.013940	0.086340	0.135760	0.056680	0.007420	0.0	0.0	0.0
6	0.000144	0.000147	0.000186	0.000315	0.000524	0.001256	0.001532	0.001036	0.000384	0.0	0.0	0.0
7	0.001060	0.001390	0.002440	0.007980	0.055760	0.083020	0.016940	0.000340	0.0	0.0	0.0	0.0
7	0.000146	0.000166	0.000221	0.000398	0.001026	0.001234	0.000577	0.000082	0.0	0.0	0.0	0.0

8	0.002000	0.002720	0.005580	0.033060	0.052580	0.012060	0.000680	0.0	0.0	0.0	0.0	0.0
8	0.000200	0.000233	0.000436	0.000800	0.000558	0.000488	0.000117	0.0	0.0	0.0	0.0	0.0
9	0.004500	0.008180	0.016860	0.023320	0.011680	0.001500	0.0	0.0	0.0	0.0	0.0	0.0
9	0.000255	0.000403	0.000576	0.000675	0.000468	0.000173	0.0	0.0	0.0	0.0	0.0	0.0
10	0.007000	0.005420	0.006080	0.007540	0.002600	0.000160	0.0	0.0	0.0	0.0	0.0	0.0
10	0.000373	0.000328	0.000400	0.000387	0.000200	0.000045	0.0	0.0	0.0	0.0	0.0	0.0
11	0.002800	0.001660	0.002286	0.001480	0.000440	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.000236	0.000193	0.000213	0.000172	0.000054	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.000500	0.000220	0.000300	0.000380	0.000100	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.000100	0.000066	0.000077	0.000087	0.000045	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 1 VERTICAL
CONSEQUENCE NUMBER 2 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.000020	0.000020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.000020	0.000020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.000020	0.0	0.000020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.000020	0.0	0.000020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.000060	0.000040	0.0	0.000060	0.000020	0.000020	0.0	0.0	0.0	0.0	0.0	0.0
3	0.000035	0.000026	0.0	0.000035	0.000020	0.000020	0.0	0.0	0.0	0.0	0.0	0.0
4	0.000020	0.000140	0.000540	0.000300	0.000440	0.000920	0.0	0.0	0.0	0.0	0.0	0.0
4	0.000020	0.000053	0.000104	0.000077	0.000094	0.000136	0.0	0.0	0.0	0.0	0.0	0.0
5	0.000020	0.000140	0.000800	0.004460	0.019760	0.275280	0.000080	0.000020	0.000020	0.0	0.0	0.000020
5	0.000020	0.000053	0.000126	0.000298	0.000622	0.001998	0.000040	0.000020	0.000020	0.0	0.0	0.000020
6	0.000040	0.0	0.000240	0.003140	0.031300	0.273760	0.000460	0.000160	0.000080	0.0	0.0	0.000020
6	0.000028	0.0	0.000069	0.000250	0.000779	0.001994	0.000096	0.000057	0.000040	0.0	0.0	0.000020
7	0.000020	0.000020	0.000040	0.000980	0.010680	0.149020	0.007480	0.000960	0.000160	0.000140	0.0	0.000040
7	0.000020	0.000020	0.000028	0.000140	0.000447	0.001593	0.000385	0.000138	0.000057	0.000053	0.0	0.000028
8	0.0	0.0	0.000100	0.000840	0.004460	0.038240	0.064780	0.0032[illegible]0	0.000640	0.000160	0.000120	0.000080
8	0.0	0.0	0.000045	0.000130	0.000298	0.000858	0.001101	0.000256	0.000113	0.000057	0.000049	0.000028
9	0.0	0.0	0.000040	0.000260	0.001680	0.005820	0.023960	0.028540	0.003920	0.000720	0.000300	0.000200
9	0.0	0.0	0.000028	0.000072	0.000183	0.000340	0.000684	0.000745	0.000279	0.000120	0.000077	0.000063
10	0.0	0.0	0.000040	0.000180	0.000220	0.000600	0.001580	0.004720	0.013020	0.007520	0.001720	0.000540
10	0.0	0.0	0.000028	0.000060	0.000066	0.000110	0.000178	0.000307	0.000507	0.000386	0.000185	0.000104
11	0.0	0.000020	0.0	0.0	0.000020	0.000060	0.000120	0.000220	0.000240	0.000740	0.003340	0.004100
11	0.0	0.000020	0.0	0.0	0.000020	0.000035	0.000049	0.000066	0.000069	0.000122	0.000258	0.000286
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.0	0.000020	0.001460
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.0	0.000020	0.000171

CONSEQUENCE NUMBER 1 VERTICAL
CONSEQUENCE NUMBER 6 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000020
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000020
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000040
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000028
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000020	0.000060	0.000020	0.000080
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000020	0.000035	0.000020	0.000040
4	0.0	0.0	0.0	0.000360	0.000880	0.000120	0.000240	0.000340	0.000140	0.000060	0.000140	0.000080
4	0.0	0.0	0.0	0.000085	0.000133	0.000049	0.000069	0.000082	0.000053	0.000035	0.000053	0.000040
5	0.0	0.0	0.0	0.001260	0.289140	0.005840	0.001800	0.001080	0.000660	0.000380	0.000180	0.000260
5	0.0	0.0	0.0	0.000159	0.002028	0.000341	0.000150	0.000147	0.000115	0.000087	0.000060	0.000072
6	0.0	0.0	0.0	0.000060	0.087840	0.201200	0.012160	0.003660	0.001840	0.001120	0.000620	0.000700
6	0.0	0.0	0.0	0.000035	0.001266	0.001793	0.000490	0.000270	0.000192	0.000150	0.000111	0.000118
7	0.0	0.0	0.0	0.0	0.000200	0.082640	0.066800	0.011120	0.004100	0.002100	0.000740	0.001240
7	0.0	0.0	0.0	0.0	0.000063	0.001231	0.001117	0.000469	0.000286	0.000205	0.000122	0.000157
8	0.0	0.0	0.0	0.0	0.000020	0.000860	0.057600	0.041900	0.007480	0.002440	0.001200	0.001180
8	0.0	0.0	0.0	0.0	0.000020	0.000131	0.001042	0.000696	0.000385	0.000221	0.000155	0.000154
9	0.0	0.0	0.0	0.0	0.0	0.0	0.000400	0.020460	0.031180	0.009800	0.001860	0.001740
9	0.0	0.0	0.0	0.0	0.0	0.0	0.000089	0.000633	0.000777	0.000441	0.000193	0.000186
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000040	0.001040	0.011940	0.010180	0.006940
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000028	0.000144	0.000486	0.000449	0.000371
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000060	0.000280	0.008520
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000035	0.000075	0.000411
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001500
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000173

CONSEQUENCE NUMBER 2 VERTICAL
CONSEQUENCE NUMBER 3 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.000040	0.000040	0.000100	0.0	0.000040	0.000140	0.000020	0.000040	0.0	0.0	0.0	0.0
1	0.000028	0.000028	0.000045	0.0	0.000028	0.000053	0.000020	0.000028	0.0	0.0	0.0	0.0
2	0.000560	0.000300	0.000540	0.000560	0.000620	0.000620	0.000480	0.000140	0.000060	0.000100	0.000020	0.0
2	0.000106	0.000077	0.000104	0.000106	0.000111	0.000111	0.000098	0.000053	0.000035	0.000045	0.000020	0.0
3	0.003880	0.002780	0.003780	0.004980	0.004240	0.003120	0.001600	0.000960	0.000360	0.000060	0.000060	0.0

3	0.000277	0.000235	0.000274	0.000312	0.000291	0.000249	0.000190	0.000138	0.000085	0.000035	0.000035	0.0
4	0.010200	0.009600	0.015700	0.018700	0.018780	0.014560	0.007780	0.003140	0.001200	0.000300	0.000060	0.0
4	0.000445	0.000436	0.000556	0.000606	0.000607	0.000536	0.000393	0.000250	0.000155	0.000077	0.000035	0.0
5	0.004200	0.007580	0.016580	0.029280	0.048000	0.048780	0.027980	0.010720	0.003820	0.000660	0.000060	0.000020
5	0.000285	0.000398	0.000571	0.000754	0.000956	0.000963	0.000738	0.000461	0.000276	0.000115	0.000035	0.000020
6	0.0	0.000560	0.004700	0.018160	0.037800	0.057980	0.066200	0.033380	0.007840	0.001100	0.000120	0.000020
6	0.0	0.000106	0.000306	0.000597	0.000853	0.001045	0.001112	0.000803	0.000394	0.000148	0.000049	0.000020
7	0.0	0.0	0.000040	0.001600	0.014140	0.038020	0.054360	0.063080	0.017140	0.001000	0.000020	0.0
7	0.0	0.0	0.000028	0.000179	0.000528	0.000855	0.001014	0.001087	0.000580	0.000141	0.000020	0.0
8	0.0	0.0	0.0	0.0	0.000580	0.010660	0.032260	0.046720	0.023120	0.001140	0.000020	0.0
8	0.0	0.0	0.0	0.0	0.000108	0.000459	0.000790	0.000944	0.000752	0.000151	0.000020	0.0
9	0.0	0.0	0.0	0.0	0.0	0.000500	0.009980	0.029940	0.027080	0.000660	0.000020	0.0
9	0.0	0.0	0.0	0.0	0.0	0.000100	0.000445	0.000762	0.000726	0.000115	0.000020	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.000820	0.014460	0.019680	0.000540	0.000040	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.000128	0.000534	0.000621	0.000104	0.000028	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.005400	0.010880	0.000400	0.000040	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000328	0.000464	0.000089	0.000028	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.000180	0.003820	0.008980	0.000360	0.000020	0.000020
12	0.0	0.0	0.0	0.0	0.0	0.0	0.000060	0.000276	0.000422	0.000085	0.000020	0.000020

