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# THE LIFE EXPECTANCY OF OLDER COUPLES AND SURVIVING SPOUSES

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## ABSTRACT

Comparisons of individual life expectancies over time and across demographic groups provide information for individuals making retirement decisions and for policy makers. For couples, analogous measures are the expected years both spouses will be alive (joint life expectancy) and the expected years the surviving spouse will be a widow or widower (survivor life expectancy). Using individual life expectancies to calculate summary measures for couples is intuitively appealing but yields misleading results because the mortality distribution of husbands and wives overlap substantially. To illustrate, consider a wife aged 60 whose husband is 62. In 2010, her life expectancy was 24.4 years and his 20.2 years. The intuitions that the spouses will die at about the same time (e.g., within 5 years of each other) and that she will not live for a long time after his death are incorrect. The probability that the wife will outlive her husband is 0.63 and, if she does, her survivor life expectancy is 12.5 years. Using 2010 data, we investigate differences in joint and survivor life expectancy by race and ethnicity and by education. We then calculate trends and patterns in joint and survivor life expectancy in each census year from 1930 to 2010.

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## 1. Introduction

Using male and female life expectancy data from the National Center for Health Statistics (NCHS), we calculate the joint life expectancy of older couples entering their retirement and the life expectancy of surviving spouses. Using 2010 data, we calculate these measures separately for non-Hispanic whites, blacks, and Hispanics and, within racial groups, by educational attainment.[1] We also calculate joint and survivor life expectancy for each census year beginning in 1930, and analyze trends in joint and survivor life expectancy from 1930 to 2010. With the exception of Goldman and Lord (1983), demographers, economists, gerontologists, and sociologists have generally ignored the joint life expectancies of married couples and the life expectancies of surviving spouses.

We illustrate our measures of joint and survivor life expectancy by considering a non-Hispanic white couple in which the wife was 60 and the husband 62 in 2010 -- that is, the wife was born in 1950 and her husband in 1948. We focus on 60 year old wives and their husbands because these are ages at which many couples make crucial retirement-related decisions such as leaving career employment and claiming social security benefits. Thus, these are ages at which we would expect joint and survivor life expectancies to be especially salient. Census data show that in 2010 the average age gap between 60 year old non-Hispanic white women and their husbands was about 2 years. The 2010 NCHS life tables show that the life expectancy of a 60 year old non-Hispanic white woman was 24.4 years and that of a 62 year old non-Hispanic white man was 20.2 years. The intuitions that the spouses will die at about the same time (e.g., within 4 or 5 years of each other) and that the wife will not live for a long time after her husband's death are incorrect. These intuitions would be correct if

[1] We ignore unmarried individuals but it is important to bear in mind that marriage rates differ substantially by race and ethnicity. In 2010, 65.2 percent of 60 year old non-Hispanic white women were currently married. For black women the corresponding figure was 36.8 percent and for Hispanic women 55.0 percent.

60 year old women lived for exactly 24.4 years and 62 year old men lived exactly 20.2 years. More generally, if the mortality distributions of the men and the women were so tightly concentrated that they did not overlap, it would be correct to use the minimum of husband and wife life expectancy as the couple's joint life expectancy and to use the difference between the individual life expectancies as the survivor life expectancy. And, if the overlap were small, these measures would be good approximations. But the overlap is substantial and calculations that rely solely on the individual life expectances provide poor approximations of joint life expectancy and very poor approximations of survivor life expectancy.

