DOCUMENT RESUME

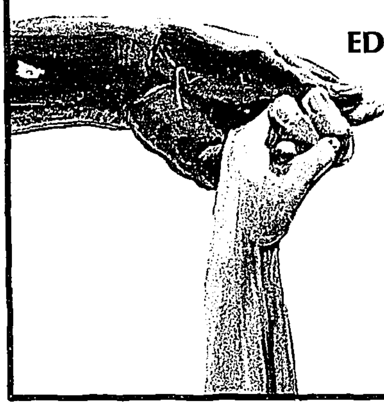
ED 045 730 TM 000 317

AUTHOR	Gregory, Thomas B.
TITLE	A Computer Program for Calculation of Scott's Coefficient of Observer Reliability.
INSTITUTION	Texas Univ., Austin. Research and Development Center for Teacher Education.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
REPORT NO	R-Ser-21
PUB DATE	Sep 69
GRANT	USOE-6-10-108
NOTE	10p.
EDRS PRICE	EDRS Price MF-$0.25 HC-$0.60
DESCRIPTORS	*Classroom Observation Techniques, *Computer Programs, Educational Research, *Reliability, *Research Methodology, *Statistical Analysis
IDENTIFIERS	FORTRAN, Inter rater Reliability, Observer Reliability

ABSTRACT

Scott's coefficient is an improved method for estimating observer reliability using any system which assigns events to mutually exclusive categories. The formula is the ratio of the actual difference between obtained and chance agreement to the maximum difference between obtained and chance agreement. A FORTRAN program for calculating this reliability coefficient is presented. The program can be used with from 2 to 20 observers and can include any number of observations as long as the product of the observations times the observers does not exceed 200. The observation system cannot exceed 30 categories. There are four outputs of the program including the average reliability coefficient of all possible pairs of observers, the average difference between all possible pairs of observers for each category, the percentage of each observer's total assignments found in each category, and each observer's average coefficient of reliability with all other observers. The data deck arrangement and program listing are included. (PR)

THE RESEARCH AND DEVELOPMENT CENTER FOR TEACHER EDUCATION



THE UNIVERSITY OF TEXAS AT AUSTIN / AUSTIN PUBLIC SCHOOLS / TEXAS EDUCATION AGENCY

A COMPUTER PROGRAM FOR CALCULATION OF SCOTT'S COEFFICIENT OF OBSERVER RELIABILITY

Thomas B. Gregory

Report Series No. 21

September, 1969

The Research and Development Center for Teacher Education
The University of Texas at Austin

This research was conducted with partial support of USOE Grant No. 6-10-108. The author wishes to acknowledge the assistance of Dr. Donald J. Veldman, Dr. Marcella Kysilka and Dr. O.L. Davis, Jr., in the preparation of this program.

A COMPUTER PROGRAM FOR CALCULATION OF SCOTT'S COEFFICIENT OF OBSERVER RELIABILITY

By

Thomas B. Gregory[1]
Indiana University

The past decade has witnessed the development of numerous observation systems that attempt to objectively record the ongoing verbal and nonverbal events occurring in the classroom. Flander's Interaction Analysis (1960) and the several revisions of the OScAR (e.g., Medley and Mitzel, 1958; Medley and others, 1968) are notable examples of this trend. Since such descriptive systems increasingly are being utilized as criterion measures in educational research, the problem of obtaining valid estimates of inter-observer reliability is a crucial one.

Scott (1955) proposed a method of estimating the reliability of observers using any observation system that assigns events to mutually exclusive categories. The method marks an

---

[1]Formerly, Department of Curriculum and Instruction, College of Education, The University of Texas at Austin.

improvement over conventional methods that are based on the percentage of observer agreements. Since such methods require the assumption of equi-probability of occurrence for all categories, they are inappropriate for these observation systems. The formula for Scott's coefficient is:

$$\pi = \frac{P_o - P_e}{1 - P_e}$$

where P_o (observed percent of agreement) represents the percentage of judgements on which two observers agree when coding the same data independently; and P_e is the percent of agreement to be expected by chance. π , then, is the ratio of the actual difference between obtained and chance agreement to the maximum difference between obtained and chance agreement (Scott, 1955, p. 323). Detailed procedures for hand-calculation of π are found elsewhere (Flanders, 1960, 1967).