CONSEQUENCE NUMBER 2 VERTICAL
CONSEQUENCE NUMBER 4 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.000280	0.000020	0.000080	0.000040	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.000075	0.000020	0.000040	0.000028	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.000520	0.000580	0.000580	0.000540	0.000500	0.000360	0.000240	0.000160	0.000100	0.0	0.0	0.000020
2	0.000136	0.000108	0.000108	0.000104	0.000100	0.000085	0.000069	0.000057	0.000045	0.0	0.0	0.000020
3	0.001020	0.000580	0.001380	0.002400	0.003700	0.004320	0.003900	0.003040	0.002120	0.001380	0.001060	0.000600
3	0.000143	0.000140	0.000166	0.000219	0.000272	0.000293	0.000279	0.000246	0.000206	0.000166	0.000146	0.000110
4	0.001420	0.001120	0.001600	0.003700	0.007420	0.013860	0.017660	0.017820	0.014680	0.009840	0.004960	0.005940
4	0.000168	0.000150	0.000179	0.000272	0.000384	0.000523	0.000589	0.000592	0.000538	0.000441	0.000314	0.000344
5	0.002060	0.001760	0.002700	0.005380	0.011260	0.025100	0.054440	0.045680	0.022420	0.013180	0.007700	0.006400
5	0.000203	0.000187	0.000232	0.000327	0.000472	0.000700	0.001015	0.000934	0.000662	0.000510	0.000391	0.000357
6	0.002280	0.002100	0.003980	0.008360	0.021380	0.057780	0.057540	0.035180	0.024340	0.011060	0.003320	0.000540
6	0.000213	0.000205	0.000282	0.000407	0.000647	0.001043	0.001041	0.000824	0.000689	0.000468	0.000257	0.000104
7	0.001840	0.002460	0.005880	0.016040	0.039700	0.043020	0.035480	0.029320	0.013520	0.002080	0.000060	0.0
7	0.000152	0.000222	0.000342	0.000562	0.000873	0.000907	0.000827	0.000754	0.000516	0.000204	0.000035	0.0
8	0.001880	0.002540	0.008320	0.019120	0.025980	0.025880	0.022020	0.012220	0.002140	0.0	0.0	0.0
8	0.000194	0.000242	0.000406	0.000612	0.000711	0.000710	0.000656	0.000491	0.000207	0.0	0.0	0.0

9	0.001800	0.003220	0.008260	0.013020	0.014080	0.017560	0.008360	0.001880	0.0	0.0	0.0	0.0
9	0.000190	0.000253	0.000405	0.000507	0.000527	0.000587	0.000407	0.000194	0.0	0.0	0.0	0.0
10	0.002220	0.003180	0.004840	0.006760	0.008240	0.008740	0.001560	0.0	0.0	0.0	0.0	0.0
10	0.000210	0.000252	0.000310	0.000366	0.000404	0.000416	0.000176	0.0	0.0	0.0	0.0	0.0
11	0.001460	0.001620	0.003000	0.003020	0.005160	0.002460	0.0	0.0	0.0	0.0	0.0	0.0
11	0.000171	0.000160	0.000245	0.000245	0.000320	0.000222	0.0	0.0	0.0	0.0	0.0	0.0
12	0.002100	0.001480	0.001820	0.002780	0.004880	0.000320	0.0	0.0	0.0	0.0	0.0	0.0
12	0.000205	0.000172	0.000191	0.000235	0.000312	0.000080	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 2 VERTICAL
CONSEQUENCE NUMBER 5 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.000020	0.0	0.000200	0.000200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.000020	0.0	0.000063	0.000063	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.000020	0.000060	0.000100	0.001480	0.002340	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.000020	0.000035	0.000045	0.000172	0.000216	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.000080	0.001000	0.012600	0.012220	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.000040	0.000141	0.000499	0.000491	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.000040	0.000180	0.000820	0.009260	0.089720	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.000028	0.000060	0.000128	0.000428	0.001278	0.0	0.0	0.0	0.0	0.0	0.0
5	0.000020	0.0	0.000080	0.001000	0.009140	0.187700	0.000140	0.0	0.0	0.0	0.0	0.0
5	0.000020	0.0	0.000040	0.000141	0.000426	0.001746	0.000053	0.0	0.0	0.0	0.0	0.0
6	0.0	0.000020	0.000080	0.000900	0.008240	0.211640	0.006720	0.000240	0.000020	0.0	0.0	0.0
6	0.0	0.000020	0.000040	0.000134	0.000404	0.001827	0.000365	0.000069	0.000020	0.0	0.0	0.0
7	0.0	0.0	0.000100	0.000840	0.008000	0.148820	0.027760	0.003500	0.000320	0.000040	0.000020	0.0
7	0.0	0.0	0.000045	0.000130	0.000398	0.001592	0.000735	0.000264	0.000080	0.000028	0.000020	0.0
8	0.000020	0.0	0.000320	0.001120	0.007620	0.065440	0.031200	0.011120	0.002900	0.000620	0.000080	0.000060
8	0.000020	0.0	0.000080	0.000150	0.000389	0.001106	0.000778	0.000469	0.000240	0.000111	0.000040	0.000035
9	0.000020	0.000100	0.000240	0.001220	0.005620	0.020740	0.021560	0.010260	0.005480	0.002200	0.000400	0.000140
9	0.000020	0.000045	0.000069	0.000156	0.000340	0.000637	0.000650	0.000451	0.000330	0.000210	0.000089	0.000053
10	0.0	0.000080	0.000180	0.000880	0.003260	0.005320	0.007940	0.007660	0.004800	0.003180	0.001380	0.000660
10	0.0	0.000040	0.000060	0.000133	0.000255	0.000325	0.000397	0.000395	0.000309	0.000252	0.000166	0.000115
11	0.000060	0.000040	0.000160	0.000460	0.001240	0.001620	0.002260	0.003500	0.002860	0.001700	0.001400	0.001420
11	0.000035	0.000028	0.000057	0.000096	0.000157	0.000180	0.000212	0.000264	0.000239	0.000184	0.000167	0.000168
12	0.000020	0.000040	0.000120	0.000300	0.000460	0.000500	0.000880	0.001440	0.001720	0.001540	0.002220	0.004140
12	0.000020	0.000026	0.000049	0.000077	0.000096	0.000100	0.000133	0.000170	0.000185	0.000175	0.000210	0.000287

CONSEQUENCE NUMBER 2 VERTICAL
CONSEQUENCE NUMBER 6 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.000040	0.000380	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.000028	0.000087	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.000060	0.003460	0.000360	0.000100	0.000020	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.000035	0.000263	0.000085	0.000045	0.000020	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.000140	0.022540	0.002960	0.000180	0.000040	0.000040	0.0	0.0	0.0
3	0.0	0.0	0.0	0.000053	0.000664	0.000243	0.000060	0.000028	0.000028	0.0	0.0	0.0
4	0.0	0.0	0.0	0.000540	0.082860	0.014740	0.001560	0.000260	0.000060	0.0	0.0	0.0
4	0.0	0.0	0.0	0.000104	0.001233	0.000539	0.000176	0.000072	0.000035	0.0	0.0	0.0
5	0.0	0.0	0.0	0.000720	0.134400	0.052940	0.007600	0.001900	0.000360	0.000100	0.000060	0.0
5	0.0	0.0	0.0	0.000120	0.001525	0.001001	0.000388	0.000195	0.000085	0.000045	0.000035	0.0
6	0.0	0.0	0.0	0.000140	0.094680	0.097640	0.026140	0.006620	0.001960	0.000480	0.000120	0.000080
6	0.0	0.0	0.0	0.000053	0.001309	0.001327	0.000714	0.000363	0.000198	0.000098	0.000049	0.000040
7	0.0	0.0	0.0	0.000040	0.034560	0.079140	0.048080	0.019240	0.006340	0.001300	0.000540	0.000160
7	0.0	0.0	0.0	0.000028	0.000817	0.001207	0.000957	0.000614	0.000355	0.000161	0.000104	0.000057
8	0.0	0.0	0.0	0.0	0.004860	0.034700	0.035900	0.023860	0.013680	0.005040	0.001720	0.000740
8	0.0	0.0	0.0	0.0	0.000311	0.000818	0.000832	0.000683	0.000519	0.000317	0.000185	0.000122
9	0.0	0.0	0.0	0.0	0.000340	0.007420	0.015620	0.018540	0.012140	0.008560	0.003560	0.002000
9	0.0	0.0	0.0	0.0	0.000082	0.000384	0.000555	0.000603	0.000490	0.000412	0.000266	0.000200
10	0.0	0.0	0.0	0.0	0.0	0.000720	0.003460	0.006220	0.008120	0.007920	0.004580	0.004520
10	0.0	0.0	0.0	0.0	0.0	0.000120	0.000263	0.000352	0.000401	0.000396	0.000302	0.000300
11	0.0	0.0	0.0	0.0	0.0	0.000040	0.000320	0.001680	0.003200	0.003340	0.003180	0.004960
11	0.0	0.0	0.0	0.0	0.0	0.000028	0.000080	0.000183	0.000253	0.000258	0.000252	0.000314
12	0.0	0.0	0.0	0.0	0.0	0.0	0.000040	0.000240	0.000560	0.001220	0.001480	0.009840
12	0.0	0.0	0.0	0.0	0.0	0.0	0.000028	0.000069	0.000106	0.000156	0.000172	0.000441

CONSEQUENCE NUMBER 3 VERTICAL
CONSEQUENCE NUMBER 4 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.000040	0.0	0.000100	0.000200	0.000400	0.000780	0.002220	0.004520	0.010600
1	0.0	0.0	0.0	0.000028	0.0	0.000045	0.000063	0.000089	0.000125	0.000210	0.000300	0.000458
2	0.0	0.0	0.000040	0.000060	0.000080	0.000140	0.000420	0.000920	0.002900	0.007240	0.006620	0.002840
2	0.0	0.0	0.000028	0.000035	0.000040	0.000053	0.000092	0.000136	0.000240	0.000379	0.000363	0.000238
3	0.000040	0.000020	0.000040	0.000120	0.000280	0.000660	0.001460	0.004720	0.014120	0.014080	0.005840	0.000060
3	0.000028	0.000020	0.000028	0.000049	0.000075	0.000115	0.000171	0.000307	0.000528	0.000527	0.000341	0.000035