The calculation of joint and survivor life expectancies requires the mortality distributions of both spouses. We use the NCHS life tables for men and women to construct mortality distributions and life tables for couples to calculate measures of joint life expectancy – i.e., the life expectancy of the couple, or expected number of years that both spouses will live.[2] We then calculate the probability of becoming a widow or widower at each age and use the individual life tables to calculate survivor life expectancy conditional on the identity of the surviving spouse (e.g., if the wife is the surviving spouse, we calculate her expected number of years as a widow).[3]

The construction of mortality distributions for couples is straightforward but tedious. To illustrate, we continue to focus on the case in which the wife was 60 and the husband 62 in 2010. From the individual life tables for men and for women, we calculate the probability that one or both

[2] We assume that the mortality of the couple arises only from the death of one or both spouses and ignore the possibility that the marriage ends in divorce. Thus, we are calculating the expected number of years that both spouses are alive, regardless of whether or not they remain married. Brown and Lin (2012) estimate that in 2010, 0.45 percent of married individuals 65 years and older divorced in the previous year.

[3] Although we use the terms "widow" and "widower," these terms are not quite accurate. We are calculating how long an individual can expect to live after the death of his or her current spouse, regardless of remarriage.

spouses will die in 2010. This probability is the sum of the probabilities of three mutually exclusive events:

(a) the husband will die between 62 and 63 AND the wife will not die between 60 and 61

(b) the wife will die between 60 and 61 AND the husband will not die between 62 and 63, and

(c) the husband will die between 62 and 63 AND the wife will die between 60 and 61.

The sum of these three probabilities is, of course, equal to one minus the probability that neither spouse will die in 2010. Thus, if our only aim were to calculate joint life expectancy, it would be easier to focus on the probability that neither spouse would die at each age or in each year. The drawback of proceeding in this way is that to calculate survivor life expectancies we need to calculate the probability that the wife (husband) will become a widow (widower) at each age.

For couples that survive into 2011, we proceed in the same way, calculating the probability that the husband will die between 63 and 64 and the wife will not die between 61 and 62, etc. These calculations give "mortality rates" for the *couple* for each year, and from these we can construct a "couple life table." More specifically, beginning with a cohort of 100,000 couples with the wife aged 60 and the husband aged 62, we can calculate expected transitions to widows, widowers, and "couple death" in each year. This corresponds to the L(X) column in the standard individual life table, with X denoting year rather than age.[4]

From the couple life table, we calculate the couple's joint life expectancy using the standard life expectancy calculation typically applied to individuals. The vertical lines in Figure 1a show the joint and individual life expectancies for a non-Hispanic white couple in which the wife was 60 and the husband 62 in 2010. For our focal couple, joint life expectancy is 17.7 years (recall that her

[4] Appendix 1 provides details of the standard life table and the calculation of joint life expectancy.

individual life expectancy is 24.4 and his individual life expectancy is 20.2 years). Figure 1b shows the focal couple transitions.

The survivor life expectancy answers questions such as: “If the wife is the surviving spouse, how many years can she expect to live after her husband’s death?" The survivor life expectancies are appropriately weighted averages of individual life expectancies at each age, where the weights are the probabilities of couple death in each year, conditional on couple survival to that year and conditional on the identity of the surviving spouse.

The probability that our focal 60 year old wife will predecease her 62 year old husband is 0.37, a surprisingly high probability that reflects the substantial overlap of their mortality distributions. Hence, the probability that the wife will be the surviving spouse is .63 and, if she is the surviving spouse, her survivor life expectancy is 12.5 years. The probability that the husband will be the surviving spouse is 0.37 and, if he is the surviving spouse, his survivor life expectancy is 9.5 years.

Although Goldman and Lord (1983) proposed couple life expectancy measures more than three decades ago, these measures have not been widely discussed or adopted.[5] In models of intra-household decision making (e.g., regarding the timing of retirement and the claiming of social security benefits), the difference between wives' and husbands' life expectancies is sometimes treated as an informal measure of survivor life expectancy.[6] Browning (1995, 2000) and Lundberg (1999) allude to the difference between husbands’ and wives’ life expectancies to motivate their discussions of

[5] Goldman and Lord (1983) estimated joint and survivor life expectancies at the time of marriage, using median age at marriage (first and higher order) for white and non-white men and women in 1970, and for brides and grooms at ages 20-50 for 1977-78. The actuarial literature addresses these issues; see, for example, Bowers et al. (1997). Brown and Poterba (2000) investigate an alternative notion of "joint life expectancy" -- the number of years that at least one spouse is expected to be alive. Similarly, the IRS provides race-ethnicity-gender-neutral tables to enable taxpayers to calculate the tax liabilities associated with joint life annuities and distributions from IRAs (https://www.irs.gov/publications/p590b).