<u>General Description of the Computer Program</u>

This Fortran program may be used with from 2 to 20 observers. Any number of individual observations may be included as long as the product of the observation N x the observer N does not exceed 200 (i.e., the maximum observation N for 20 observers is 10). The observation system cannot exceed 30 categories. Data may be input as decimal fractions or percents of the total assignments by each observer or as raw scores for each category for each observer. Any input format may be specified. Subroutine CCDS (Veldman, 1967, p. 132) allows several separate jobs to be "stacked" if the need arises.

Four outputs of the program are:

1. The average difference between all possible pairs of observers for each category.
2. The percentage of each observer's total assignments found in each category.
3. The average reliability coefficient of all possible pairs of observers.
4. Each observer's average coefficient of reliability with all other observers.

Data Deck Arrangement

<u>Card 1</u> Title Control Card

Columns:

1-80	Title identifying this particular job. It may be of any length but cannot be left blank.

<u>Card 2</u> Parameter Control Card

Columns:

1-5	Number of observers (max., 20).
6-10	Number of observations (max., 200 / observer N).
11-15	Number of categories in the system (max., 30).
16-20	A 1 if data is input as percents of total, a 2 if data is input as decimal fractions of total, or a 3 if data is input as raw scores for each category.
21-80	Blank.

<u>Card 3</u>

Columns:

1-80	An appropriate format statement (F mode) for reading the data as it is arranged on the tab cards (e.g., (10X, 10F3)).

Card 4 Beginning of the data deck arranged with all of observer 1's observations first, then all of observer 2's,...,then all of observer N's.

Last Card Another Title Control Card indicating the beginning of a new job or a blank card.

Program Listing

REFERENCES

Flanders, Ned A. Interaction Analysis in the Classroom. Minneapolis: University of Minnesota, College of Education, (Pre-Publication draft), 1960. (Mimeographed).

________. "The Problems of Observer Training and Reliability." pp. 158-66 in Amidon, Edmund J. and Hough, John B. Interaction Analysis: Theory, Research, and Application. Reading, Massachusetts: Addison-Wesley Publishing Co., 1967.

Medley, Donald M. and Mitzel, Harold E. "A Technique for Measuring Classroom Behavior." Journal of Educational Psychology, 49: 86-92; 1958.

Medley, Donald M., Schluck, Carolyn G. and Ames, Nancy P. Assessing the Learning Environment in the Classroom: A Manual for Users of OScAR 5V. Princeton: Educational Testing Service, 1968. (Mimeographed).

Scott, William A. "Reliability of Content Analysis: The Case for Nominal Scale Coding." Public Opinion Quarterly, 19: 321-25; Fall, 1955.