4	0.0	0.000060	0.000140	0.000200	0.000820	0.002060	0.005760	0.022540	0.028020	0.013440	0.000120	0.0
4	0.0	0.000035	0.000053	0.000063	0.000128	0.000204	0.000338	0.000664	0.000738	0.000515	0.000049	0.0
5	0.000080	0.000140	0.000320	0.000680	0.002100	0.005760	0.027580	0.056720	0.030240	0.000560	0.0	0.0
5	0.000040	0.000053	0.000080	0.000117	0.000205	0.000339	0.000732	0.001034	0.000766	0.000106	0.0	0.0
6	0.000260	0.000360	0.000680	0.001620	0.004440	0.019420	0.089300	0.055040	0.003260	0.0	0.0	0.0
6	0.000072	0.000085	0.000117	0.000180	0.000297	0.000617	0.001275	0.001020	0.000255	0.0	0.0	0.0
7	0.000580	0.000640	0.001060	0.003400	0.013620	0.102600	0.075000	0.004960	0.0	0.0	0.0	0.0
7	0.000108	0.000113	0.000146	0.000260	0.000518	0.001357	0.001178	0.000314	0.0	0.0	0.0	0.0
8	0.001240	0.001440	0.003740	0.030760	0.104540	0.068600	0.001480	0.0	0.0	0.0	0.0	0.0
8	0.000157	0.000170	0.000273	0.000772	0.001368	0.001130	0.000172	0.0	0.0	0.0	0.0	0.0
9	0.011700	0.017680	0.036060	0.044280	0.016420	0.000020	0.0	0.0	0.0	0.0	0.0	0.0
9	0.000481	0.000589	0.000834	0.000920	0.000568	0.000020	0.0	0.0	0.0	0.0	0.0	0.0
10	0.004840	0.001120	0.000360	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.000310	0.000150	0.000085	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.000480	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.000098	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.000060	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.000035	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER [illegible] VERTICAL
CONSEQUENCE NUMBER 5 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.000080	0.001240	0.017540	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.000040	0.000157	0.000567	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.000140	0.001120	0.020000	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.000053	0.000150	0.000626	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.000080	0.000140	0.002220	0.039000	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.000040	0.000053	0.000210	0.000866	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.000020	0.000100	0.000200	0.003580	0.069280	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.000020	0.000045	0.000063	0.000267	0.001136	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.000040	0.000500	0.005120	0.118540	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.000028	0.000100	0.000319	0.001446	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.000120	0.000740	0.008500	0.165020	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.000049	0.000122	0.000411	0.001660	0.0	0.0	0.0	0.0	0.0	0.0
7	0.000020	0.000040	0.000280	0.002880	0.022900	0.173660	0.001900	0.0	0.0	0.0	0.000020	0.000160
7	0.000020	0.000026	0.000075	0.000240	0.000669	0.001694	0.000195	0.0	0.0	0.0	0.000020	0.000057
8	0.000080	0.000260	0.000960	0.003940	0.017200	0.123100	0.059940	0.004600	0.000620	0.000180	0.000060	0.000840
8	0.000040	0.000072	0.000140	0.000280	0.000561	0.001469	0.001062	0.000303	0.000111	0.000060	0.000035	0.000130
9	0.000060	0.000020	0.000120	0.001180	0.005240	0.016480	0.035600	0.032500	0.016640	0.008340	0.005060	0.004920

9	0.000035	0.000020	0.000049	0.000154	0.000323	0.000569	0.000829	0.000793	0.000572	0.000407	0.000317	0.000313
10	0.0	0.000020	0.000080	0.000340	0.000740	0.001060	0.000920	0.000760	0.000820	0.000760	0.000340	0.000480
10	0.0	0.000020	0.000040	0.000082	0.000122	0.000146	0.000136	0.000123	0.000128	0.000123	0.000082	0.000098
11	0.000020	0.000020	0.000040	0.000080	0.000100	0.000020	0.000100	0.000060	0.0	0.0	0.000020	0.000020
11	0.000020	0.000020	0.000028	0.000040	0.000045	0.000020	0.000045	0.000035	0.0	0.0	0.000020	0.000020
12	0.0	0.0	0.0	0.0	0.000020	0.000020	0.0	0.0	0.000020	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.000020	0.000020	0.0	0.0	0.000020	0.0	0.0	0.0

CONSEQUENCE NUMBER 3 VERTICAL
CONSEQUENCE NUMBER 6 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.000860	0.017640	0.000360	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.000131	0.000589	0.000085	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.000300	0.020880	0.000080	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.000077	0.000639	0.000040	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.000360	0.041020	0.000060	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.000085	0.000867	0.000035	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.000080	0.072760	0.000320	0.000020	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.000040	0.001162	0.000080	0.000020	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.000040	0.122780	0.001340	0.000040	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.000028	0.001468	0.000164	0.000028	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.000020	0.100260	0.073920	0.000160	0.000020	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.000020	0.001343	0.001170	0.000057	0.000020	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.000020	0.002520	0.179300	0.019380	0.000440	0.0	0.000020	0.0	0.000180
7	0.0	0.0	0.0	0.000020	0.000224	0.001716	0.000617	0.000094	0.0	0.000020	0.0	0.000060
8	0.0	0.0	0.0	0.0	0.000200	0.034640	0.112040	0.043840	0.010880	0.004500	0.002060	0.003640
8	0.0	0.0	0.0	0.0	0.000063	0.000918	0.001411	0.000916	0.000464	0.000299	0.000203	0.000269
9	0.0	0.0	0.0	0.0	0.0	0.000620	0.007040	0.033460	0.034340	0.022240	0.011760	0.016700
9	0.0	0.0	0.0	0.0	0.0	0.000111	0.000374	0.000804	0.000814	0.000659	0.000482	0.000573
10	0.0	0.0	0.0	0.0	0.000020	0.000020	0.000300	0.000760	0.001140	0.001100	0.001320	0.001660
10	0.0	0.0	0.0	0.0	0.000020	0.000020	0.000077	0.000123	0.000151	0.000148	0.000162	0.000182
11	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000100	0.000100	0.000080	0.000080	0.000100
11	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000045	0.000045	0.000040	0.000040	0.000045
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000020	0.000020
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000020	0.000020	0.000020

CONSEQUENCE NUMBER 4 VERTICAL
CONSEQUENCE NUMBER 5 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.000040	0.000060	0.000380	0.001880	0.002960	0.003160	0.003040	0.002460	0.001760	0.001260	0.000820	0.001460
1	0.000028	0.000035	0.000087	0.000194	0.000243	0.000251	0.000246	0.000222	0.000187	0.000159	0.000128	0.000171
2	0.0	0.0	0.000060	0.000960	0.003340	0.003660	0.003900	0.003580	0.002180	0.001600	0.001080	0.001100
2	0.0	0.0	0.000035	0.000138	0.000258	0.000270	0.000279	0.000267	0.000209	0.000179	0.000147	0.000148
3	0.000040	0.000060	0.000060	0.000840	0.004600	0.009360	0.010020	0.007520	0.004480	0.002380	0.001640	0.001440
3	0.000028	0.000035	0.000035	0.000130	0.000303	0.000431	0.000445	0.000386	0.000299	0.000218	0.000181	0.000170
4	0.000060	0.000100	0.000180	0.000920	0.008080	0.023280	0.023480	0.012760	0.006300	0.002980	0.001320	0.001700
4	0.000035	0.000045	0.000060	0.000136	0.000400	0.000674	0.000677	0.000502	0.000354	0.000244	0.000162	0.000184
5	0.000040	0.000140	0.000360	0.001420	0.010820	0.069700	0.043960	0.010380	0.003140	0.001020	0.000640	0.000680
5	0.000028	0.000053	0.000085	0.000168	0.000463	0.001139	0.000917	0.000453	0.000250	0.000143	0.000113	0.000117
6	0.0	0.0	0.000700	0.003060	0.018720	0.163720	0.011660	0.001220	0.000240	0.000040	0.0	0.000040
6	0.0	0.0	0.000118	0.000247	0.000606	0.001655	0.000480	0.000156	0.000069	0.000028	0.0	0.000028
7	0.0	0.000020	0.000080	0.001100	0.015300	0.182320	0.002380	0.0	0.0	0.0	0.0	0.0
7	0.0	0.000020	0.000040	0.000148	0.000549	0.001727	0.000218	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.000020	0.000020	0.002460	0.142780	0.000020	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.000020	0.000020	0.000222	0.001565	0.000020	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.000880	0.078440	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.000133	0.001202	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.000020	0.000560	0.036960	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.000020	0.000106	0.000844	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.000140	0.016960	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.000053	0.000577	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.000120	0.013380	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.000049	0.000514	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 4 VERTICAL
CONSEQUENCE NUMBER 6 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.000800	0.001240	0.001600	0.002300	0.002380	0.002260	0.002860	0.005840
1	0.0	0.0	0.0	0.0	0.000126	0.000157	0.000179	0.000214	0.000218	0.000212	0.000239	0.000341
2	0.0	0.0	0.0	0.000020	0.000760	0.001520	0.001860	0.002460	0.004280	0.004620	0.002500	0.003440
2	0.0	0.0	0.0	0.000020	0.000123	0.000174	0.000193	0.000222	0.000292	0.000303	0.000223	0.000262
3	0.0	0.0	0.0	0.000020	0.001280	0.002620	0.004060	0.010380	0.011080	0.006400	0.002920	0.003680
3	0.0	0.0	0.0	0.000020	0.000160	0.000229	0.000284	0.000453	0.000468	0.000357	0.000241	0.000271
4	0.0	0.0	0.0	0.000020	0.002660	0.007160	0.020340	0.024860	0.012440	0.006590	0.003020	0.004080
4	0.0	0.0	0.0	0.000020	0.000230	0.000377	0.000631	0.000696	0.000496	0.000362	0.000245	0.000285

5	0.0	0.0	0.0	0.000020	0.006640	0.027200	0.061980	0.022160	0.009920	0.005620	0.003640	0.005120
5	0.0	0.0	0.0	0.000020	0.000363	0.000727	0.001078	0.000658	0.000443	0.000334	0.000269	0.000319
6	0.0	0.0	0.0	0.000020	0.017200	0.120420	0.037120	0.015360	0.006360	0.002480	0.000300	0.000140
6	0.0	0.0	0.0	0.000020	0.000581	0.001455	0.000845	0.000550	0.000356	0.000222	0.000077	0.000053
7	0.0	0.0	0.0	0.000040	0.085440	0.102660	0.011960	0.001100	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.000028	0.001250	0.001357	0.000486	0.000148	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.000040	0.119140	0.026040	0.000080	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.000028	0.001449	0.000712	0.000040	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.000120	0.077860	0.001340	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.000049	0.001198	0.000164	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.000340	0.037140	0.000060	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.000082	0.000846	0.000035	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.000320	0.016700	0.000080	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.000080	0.000573	0.000040	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.000720	0.012460	0.000320	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.000120	0.000496	0.000080	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 5 VERTICAL
CONSEQUENCE NUMBER 6 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.000020	0.0	0.0	0.000040	0.000060	0.000040	0.0	0.000020
1	0.0	0.0	0.0	0.0	0.000020	0.0	0.0	0.000028	0.000035	0.000028	0.0	0.000020
2	0.0	0.0	0.0	0.0	0.0	0.000120	0.000040	0.000080	0.000020	0.000060	0.0	0.000060
2	0.0	0.0	0.0	0.0	0.0	0.000049	0.000028	0.000040	0.000020	0.000035	0.0	0.000035
3	0.0	0.0	0.0	0.000020	0.000220	0.000200	0.000560	0.000360	0.000200	0.000040	0.000120	0.000120
3	0.0	0.0	0.0	0.000020	0.000066	0.000063	0.000106	0.000085	0.000063	0.000028	0.000049	0.000049
4	0.0	0.0	0.0	0.000080	0.001580	0.002620	0.002260	0.001640	0.000980	0.000540	0.000280	0.000240
4	0.0	0.0	0.0	0.000040	0.000178	0.000229	0.000212	0.000181	0.000140	0.000104	0.000075	0.000069
5	0.0	0.0	0.0	0.000380	0.017480	0.023720	0.014220	0.006880	0.003180	0.001260	0.000480	0.000380
5	0.0	0.0	0.0	0.000087	0.000566	0.000681	0.000529	0.000370	0.000252	0.000159	0.000098	0.000087
6	0.0	0.0	0.0	0.001200	0.358780	0.263100	0.089400	0.021580	0.006140	0.002240	0.000820	0.000460
6	0.0	0.0	0.0	0.000155	0.002145	0.001969	0.001276	0.000650	0.000349	0.000211	0.000128	0.000096
7	0.0	0.0	0.0	0.0	0.0	0.000900	0.032520	0.044860	0.013880	0.003920	0.001320	0.001060
7	0.0	0.0	0.0	0.0	0.0	0.000134	0.000793	0.000926	0.000523	0.000279	0.000162	0.000146
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.003180	0.021340	0.009240	0.002520	0.001640
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000252	0.000646	0.000428	0.000224	0.000181
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000660	0.010460	0.004720	0.002260
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000115	0.000455	0.000307	0.000212