[6] Uhlenberg (1980) is an early example of the use of such informal measures.

saving and other retirement-related decisions. As shown in our focal example, couple life expectancy measures cannot be deduced from individual life expectancy measures.

To the extent that demographers, economists, gerontologists, and sociologists have considered couples and surviving spouses, they have focused on age-specific joint and survivor mortality rates rather than on summary measures such as life expectancies (Hurd (1999), Mitchell et al. (1999), van der Klaauw and Wolpin (2008), Nishiyama (2015)). Although age-specific mortality rates are the basic building blocks, they are much more complex and thus less accessible than summary measures such as the probability that the wife will predecease the husband, and joint and survivor life expectancy. We focus on couples approaching retirement age because we think this is most relevant to policy makers and to couples.

Evidence suggests that the life expectancy of married individuals is greater than that of unmarried individuals both because healthier individuals select into marriage and because marriage has protective effects; see Goldman (1993), Hu and Goldman (1990), Frees, Carriere and Valdez (1996), Drefahl (2010), Sanders and Melenberg (2016). Our calculations, which are based on NCHS life tables, ignore these effects and assume that individuals' age-specific mortality probabilities are independent of their marital status.[7] Our calculations also assume that spouses' mortality probabilities are independent of each other, although we expect that assortative mating, shared environments, and behavioral habits would create correlations in mortality probabilities. We make these assumptions

[7] It is reasonable to compare the survival probabilities of married and unmarried individuals on a year-to-year basis – the probability that a married 60 year old woman survives to 61 may differ from the probability that an unmarried 60 year old woman survives to 61. However, calculating the life expectancy of a married 60 year old woman based on survival probabilities that are specific to marital status adds a bias, because doing so assumes that she remains married until her death (i.e., if her husband predeceases her or they divorce, she immediately remarries).

because publicly available life tables do not provide the information that would allow us to condition on marital status or take account of the correlations between spouses' mortality probabilities.[8]

In the following sections, we compute the joint life expectancies of couples nearing normal retirement age and the life expectancies of surviving spouses. In section 2 we use 2010 Census and NCHS data to calculate joint and survivor life expectancy separately for non-Hispanic white couples, black couples, and Hispanic couples.[9] Bound et al. (2015) estimate individual mortality rates by education for non-Hispanic whites and for blacks, and we use their estimates to calculate joint and survivor life expectancies for non-Hispanic white couples and for black couples.

In section 3 we describe trends in the life expectancies of older white and black couples from 1930 to 2010.[10] We use census data to calculate the age gap between 60 year old wives and their husbands in each census year. Using the 1930-2010 NCHS life tables for white men, white women, black men, and black women, we calculate joint life expectancy and survivor life expectancies. The proximate causes of the trends we describe are changes in the age gaps between spouses and changes in the mortality distributions of older men and women, but the trends are driven by changes in the mortality distributions. In section 4 we discuss briefly the dispersion around the summary measures. Section 5 concludes.

[8] To account for the dependence in mortality rates of spouses would require detailed longitudinal data on couples.
[9] We treat Hispanic blacks as blacks rather than as Hispanics.
[10] Unfortunately, we are unable to calculate the historical trends separately for Hispanics, as the NCHS life tables only began providing separate life tables for Hispanics in 2006.