Veldman, Donald J. Fortran Programming for the Behavioral Sciences. New York: Holt, Rinehart and Winston, 1967.

```
      PROGRAM SCOTTR (INPUT, OUTPUT)
C
     0DIMENSION R(30,200), RT(30,20), PI(20,20), S(200), DIF(30),
     1AVG(30), ADIF(30), RAVG(20), KF(16)
    5 CALL CCDS (KF, NR, NT, NC, NP, N)
      TPI = 0
      DO 15 I = 1,NC
      DO 10 J = 1,NR
   10 RT(I,J) = 0
   15 ADIF(I) = 0
      DO 20 I = 1,NR
   20 RAVG(I) = 0
      NRT = NR * NT
      READ KF, ((R(I,J), I = 1,NC), J = 1,NRT)
      DO 25 I = 1,NC
      DO 25 J = 1,NRT
   25 R(I,J) = R(I,J) + 0.00001
      GO TO (55, 45, 30) NP
   30 DO 35 I = 1,NC
      DO 35 J = 1,NRT
   35 S(J) = SUMF (R, J, NC, 30)
      DO 40 J = 1,NRT
      DO 40 I = 1,NC
   40 R(I,J) = R(I,J) / S(J)
   45 DO 50 J = 1,NRT
      DO 50 I = 1,NC
   50 R(I,J) = R(I,J) * 100
   55 NT1 = 1
      NT2 = NT
      DO 70 J = 1,NR
      DO 65 I = 1,NC
      DO 60 K = NT1, NT2
   60 RT(I,J) = RT(I,J) + R(I,K)
   65 RT(I,J) = RT(I,J) / NT
      NT1 = NT1 + NT
   70 NT2 = NT2 + NT
      DO 85 I = 1,NR
      DO 85 J = 1,NR
      IF (I .NE. J) GO TO 75
      PI(I,J) = 1
      GO TO 85
   75 DO 80 K = 1,NC
      DIF(K) = ABS (RT(K,I) - RT(K,J))
      ADIF(K) = ADIF(K) + DIF(K)
   80 AVG(K) = (((RT(K,I) + RT(K,J)) / 2) ** 2) * .01
      DIFS = SUMF (DIF, 1, NC, 30)
      AVGS = SUMF (AVG, 1, NC, 30)
      PI(I,J) = (100 - DIFS - AVGS) / (100 - AVGS)
   85 TPI = TPI + PI(I,J)
      DO 90 K = 1,NC
   90 ADIF(K) = ADIF(K) / (NR * NR - NR)
      TPI = (TPI - NR) / (NR * NR - NR)
      DO 100 I = 1,NR
      DO 95  J = 1,NR
      IF (I .EQ. J) GO TO 95
```

```
      RAVG(I) = RAVG(I) + PI(I,J)
   95 CONTINUE
  100 RAVG(I) = RAVG(I) / (NR - 1)
      PRINT 105
  1050FORMAT (37H1PERCENT OF TOTAL FOR EACH CATEGORY. // 22H CAT.  A.DIF
     1.  RATER  /)
      PRINT 110, (J, J = 1,NR)
  110 FORMAT (13X, 20I5 /)
      DO 120  I = 1,NC
      PRINT 115, I, ADIF(I), (RT(I,J), J = 1,NR)
  115 FORMAT (/ 1X, I2, F8.2, 3X, 20F5.1)
  120 CONTINUE
      PRINT 125, TPI
  125 FORMAT (// 39H0COEFFICIENT FOR ENTIRE RATER GROUP IS , F6.4)
      PRINT 130, NR
  1300FORMAT (/ 66H0SCOTTS RELIABILITY COEFFICIENTS FOR ALL POSSIBLE COM
     1BINATIONS OF , I2, 9H RATERS. /)
      CALL PRTS (PI, NR, NR, 1H , 20)
      PRINT 135
  135 FORMAT (// 34H0AVERAGE R WITH ALL OTHER RATERS. //)
      PRINT 140, (I, RAVG(I), I = 1,NR)
  140 FORMAT (I3, F10.4 /)
      GO TO 5
      END
C
C
      SUBROUTINE CCDS (KF, KI, KJ, KK, KL, KM)
C
      DIMENSION KF(16), KH(16)
      READ 5, KH
    5 FORMAT (16A5)
      IF (KH(1) .EQ. KH(2)) STOP
      READ 10, KI, KJ, KK, KL, KM, KF
   10 FORMAT (5I5 / 16A5)
      PRINT 15, KH, KI, KJ, KK, KL, KM, KF
   150FORMAT (1H1, 16A5 // 11H PARAMETERS / 13H COL  1- 5 = , I5 /
     113H COL  6-10 = , I5 / 13H COL 11-15 = , I5 / 13H COL 16-20 = ,
     2I5 / 13H COL 21-25 = , I5 // 15H DATA FORMAT = , 16A5)
      RETURN
      END
C
C
      SUBROUTINE PRTS (X, N, M, KH, ND)
C
      DIMENSION X(ND,M)
      IF (M .GT. 1) GO TO 20
      PRINT 15
      DO 10 I = 1, N, 10
      J = MIN0 (I + 9, N)
      PRINT 5, KH, (K, K = I,J)
    5 FORMAT (/ A7, 10I11)
   10 PRINT 15, (X(K,1), K = I,J)
   15 FORMAT (10X, 10F11.4)
      RETURN
   20 DO 25 K = 1, M, 10
```

```
      PRINT 15
      L = MINO (K + 9, M)
      PRINT 5, KH, (J, J = K,L)
      DO 25 I = 1,N
   25 PRINT 30, I, (X(I,J), J = K,L)
   30 FORMAT (/ I6, 4X, 10F11.4)
      RETURN
      END
```

CORRIGENDUM

The following function was accidentially omitted from the program listing:

```
      FUNCTION SUMF (X, KK, NN, ND)
C
      DIMENSION X(ND,1)
      SUMF = 0
      N = IABS (NN)
      K = IABS (KK)
      IF (NN) 5, 55, 10
    5 IF (KK) 15, 55, 25
   10 IF (KK) 35, 55, 45
   15 DO 20 I = 1,N
   20 SUMF = SUMF + X(K,I) ** 2
      RETURN
   25 DO 30 I = 1,N
   30 SUMF = SUMF + X(I,K) ** 2
      RETURN
   35 DO 40 I = 1,N
   40 SUMF = SUMF + X(K,I)
      RETURN
   45 DO 50 I = 1,N
   50 SUMF = SUMF + X(I,K)
   55 RETURN
      END
```