10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000160	0.004940	0.004180
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000057	0.000314	0.000289
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000040	0.005460
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000028	0.000330
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.006420
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000357

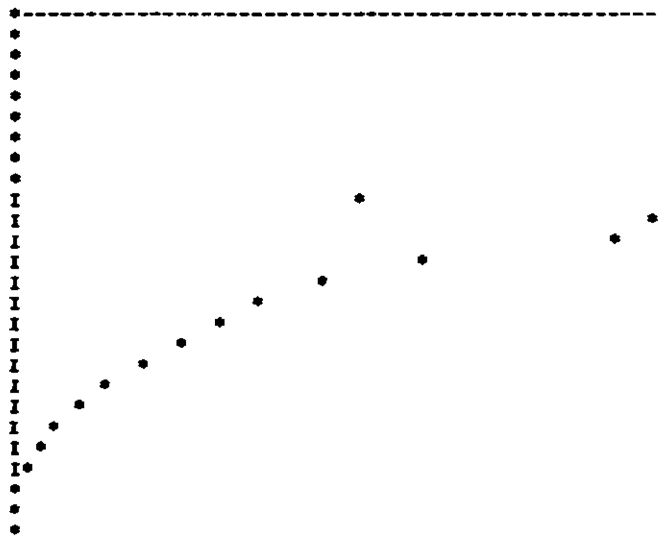
END OF JOINT DISTRIBUTIONS IN ZONE 3

PROBABILITY FOR CATEGORY SKETCH IN HALF CATEGORY INTERVALS

CONSEQUENCE 1

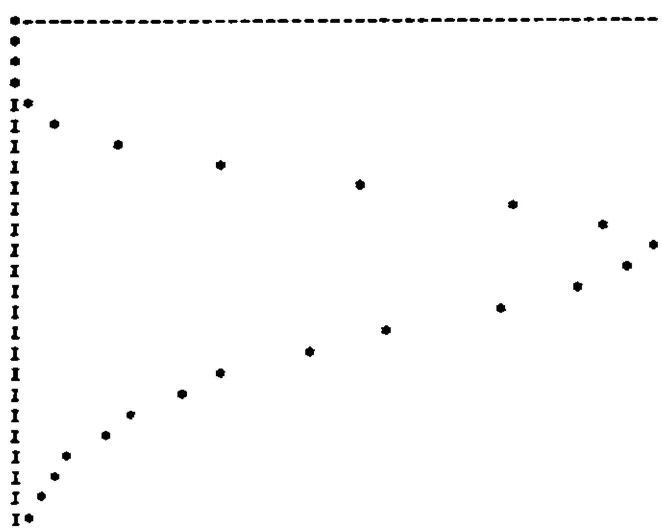
CATEGORY	PROBABILITY
0.0	0.0
1.000	0.0
1.000	0.8000E-04
2.000	0.0
2.000	0.8000E-04
3.000	0.1200E-03
3.000	0.2800E-03
4.000	0.8400E-03
4.000	0.3840E-02
5.000	0.2105
5.000	0.3907
6.000	0.3665
6.000	0.2519
7.000	0.1883
7.000	0.1496
8.000	0.1248
8.000	0.1006
9.000	0.7472E-01
9.000	0.5616E-01
10.00	0.3796E-01
10.00	0.2232E-01
11.00	0.1260E-01
11.00	0.5120E-02
12.00	0.2120E-02
12.00	0.5200E-03
13.00	0.3600E-03

SKETCH



CONSEQUENCE 2

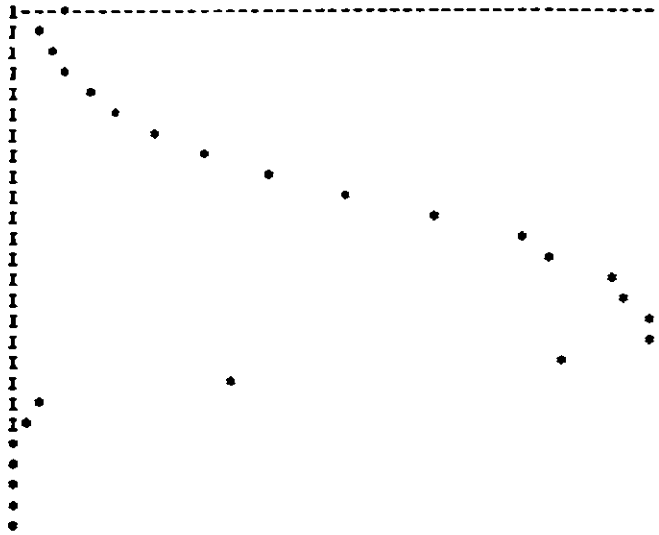
CATEGORY	PROBABILITY
0.0	0.8000E-04
1.000	0.2400E-03
1.000	0.5200E-03
2.000	0.2040E-02
2.000	0.5960E-02
3.000	0.1476E-01
3.000	0.3704E-01
4.000	0.7452E-01
4.000	0.1255
5.000	0.1803
5.000	0.2158
6.000	0.2327
6.000	0.2230
7.000	0.2040
7.000	0.1748
8.000	0.1360
8.000	0.1050
9.000	0.7588E-01
9.000	0.6048E-01
10.00	0.4020E-01
10.00	0.3088E-01
11.00	0.2004E-01
11.00	0.1340E-01
12.00	0.9000E-02
12.00	0.6040E-02



13.00	0.1172E-01

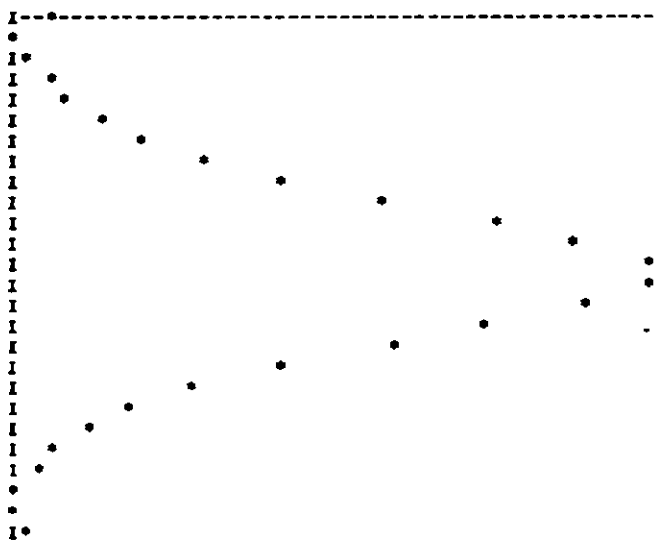
CCBSEQUENCE 3

0.0	0.1668E-01
1.000	0.9440E-02
1.000	0.1160E-01
2.000	0.1836E-01
2.000	0.2416E-01
3.000	0.3412E-01
3.000	0.4676E-01
4.000	0.6176E-01
4.000	0.8460E-01
5.000	0.1102
5.000	0.1382
6.000	0.1688
6.000	0.1800
7.000	0.1986
7.000	0.2052
8.000	0.2121
8.000	0.2115
9.000	0.1817
9.000	0.7060E-01
10.00	0.1028E-01
10.00	0.2360E-02
11.00	0.7200E-03
11.00	0.2400E-03
12.00	0.8000E-04
12.00	0.4000E-04
13.00	0.0



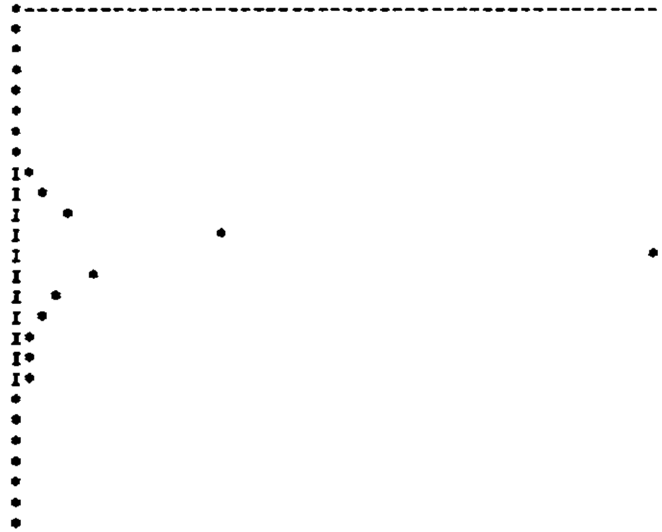
CCBSEQUENCE 4

0.0	0.1820E-01
1.000	0.8720E-02
1.000	0.1164E-01
2.000	0.1788E-01
2.000	0.2504E-01
3.000	0.3512E-01
3.000	0.4976E-01
4.000	0.6952E-01
4.000	0.9280E-01
5.000	0.1243
5.000	0.1603
6.000	0.1885
6.000	0.2103
7.000	0.2114
7.000	0.1910
8.000	0.1590
8.000	0.1316
9.000	0.9324E-01
9.000	0.6540E-01
10.00	0.4504E-01
10.00	0.3004E-01
11.00	0.2012E-01
11.00	0.1408E-01
12.00	0.8960E-02
12.00	0.7160E-02
13.00	0.1088E-01



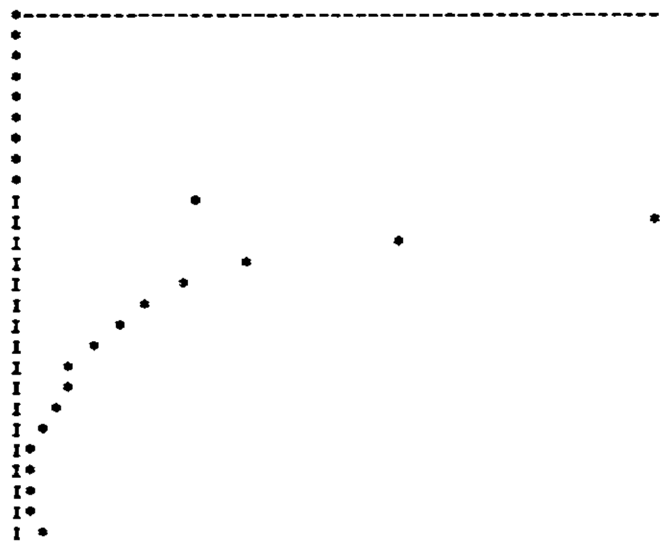
CCBSEQUENCE 5

0.0	0.4000E-04	*---
1.000	0.1200E-03	
1.000	0.2000E-03	
2.000	0.2400E-03	
2.000	0.5200E-03	
3.000	0.7600E-03	
3.000	0.2920E-02	
4.000	0.6000E-02	
4.000	0.1444E-01	I
5.000	0.3616E-01	I
5.000	0.9980E-01	I
6.000	0.3556	I
6.000	1.132	I
7.000	0.1281	I
7.000	0.6880E-01	I
8.000	0.4504E-01	I
8.000	0.3080E-01	I
9.000	0.2104E-01	I
9.000	0.1516E-01	I
10.00	0.1084E-01	
10.00	0.7720E-02	
11.00	0.6360E-02	
11.00	0.4640E-02	
12.00	0.3120E-02	
12.00	0.1960E-02	
13.00	0.7760E-02	



CONSEQUENCE 6

0.0	0.0	*---
1.000	0.0	
1.000	0.0	
2.000	0.0	
2.000	0.0	
3.000	0.0	
3.000	0.0	
4.000	0.4000E-04	
4.000	0.3320E-02	
5.000	0.1616	I
5.000	0.5946	I
6.000	0.3622	I
6.000	0.2192	I
7.000	0.1570	I
7.000	0.1210	I
8.000	0.9032E-01	I
8.000	0.6692E-01	I
9.000	0.5056E-01	I
9.000	0.4236E-01	I
10.00	0.3144E-01	I
10.00	0.2448E-01	I
11.00	0.1648E-01	I
11.00	0.1400E-01	I
12.00	0.1152E-01	I
12.00	0.8360E-02	I
13.00	0.2472E-01	I



CONDITIONAL DISTRIBUTIONS OF CONSEQUENCES -JOB1 4 - WORK NUMBER = 400025

SELECTIVE SIMULATION OF POLYNOMIAL CONSEQUENCES

LIMIT FOR UNCONDITIONAL SIMULATION CYCLES NSA= 50000
LIMIT FOR UNRELIEVED COND. SIMUL. CYCLES NSR= 20000
LIMIT FOR RELIEVED COND. CARDS FOR JOB1 5 NSC= 0 WITH TOLERANCE = 0.01

CONSEQUENCE 1 LIMIT TYPE= 0 VALUE= 25.000
CONSEQUENCE 0 LIMIT TYPE= 0 VALUE= 0.0
CONSEQUENCE 0 LIMIT TYPE= 0 VALUE= 0.0
CONSEQUENCE 0 LIMIT TYPE= 0 VALUE= 0.0
LIMIT TYPE 0 MEANS LOWER LIMIT, 1 MEANS UPPER LIMIT
TOLERANCE AS A FRACTION OF STANDARD DEVIATION

NUMBERS OF SIMULATION CYCLES
UNCONDITIONAL NC= 50000
CONDITIONAL ND= 12404
RELIEVED CONDIT , NE= 12546

FRACTION SATISFYING CONDITIONS = ND/NC =0.248080

FRACTION SATISFYING RELIEVED CONDITIONS NE/NC=0.250920

FOR POLYNOMIAL CONSEQUENCES WITH UNRELIEVED CRITERIA
STATISTICS FOR ND= 12404 RESPONSE S. CONSEQUENCES

SAMPLE CONDITIONAL MEAN AND OTHER CHARACTERISTICS IN JOB1 4 (RESPONSE SURFACE CONSEQUENCES)
OF WORK 400025

CONSEQUENCE	MEAN VALUE	STANDARD DEVIATION	SCCM3	SCCM4
1	34.2302	7.22376	354.199	9583.69
2	18.2922	0.818494	0.353969	1.92595
3	0.928663	0.147314E-01	0.144541E-05	0.213855E-06
4	0.550627	0.623711E-02	-.359261E-06	0.121129E-07
5	0.190767	0.636294E-01	0.577802E-03	0.194215E-03
6	0.328565	0.163638	0.806151E-02	0.572869E-02

CONDITIONAL DISTRIBUTIONS

(ANALYTICAL UNCONDITIONAL MOMENTS IN TITLES)

CONSEQUENCE 1 MEAN= 0.190536E 02 STANDARD DEVIATION= 0.150403E 02 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	0.250000E 02	0.325202E 02	6190	0.49903256	0.00448940	0.900 P/C
2	0.325202E 02	0.400403E 02	3648	0.29409868	0.00409106	1.391 P/C
3	0.400403E 02	0.475605E 02	1830	0.14753300	0.00318422	2.158 P/C
4	0.475605E 02	0.550807E 02	614	0.04950016	0.00194759	3.935 P/C
5	0.550807E 02	0.626008E 02	111	0.00894872	0.00084557	9.449 P/C
6	0.626008E 02	0.701210E 02	11	0.00088681	0.00026726	30.138 P/C
7	0.701210E 02	0.776412E 02	0	0.0	0.0	100.000 P/C
8	0.776412E 02	0.851613E 02	0	0.0	0.0	100.000 P/C
9	0.851614E 02	0.926815E 02	0	0.0	0.0	100.000 P/C
10	0.926815E 02	0.100202E 03	0	0.0	0.0	100.000 P/C
11	0.100202E 03	0.107722E 03	0	0.0	0.0	100.000 P/C
12	0.107722E 03	0.115242E 03	0	0.0	0.0	100.000 P/C

CONSEQUENCE 2 MEAN= 0.174367E 02 STANDARD DEVIATION= 0.940624E 00 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	0.146148E 02	0.150851E 02	0	0.0	0.0	100.000 P/C
2	0.150851E 02	0.155554E 02	4	0.00032248	0.00016121	49.992 P/C
3	0.155554E 02	0.160257E 02	13	0.00104805	0.00029052	27.720 P/C
4	0.160257E 02	0.164960E 02	68	0.00548210	0.00066298	12.093 P/C
5	0.164561E 02	0.169664E 02	324	0.02612060	0.00143207	5.483 P/C
6	0.169664E 02	0.174367E 02	1103	0.08892292	0.00255566	2.874 P/C
7	0.174367E 02	0.179070E 02	2670	0.21525311	0.00369027	1.714 P/C
8	0.179070E 02	0.183773E 02	3101	0.25000000	0.00388794	1.555 P/C
9	0.183773E 02	0.188476E 02	2412	0.19445336	0.00355363	1.827 P/C
10	0.188476E 02	0.193179E 02	1434	0.11560786	0.00287101	2.483 P/C
11	0.193179E 02	0.197882E 02	698	0.05627217	0.00206914	3.677 P/C
12	0.197882E 02	0.202585E 02	577	0.04651725	0.00189096	4.065 P/C

CONSEQUENCE 3 MEAN= 0.866257E 00 STANDARD DEVIATION= 0.606641E-01 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	0.684265E 00	0.714597E 00	0	0.0	0.0	100.000 P/C
2	0.714597E 00	0.744929E 00	0	0.0	0.0	100.000 P/C
3	0.744929E 00	0.775261E 00	0	0.0	0.0	100.000 P/C
4	0.775261E 00	0.805593E 00	0	0.0	0.0	100.000 P/C
5	0.805593E 00	0.835925E 00	0	0.0	0.0	100.000 P/C
6	0.835925E 00	0.866257E 00	0	0.0	0.0	100.000 P/C
7	0.866257E 00	0.896589E 00	37	0.00298291	0.00048966	16.415 P/C
8	0.896589E 00	0.926921E 00	5816	0.46888095	0.00448070	0.956 P/C
9	0.926921E 00	0.957253E 00	6213	0.50088680	0.00448940	0.896 P/C
10	0.957253E 00	0.987585E 00	312	0.02515317	0.00140599	5.590 P/C
11	0.987585E 00	0.101792E 01	23	0.00185424	0.00038628	20.832 P/C
12	0.101792E 01	0.104825E 01	3	0.00024186	0.00013962	57.728 P/C

CONSEQUENCE 4 MEAN= 0.561240E 00 STANDARD DEVIATION= 0.817644E-02 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	0.526711E 00	0.540799E 00	851	0.06860685	0.00226970	3.308 P/C
2	0.540799E 00	0.554887E 00	929	0.07489514	0.00236342	3.156 P/C

3	0.544887E 00	0.548576E 00	1890	0.15237015	0.003[illegible]680	2.118 P/C
4	0.548576E 00	0.553064E 00	3423	0.27595931	0.00401350	1.454 P/C
5	0.553064E 00	0.557152E 00	4195	0.33819735	0.00424784	1.256 P/C
6	0.557152E 00	0.561240E 00	1052	0.08481133	0.00250150	2.949 P/C
7	0.561240E 00	0.565328E 00	64	0.00515962	0.00064329	12.468 P/C
8	0.565328E 00	0.569417E 00	0	0.0	0.0	100.000 P/C
9	0.569417E 00	0.573505E 00	0	0.0	0.0	100.000 P/C
10	0.573505E 00	0.577593E 00	0	0.0	0.0	100.000 P/C
11	0.577593E 00	0.581681E 00	0	0.0	0.0	100.000 P/C
12	0.581681E 00	0.585769E 00	0	0.0	0.0	100.000 P/C

CONSEQUENCE 5 MEAN= 0.158810E 00 STANDARD DEVIATION= 0.795816E-01 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	-0.799349E-01	-0.401441E-01	0	0.0	0.0	100.000 P/C
2	-0.401441E-01	-0.353307E-03	1	0.00008062	0.00008062	99.996 P/C
3	-0.353336E-03	0.394374E-01	9	0.00072557	0.00024177	33.321 P/C
4	0.394375E-01	0.792282E-01	71	0.00572396	0.00067736	11.834 P/C
5	0.792282E-01	0.119019E 00	373	0.03007094	0.00153343	5.099 P/C
6	0.119019E 00	0.158810E 00	3426	0.27620119	0.00401459	1.453 P/C
7	0.158810E 00	0.198601E 00	4727	0.38108671	0.00436060	1.144 P/C
8	0.198601E 00	0.238391E 00	1852	0.14930665	0.00319996	2.143 P/C
9	0.238391E 00	0.278182E 00	894	0.07207352	0.00232201	3.222 P/C
10	0.278182E 00	0.317973E 00	458	0.03692357	0.00169317	4.586 P/C
11	0.317973E 00	0.357764E 00	275	0.02217026	0.00132201	5.963 P/C
12	0.357764E 00	0.397554E 00	318	0.02563689	0.00141910	5.535 P/C

CONSEQUENCE 6 MEAN= 0.146591E 00 STANDARD DEVIATION= 0.172876E 00 SCALE= 0.50

CATEGORY	LOWER B	UPPER B	COUNTS	PROBABILITY	ACCURACY	PERCENT
1	-0.372038E 00	-0.285599E 00	0	0.0	0.0	100.000 P/C
2	-0.285599E 00	-0.199161E 00	0	0.0	0.0	100.000 P/C
3	-0.199161E 00	-0.112723E 00	0	0.0	0.0	100.000 P/C
4	-0.112723E 00	-0.262849E-01	0	0.0	0.0	100.000 P/C
5	-0.262849E-01	0.601533E-01	1	0.00008062	0.00008062	99.996 P/C
6	0.601533E-01	0.146591E 00	118	0.00951306	0.00087157	9.162 P/C
7	0.146591E 00	0.233030E 00	4051	0.32658815	0.00421075	1.289 P/C
8	0.233030E 00	0.319468E 00	3267	0.26338273	0.00395488	1.502 P/C
9	0.319468E 00	0.405906E 00	2033	0.16389871	0.00332381	2.028 P/C
10	0.405906E 00	0.492344E 00	1243	0.10020959	0.00269615	2.691 P/C
11	0.492344E 00	0.578782E 00	683	0.05506288	0.00204809	3.720 P/C
12	0.578782E 00	0.665221E 00	1008	0.08126406	0.00245337	3.019 P/C

JOINT DISTRIBUTIONS OF POLYNOMIAL CONSEQUENCES

CONSEQUENCE NUMBER 1 VERTICAL
CONSEQUENCE NUMBER 2 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.000242	0.000726	0.004112	0.019913	0.066511	0.158175	0.141164	0.074653	0.024589	0.005401	0.003547
1	0.0	0.000140	0.000242	0.000575	0.001254	0.002237	0.003276	0.003126	0.002360	0.001391	0.000658	0.000534
2	0.0	0.000081	0.000161	0.001209	0.005401	0.018381	0.047807	0.083844	0.077959	0.040874	0.014592	0.003789
2	0.0	0.000081	0.000114	0.000312	0.000658	0.001206	0.001916	0.002489	0.002407	0.001778	0.001077	0.000552
3	0.0	0.0	0.000161	0.000161	0.000645	0.003225	0.008384	0.022251	0.036682	0.040310	0.024750	0.010964
3	0.0	0.0	0.000114	0.000114	0.000228	0.000509	0.000819	0.001324	0.001688	0.001766	0.001395	0.000935
4	0.0	0.0	0.0	0.0	0.000161	0.000726	0.000806	0.002580	0.004757	0.008787	0.010319	0.021364
4	0.0	0.0	0.0	0.0	0.000114	0.000242	0.000255	0.000455	0.000618	0.000838	0.000907	0.001298
5	0.0	0.0	0.0	0.0	0.0	0.000081	0.000081	0.000081	0.000403	0.000967	0.001209	0.006127
5	0.0	0.0	0.0	0.0	0.0	0.000081	0.000081	0.000081	0.000180	0.000279	0.000312	0.000701
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.0	0.000081	0.0	0.000726
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.0	0.000081	0.0	0.000242
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 1 VERTICAL
CONSEQUENCE NUMBER 3 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.002499	0.420268	0.075218	0.001048	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.000448	0.004432	0.002363	0.000291	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.043131	0.245324	0.005401	0.000242	0.0

2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001824	0.003863	0.000658	0.000140	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.002419	0.134311	0.010077	0.000726	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000441	0.003062	0.000897	0.000242	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.001048	0.040390	0.007175	0.000726	0.000081
4	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000291	0.001768	0.000758	0.000242	0.000081
5	0.0	0.0	0.0	0.0	0.0	0.0	0.000322	0.001612	0.005401	0.001371	0.000081	0.000161
5	0.0	0.0	0.0	0.0	0.0	0.0	0.000161	0.000360	0.000658	0.000332	0.000081	0.000114
6	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000403	0.000242	0.000081	0.000081	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000180	0.000140	0.000081	0.000081	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 1 VERTICAL
CONSEQUENCE NUMBER 4 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.006853	0.008304	0.023944	0.119556	0.260319	0.074895	0.005160	0.0	0.0	0.0	0.0	0.0
1	0.000741	0.000815	0.001373	0.002913	0.003940	0.002363	0.000643	0.0	0.0	0.0	0.0	0.0
2	0.015318	0.028136	0.072477	0.105772	0.063608	0.008787	0.0	0.0	0.0	0.0	0.0	0.0
2	0.001103	0.001485	0.002328	0.002761	0.002191	0.000838	0.0	0.0	0.0	0.0	0.0	0.0
3	0.028297	0.026604	0.041599	0.039100	0.010803	0.001129	0.0	0.0	0.0	0.0	0.0	0.0
3	0.001485	0.001445	0.001793	0.001740	0.000928	0.000301	0.0	0.0	0.0	0.0	0.0	0.0
4	0.014834	0.010400	0.012093	0.009191	0.002983	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.001085	0.000511	0.000981	0.000857	0.000490	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.003144	0.001290	0.002015	0.002177	0.000322	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.000503	0.000322	0.000403	0.000418	0.000161	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.000161	0.000161	0.000242	0.000161	0.000161	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.000114	0.000114	0.000140	0.000114	0.000114	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 1 VERTICAL
CONSEQUENCE NUMBER 5 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.000403	0.003305	0.019107	0.235892	0.227265	0.010158	0.001854	0.000484	0.000403	0.000161
1	0.0	0.0	0.000180	0.000515	0.001229	0.003812	0.003763	0.000900	0.000386	0.000197	0.000180	0.000114
2	0.0	0.0	0.000161	0.001451	0.008949	0.036037	0.142535	0.092067	0.009110	0.002257	0.000967	0.000564
2	0.0	0.0	0.000114	0.000342	0.000846	0.001673	0.003139	0.002596	0.000853	0.000426	0.000279	0.000213
3	0.0	0.0	0.000161	0.000806	0.001854	0.003789	0.010239	0.046034	0.058691	0.022170	0.001532	0.002257
3	0.0	0.0	0.000114	0.000255	0.000386	0.000552	0.000904	0.001882	0.002110	0.001322	0.000351	0.000426
4	0.0	0.000081	0.0	0.000161	0.000081	0.000484	0.001048	0.001048	0.002338	0.012012	0.019107	0.013141
4	0.0	0.000081	0.0	0.000114	0.000081	0.000197	0.000291	0.000291	0.000434	0.000978	0.001229	0.001022
5	0.0	0.0	0.0	0.0	0.000081	0.0	0.0	0.0	0.000081	0.0	0.000161	0.008626
5	0.0	0.0	0.0	0.0	0.000081	0.0	0.0	0.0	0.000081	0.0	0.000114	0.000830
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000887
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000267
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 1 VERTICAL
CONSEQUENCE NUMBER 6 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.000081	0.009513	0.321106	0.123186	0.025556	0.010239	0.004353	0.004998
1	0.0	0.0	0.0	0.0	0.000081	0.000872	0.004192	0.002951	0.001417	0.000904	0.000591	0.000633
2	0.0	0.0	0.0	0.0	0.0	0.0	0.005401	0.139632	0.114318	0.022090	0.006127	0.006530
2	0.0	0.0	0.0	0.0	0.0	0.0	0.000658	0.003112	0.002857	0.001320	0.000701	0.000723
3	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000564	0.023944	0.067317	0.038213	0.017414
3	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000213	0.001373	0.002250	0.001721	0.001174
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000494	0.006369	0.042567
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000197	0.000714	0.001813
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.0	0.008868
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.0	0.000842
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000887
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000267
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 2 VERTICAL
CONSEQUENCE NUMBER 3 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000322	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000161	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000564	0.000242	0.000242	0.0

3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000213	0.000140	0.000140	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000322	0.003789	0.001129	0.000242	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000161	0.000552	0.000301	0.000140	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.009191	0.014028	0.002580	0.000242	0.000081
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000857	0.001056	0.000455	0.000140	0.000081
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.053209	0.030797	0.004353	0.000484	0.000081
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.002015	0.001551	0.000591	0.000197	0.000081
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.142857	0.068284	0.004031	0.000081	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.003142	0.002265	0.000569	0.000081	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.000403	0.128588	0.116333	[illegible]	0.000081	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.000180	0.003006	0.002879	0.000607	0.000081	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.001693	0.081828	0.108191	0.002660	0.000081	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.000369	0.002461	0.002789	0.000463	0.000081	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.000403	0.033779	0.079087	0.002177	0.000161	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.000180	0.001622	0.002423	0.000418	0.000114	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.010803	0.043696	0.001612	0.000161	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000928	0.001835	0.000360	0.000114	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.000484	0.008304	0.036117	0.001451	0.000081	0.000081
12	0.0	0.0	0.0	0.0	0.0	0.0	0.000197	0.000815	0.001675	0.000342	0.000081	0.000081

CONSEQUENCE NUMBER 2 VERTICAL
CONSEQUENCE NUMBER 4 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.000322	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.000161	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.001048	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.000291	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.004595	0.000726	0.000161	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.000607	0.000242	0.000114	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.007981	0.005665	0.007417	0.004757	0.000081	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.000799	0.000667	0.000770	0.000618	0.000081	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.009110	0.008304	0.015640	0.028942	0.026846	0.000081	0.0	0.0	0.0	0.0	0.0	0.0
6	0.000653	0.000615	0.001114	0.001505	0.001451	0.000081	0.0	0.0	0.0	0.0	0.0	0.0
7	0.007417	0.009636	0.023621	0.063931	0.108110	0.002338	0.0	0.0	0.0	0.0	0.0	0.0
7	0.000770	0.000686	0.001364	0.002196	0.002788	0.000434	0.0	0.0	0.0	0.0	0.0	0.0
8	0.007576	0.011651	0.033538	0.076508	0.093115	0.027007	0.000403	0.0	0.0	0.0	0.0	0.0
8	0.000779	0.00097[illegible]	0.001617	0.002387	0.002609	0.001456	0.000180	0.0	0.0	0.0	0.0	0.0

9	0.007256	0.012980	0.033215	0.052161	0.051838	0.034102	0.002902	0.0	0.0	0.0	0.0	0.0
9	0.000762	0.001016	0.001609	0.001996	0.001991	0.001630	0.000483	0.0	0.0	0.0	0.0	0.0
10	0.008945	0.012818	0.019510	0.027169	0.029345	0.015963	0.001854	0.0	0.0	0.0	0.0	0.0
10	0.000846	0.001010	0.001242	0.001460	0.001515	0.001125	0.000386	0.0	0.0	0.0	0.0	0.0
11	0.005665	0.006530	0.012012	0.011932	0.015479	0.004434	0.0	0.0	0.0	0.0	0.0	0.0
11	0.000687	0.000723	0.000978	0.000975	0.001108	0.000597	0.0	0.0	0.0	0.0	0.0	0.0
12	0.008465	0.005966	0.007256	0.010561	0.013383	0.000887	0.0	0.0	0.0	0.0	0.0	0.0
12	0.000823	0.000691	0.000762	0.000918	0.001032	0.000267	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 2 VERTICAL
CONSEQUENCE NUMBER 5 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.000161	0.000161	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.000114	0.000114	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.000081	0.000645	0.000322	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.000081	0.000228	0.000161	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.000161	0.004353	0.000967	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.000114	0.000591	0.000279	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.000484	0.004031	0.021042	0.000564	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.000197	0.000569	0.001289	0.000213	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.001209	0.003064	0.056595	0.027007	0.000967	0.000081	0.0	0.0	0.0
6	0.0	0.0	0.0	0.000312	0.000496	0.002075	0.001456	0.000279	0.000081	0.0	0.0	0.0
7	0.0	0.0	0.000081	0.000967	0.005321	0.082796	0.110529	0.014028	0.001290	0.000161	0.000081	0.0
7	0.0	0.0	0.000081	0.000279	0.000653	0.002474	0.002815	0.001056	0.000322	0.000114	0.000081	0.0
8	0.0	0.0	0.000161	0.001290	0.007175	0.062319	0.119961	0.044341	0.011690	0.002499	0.000322	0.000242
8	0.0	0.0	0.000114	0.000322	0.000758	0.002170	0.002917	0.001848	0.000965	0.000448	0.000161	0.000140
9	0.0	0.0	0.000081	0.000564	0.004031	0.034586	0.082070	0.040390	0.021687	0.008868	0.001612	0.000564
9	0.0	0.0	0.000081	0.000213	0.000569	0.001641	0.002464	0.001768	0.001308	0.000842	0.000364	0.000213
10	0.0	0.000081	0.000161	0.000161	0.001129	0.012818	0.030152	0.031038	0.019187	0.012657	0.005563	0.002660
10	0.0	0.000081	0.000114	0.000114	0.000301	0.001010	0.001535	0.001557	0.001232	0.001004	0.000668	0.000463
11	0.0	0.0	0.0	0.000081	0.000564	0.004031	0.008143	0.013947	0.011367	0.006772	0.005643	0.005724
11	0.0	0.0	0.0	0.000081	0.000213	0.000569	0.000807	0.001053	0.000952	0.000736	0.000673	0.000677
12	0.0	0.0	0.0	0.0	0.000081	0.001048	0.002660	0.004595	0.006772	0.005966	0.008949	0.016446
12	0.0	0.0	0.0	0.0	0.000081	0.000291	0.000463	0.000607	0.000736	0.000691	0.000846	0.001142

CONSEQUENCE NUMBER 2 VERTICAL
CONSEQUENCE NUMBER 6 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.000322	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.000161	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.000161	0.000564	0.000161	0.000161	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.000114	0.000213	0.000114	0.000114	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.000081	0.004192	0.001048	0.000161	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.000081	0.000580	0.000291	0.000114	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.017656	0.006772	0.001209	0.000242	0.000242	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.001182	0.000736	0.000312	0.000140	0.000140	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.054499	0.024186	0.007659	0.001854	0.000484	0.000242
6	0.0	0.0	0.0	0.0	0.0	0.0	0.002038	0.001379	0.000783	0.000386	0.000197	0.000140
7	0.0	0.0	0.0	0.0	0.0	0.0	0.111980	0.070864	0.024508	0.005160	0.002177	0.000564
7	0.0	0.0	0.0	0.0	0.0	0.0	0.002831	0.002304	0.001388	0.000643	0.000418	0.000213
8	0.0	0.0	0.0	0.0	0.0	0.001854	0.083280	0.083521	0.052483	0.018946	0.006933	0.002983
8	0.0	0.0	0.0	0.0	0.0	0.000386	0.002481	0.002484	0.002002	0.001224	0.000745	0.000490
9	0.0	0.0	0.0	0.0	0.000081	0.005482	0.040793	0.052886	0.041761	0.032167	0.013705	0.007578
9	0.0	0.0	0.0	0.0	0.000081	0.000663	0.001776	0.002010	0.001796	0.001584	0.001044	0.000779
10	0.0	0.0	0.0	0.0	0.0	0.001774	0.011851	0.017011	0.023541	0.027249	0.016769	0.017414
10	0.0	0.0	0.0	0.0	0.0	0.000378	0.000972	0.001161	0.001361	0.001462	0.001153	0.001174
11	0.0	0.0	0.0	0.0	0.0	0.000161	0.001290	0.005966	0.010158	0.010077	0.009997	0.018623
11	0.0	0.0	0.0	0.0	0.0	0.000114	0.000322	0.000691	0.000900	0.000897	0.000893	0.001214
12	0.0	0.0	0.0	0.0	0.0	0.0	0.000161	0.000967	0.002257	0.004515	0.004757	0.033860
12	0.0	0.0	0.0	0.0	0.0	0.0	0.000114	0.000279	0.000426	0.000602	0.000618	0.001624

CONSEQUENCE NUMBER 3 VERTICAL
CONSEQUENCE NUMBER 4 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.000403	0.000081	0.0	0.0	0.0	0.000081	0.002419	0.0	0.0	0.0	0.0	0.0
7	0.000180	0.000081	0.0	0.0	0.0	0.000081	0.000441	0.0	0.0	0.0	0.0	0.0
8	0.001774	0.000645	0.006369	0.098758	0.273944	0.084650	0.002741	0.0	0.0	0.0	0.0	0.0
8	0.000378	0.000226	0.000714	0.002679	0.004004	0.002499	0.000469	0.0	0.0	0.0	0.0	0.0
9	0.045147	0.069655	0.144550	0.177201	0.064253	0.000081	0.0	0.0	0.0	0.0	0.0	0.0
9	0.001864	0.002286	0.003157	0.003428	0.002202	0.000081	0.0	0.0	0.0	0.0	0.0	0.0
10	0.019187	0.004515	0.001451	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.001232	0.000602	0.000342	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.001854	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.000386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.000242	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.000140	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 3 VERTICAL
CONSEQUENCE NUMBER 5 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.000081	0.002419	0.0	0.0	0.0	0.000081	0.000403
7	0.0	0.0	0.0	0.0	0.0	0.000081	0.000441	0.0	0.0	0.0	0.000081	0.000180
8	0.0	0.0	0.000081	0.001048	0.007336	0.206143	0.232103	0.016124	0.002015	0.000403	0.000242	0.003386
8	0.0	0.0	0.000081	0.000291	0.000766	0.003632	0.003791	0.001131	0.000403	0.000180	0.000140	0.000522
9	0.0	0.0	0.000242	0.002983	0.019349	0.065543	0.142535	0.129877	0.066672	0.033457	0.020397	0.019832

9	0.0	0.0	0.000140	0.000490	0.001237	0.002222	0.003139	0.003018	0.002240	0.001615	0.001269	0.001252
10	0.0	0.0	0.000242	0.001371	0.002902	0.004273	0.003628	0.003064	0.003305	0.003064	0.001371	0.001935
10	0.0	0.0	0.000140	0.000332	0.000483	0.000586	0.000540	0.000496	0.000515	0.000496	0.000332	0.000395
11	0.0	0.000081	0.000161	0.000322	0.000403	0.000081	0.000403	0.000242	0.0	0.0	0.000081	0.000081
11	0.0	0.000081	0.000114	0.000161	0.000180	0.000081	0.000180	0.000140	0.0	0.0	0.000081	0.000081
12	0.0	0.0	0.0	0.0	0.000081	0.000081	0.0	0.0	0.000081	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.000081	0.000081	0.0	0.0	0.000081	0.0	0.0	0.0

CONSEQUENCE NUMBER 3 VERTICAL
CONSEQUENCE NUMBER 6 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.002499	0.0	0.0	0.0	0.0	0.000484
7	0.0	0.0	0.0	0.0	0.0	0.0	0.000448	0.0	0.0	0.0	0.0	0.000197
8	0.0	0.0	0.0	0.0	0.0	0.008304	0.296114	0.126088	0.021928	0.007175	0.002257	0.007014
8	0.0	0.0	0.0	0.0	0.0	0.000815	0.004099	0.002981	0.001315	0.000758	0.000426	0.000749
9	0.0	0.0	0.0	0.0	0.0	0.001129	0.026766	0.133908	0.137053	0.088278	0.047082	0.066672
9	0.0	0.0	0.0	0.0	0.0	0.000301	0.001449	0.003058	0.003088	0.002547	0.001902	0.002240
10	0.0	0.0	0.0	0.0	0.000081	0.000081	0.001129	0.003064	0.004515	0.004353	0.005321	0.006611
10	0.0	0.0	0.0	0.0	0.000081	0.000081	0.000301	0.000496	0.000602	0.000591	0.000653	0.000728
11	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000322	0.000403	0.000322	0.000322	0.000403
11	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000161	0.000180	0.000161	0.000161	0.000180
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000081	0.000081
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000081	0.000081	0.000081

CONSEQUENCE NUMBER 4 VERTICAL
CONSEQUENCE NUMBER 5 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.000081	0.000484	0.002338	0.009513	0.012738	0.012173	0.009916	0.007094	0.005079	0.003305	0.005885
1	0.0	0.000081	0.000197	0.000434	0.000872	0.001007	0.000985	0.000890	0.000754	0.000638	0.000515	0.000687
2	0.0	0.0	0.000081	0.001129	0.004998	0.014592	0.015721	0.014350	0.008787	0.006450	0.004353	0.004434
2	0.0	0.0	0.000081	0.000301	0.000633	0.001077	0.001117	0.001068	0.000838	0.000719	0.000591	0.000597
3	0.0	0.0	0.000081	0.000887	0.005724	0.034908	0.040390	0.030313	0.018059	0.009594	0.006611	0.005805
3	0.0	0.0	0.000081	0.000267	0.000677	0.001648	0.001768	0.001539	0.001196	0.000875	0.000728	0.000682
4	0.0	0.0	0.000081	0.001371	0.007578	0.071993	0.094324	0.051193	0.025234	0.012012	0.005321	0.006853
4	0.0	0.0	0.000081	0.000332	0.000779	0.002321	0.002624	0.001979	0.001408	0.000978	0.000653	0.000741
5	0.0	0.0	0.0	0.0	0.002257	0.108836	0.167607	0.038617	0.012012	0.003628	0.002580	0.002660
5	0.0	0.0	0.0	0.0	0.000426	0.002796	0.003354	0.001730	0.000978	0.000540	0.000455	0.000463
6	0.0	0.0	0.0	0.0	0.0	0.032973	0.045872	0.004918	0.000887	0.000161	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.001603	0.001878	0.000628	0.000267	0.000114	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.000161	0.004998	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.000114	0.000633	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 4 VERTICAL
CONSEQUENCE NUMBER 6 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.000081	0.000242	0.005724	0.009110	0.009432	0.009029	0.011529	0.023460
1	0.0	0.0	0.0	0.0	0.000081	0.000140	0.000677	0.000853	0.000868	0.000849	0.000958	0.001359
2	0.0	0.0	0.0	0.0	0.0	0.000081	0.005724	0.009594	0.017091	0.018542	0.010077	0.013786
2	0.0	0.0	0.0	0.0	0.0	0.000081	0.000677	0.000875	0.001164	0.001211	0.000897	0.001047
3	0.0	0.0	0.0	0.0	0.0	0.000403	0.013947	0.041196	0.044502	0.025798	0.011770	0.014753
3	0.0	0.0	0.0	0.0	0.0	0.000180	0.001053	0.001784	0.001851	0.001423	0.000968	0.001083
4	0.0	0.0	0.0	0.0	0.0	0.001451	0.072557	0.098678	0.049500	0.025959	0.012173	0.015640
4	0.0	0.0	0.0	0.0	0.0	0.000342	0.002329	0.002678	0.001948	0.001428	0.000985	0.001114

5	0.0	0.0	0.0	0.0	0.0	0.004353	0.177685	0.080861	0.035150	0.017414	0.009110	0.013625
5	0.0	0.0	0.0	0.0	0.0	0.000591	0.003432	0.002448	0.001654	0.001174	0.000853	0.001041
6	0.0	0.0	0.0	0.0	0.0	0.002822	0.046275	0.023621	0.008223	0.003467	0.000403	0.0
6	0.0	0.0	0.0	0.0	0.0	0.000476	0.001686	0.001364	0.000811	0.000529	0.000180	0.0
7	0.0	0.0	0.0	0.0	0.0	0.000161	0.004676	0.000322	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.000114	0.000613	0.000161	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CONSEQUENCE NUMBER 5 VERTICAL
CONSEQUENCE NUMBER 6 HORIZONTAL

PROBABILITY AND ACCURACY (STANDARD DEVIATION)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000081
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000081
3	0.0	0.0	0.0	0.0	0.0	0.0	0.000161	0.000161	0.000242	0.000081	0.0	0.000081
3	0.0	0.0	0.0	0.0	0.0	0.0	0.000114	0.000114	0.000140	0.000081	0.0	0.000081
4	0.0	0.0	0.0	0.0	0.0	0.000161	0.000967	0.001612	0.001612	0.000726	0.000242	0.000403
4	0.0	0.0	0.0	0.0	0.0	0.000114	0.000279	0.000360	0.000360	0.000242	0.000140	0.000180
5	0.0	0.0	0.0	0.0	0.000081	0.000967	0.010803	0.010964	0.005079	0.001532	0.000484	0.000161
5	0.0	0.0	0.0	0.0	0.000081	0.000279	0.000928	0.000935	0.000438	0.000351	0.000197	0.000114
6	0.0	0.0	0.0	0.0	0.0	0.007981	0.185908	0.058449	0.015640	0.005724	0.001854	0.000645
6	0.0	0.0	0.0	0.0	0.0	0.000799	0.003493	0.002106	0.001114	0.000677	0.000386	0.000228
7	0.0	0.0	0.0	0.0	0.0	0.000403	0.128749	0.179378	0.052644	0.013060	0.004112	0.002741
7	0.0	0.0	0.0	0.0	0.0	0.000180	0.003007	0.003445	0.002005	0.001019	0.000575	0.000469
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.012818	0.086021	0.036279	0.009352	0.004837
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001010	0.002518	0.001679	0.000864	0.000623
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.002660	0.042164	0.018946	0.008304
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000463	0.001804	0.001224	0.000815

10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000645	0.019913	0.016366
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000228	0.001254	0.001139
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000161	0.022009
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000114	0.001317
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.025637
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001419

PROBABILITY PER CATEGORY SKETCH IN HALF CATEGORY INTERVALS

```
           CATEGORY   PROBABILITY                     SKETCH
        CONDITIONAL DISTRIBUTIONS OF THE RESPONSE SUMS

        CONSEQUENCE  1

            0.0       0.0          *----------------------------------------------------
             1.000    0.5445       I                                                   *
             1.000    0.4536       I                                           *
             2.000    0.3328       I                               *
             2.000    0.2554       I                       *
             3.000    0.1870       I                 *
             3.000    0.1080       I         *
             4.000    0.7062E-01   I     *
             4.000    0.2838E-01   I  *
             5.000    0.1419E-01   I*
             5.000    0.3708E-02   *
             6.000    0.1451E-02   *
             6.000    0.3225E-03   *
             7.000    0.0          *
             7.000    0.0          *
             8.000    0.0          *
             8.000    0.0          *
             9.000    0.0          *
             9.000    0.0          *
            10.00     0.0          *
            10.00     0.0          *
            11.00     0.0          *
            11.00     0.0          *
            12.00     0.0          *
            12.00     0.0          *
            13.00     0.0          *

        CONSEQUENCE  2

            0.0       0.0          *----------------------------------------------------
             1.000    0.0          *
             1.000    0.0          *
             2.000    0.0          *
             2.000    0.6450E-03   *
             3.000    0.6450E-03   *
             3.000    0.1451E-02   *
             4.000    0.3547E-02   I*
             4.000    0.7417E-02   I*
             5.000    0.1886E-01   I   *
             5.000    0.3338E-01   I      *
             6.000    0.6240E-01   I            *
             6.000    0.1154       I                       *
             7.000    0.1659       I                                      *
             7.000    0.2446       I                                                 *
             8.000    0.2523       I                                                   *
             8.000    0.2477       I                                                  *
             9.000    0.2053       I                                          *
             9.000    0.1837       I                                     *
            10.00     0.1274       I                         *
            10.00     0.1038       I                     *
            11.00     0.6611E-01   I             *
            11.00     0.4644E-01   I         *
            12.00     0.3080E-01   I     *
```

```
       12.00    0.2144E-01  I   *
       13.00    0.4079E-01  I       *

CONSEQUENCE  3

      0.0       0.0         *--------------------------------------------------
       1.000    0.0         *
       1.000    0.0         *
       2.000    0.0         *
       2.000    0.0         *
       3.000    0.0         *
       3.000    0.0         *
       4.000    0.0         *
       4.000    0.0         *
       5.000    0.0         *
       5.000    0.0         *
       6.000    0.0         *
       6.000    0.0         *
       7.000    0.4837E-03  *
       7.000    0.5482E-02  *
       8.000    0.2272      I               *
       8.000    0.7106      I                                               *
       9.000    0.7185      I                                                *
       9.000    0.2833      I                   *
       10.00    0.4079E-01  I  *
       10.00    0.9513E-02  I*
       11.00    0.2741E-02  *
       11.00    0.9674E-03  *
       12.00    0.3225E-03  *
       12.00    0.1612E-03  *
       13.00    0.0         *

CONSEQUENCE  4

      0.0       0.6401E-01  I--------*-----------------------------------------
       1.000    0.3193E-01  I   *
       1.000    0.4128E-01  I     *
       2.000    0.6192E-01  I       *
       2.000    0.8787E-01  I           *
       3.000    0.1264      I                *
       3.000    0.1783      I                       *
       4.000    0.2425      I                               *
       4.000    0.3094      I                                       *
       5.000    0.3734      I                                                *
       5.000    0.3030      I                                       *
       6.000    0.1203      I               *
       6.000    0.4934E-01  I      *
       7.000    0.9674E-02  I*
       7.000    0.6450E-03  *
       8.000    0.0         *
       8.000    0.0         *
       9.000    0.0         *
       9.000    0.0         *
       10.00    0.0         *
       10.00    0.0         *
       11.00    0.0         *
       11.00    0.0         *
       12.00    0.0         *
       12.00    0.0         *
       13.00    0.0         *

CONSEQUENCE  5
```

```
0.0          0.0         *--------------------------------------------------
 1.000       0.0         *
 1.000       0.0         *
 2.000       0.1612E-03  *
 2.000       0.0         *
 3.000       0.1612E-03  *
 3.000       0.1290E-02  *
 4.000       0.3386E-02  *
 4.000       0.8062E-02  I*
 5.000       0.1757E-01  I *
 5.000       0.4257E-01  I   *
 6.000       0.1233      I            *
 6.000       0.4291      I                                           *
 7.000       0.4911      I                                                 *
 7.000       0.2710      I                           *
 8.000       0.1772      I                 *
 8.000       0.1214      I           *
 9.000       0.8352E-01  I        *
 9.000       0.6063E-01  I     *
 10.00       0.4273E-01  I   *
 10.00       0.3112E-01  I  *
 11.00       0.2564E-01  I  *
 11.00       0.1870E-01  I *
 12.00       0.1242E-01  I*
 12.00       0.7739E-02  I*
 13.00       0.3112E-01  I  *
```

CCNSEQUENCE 6

```
0.0          0.0         *--------------------------------------------------
 1.000       0.0         *
 1.000       0.0         *
 2.000       0.0         *
 2.000       0.0         *
 3.000       0.0         *
 3.000       0.0         *
 4.000       0.0         *
 4.000       0.0         *
 5.000       0.0         *
 5.000       0.1612E-03  *
 6.000       0.1290E-02  *
 6.000       0.1774E-01  I *
 7.000       0.2846      I                                      *
 7.000       0.3686      I                                                 *
 8.000       0.2978      I                                       *
 8.000       0.2290      I                              *
 9.000       0.1799      I                       *
 9.000       0.1479      I                   *
 10.00       0.1114      I              *
 10.00       0.8900E-01  I           *
 11.00       0.6014E-01  I       *
 11.00       0.4998E-01  I      *
 12.00       0.4079E-01  I     *
 12.00       0.3096E-01  I   *
 13.00       0.9078E-01  I           *
```

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