## 2. Patterns in the Life Expectancies of Older Couples and Surviving Spouses by Race, Ethnicity, and Education: 2010

In this section, we first discuss joint and survivor life expectancy measures by race and ethnicity. We then discuss how these racial and ethnic differences in joint and survivor life expectancy are affected by education using the Bound et al. (2015) data linking educational attainment with mortality.

Before doing this, however, we generalize our analysis beyond focal couples consisting of 60 year old women married to 62 year old men. We begin with an example. Retaining our focus on 60 year old women, we recognize that some of them are married to 61 years old men, others to 62 year old men, and still others to 63 year old men. In this example, the way forward is first to calculate the joint and survivor life expectancies of these three types of couples and then to compute the appropriately weighted average. We generalize the procedure used in this example to calculate joint and survivor life expectancy for couples consisting of a 60 year old woman and her husband, regardless of her husband's age. That is, using census data about the age gap between 60 year old married women and their husbands, we calculate joint and survivor life expectancies for each race and ethnicity and for each education category as appropriately weighted averages.[11] Thus, the differences we report in joint and survivor life expectancy across groups reflect differences in both age-specific mortalities and in the age gaps between 60 year old women and their husbands.

[11] Census data was obtained through IPUMS. (Ruggles et al. (2017)).

**2a. Race and Ethnicity**

Table 1 shows the 2010 measures of life expectancy for non-Hispanic white, black, and Hispanic couples.[12] We present individual life expectancy of women aged 60, the average life expectancy of their spouses, and measures of joint and survivor life expectancy for the appropriately weighted average of couples in which the wife was aged 60.

Both Hispanic men and Hispanic women have longer life expectancies than their non-Hispanic white and black counterparts, and Hispanic couples have a higher joint life expectancy.[13] Black men and black women have shorter life expectancies than their non-Hispanic white and Hispanic counterparts, and black couples have a lower joint life expectancy. The pattern for survivor life expectancy is the opposite: conditional on becoming a widow, black women have a longer survivor life expectancy (13.5 years), than Hispanic women (13.1 years), and white women (12.5 years). Hispanic men have the shortest survivor life expectancies (9.3 years), followed by white men (9.5 years), with black men having the longest expected survivor life expectancies (10.1 years). While Hispanic men and women have the longest individual life expectancies at age 60, they have the lowest

[12] We define race of couples by the race of the wife. There is little intermarriage reported in the 2010 census for non-Hispanic white women or for black women aged 60. Fully 99 percent of married non-Hispanic white women are married to non-Hispanic white men, and over 97 percent of married black women are married to black men. Hispanic women are more likely to intermarry. In 2010, 79.2 percent of married Hispanic women were married to Hispanic men, 19.5 percent were married to non-Hispanic white men, and 1.4 percent were married to black men. When we limit the sample to exclude interracial couples, the results do not change substantially.

[13] We have taken at face value the mortality distributions and life expectancies for Hispanic men and women reported by the CDC, but these should be viewed with caution. The CDC life tables report that Hispanics have substantially longer life expectancies than non-Hispanic whites, despite Hispanics' lower incomes and lower levels of educational attainment. Demographers have termed this the "Hispanic Paradox" and have offered a variety of explanations; see Smith and Bradshaw (2006), Goldman (2016). Black et al (2017) argue that the longer Hispanic life expectancy are probably due to measurement error.

expected number of years in widowhood. Black men and women have the shortest life expectancies at age 60, and they have the highest expected number of years in widowhood.

**2b. Education**

Bound et al. (2015) estimate individual age-specific mortalities by education. We use their mortality estimates to calculate couple-based life expectancy measures by education for non-Hispanic white couples and black couples, but not for Hispanic couples.[14] We classify couples into four education categories, using the "power couples" terminology introduced by Costa and Kahn (2000) and extended by Compton and Pollak (2007). Couples are defined as "low-power" if neither spouse has a college degree; "half-power-her" if only the wife has a college degree; "half-power-him" if only the husband has a college degree; and "full-power" if both spouses have college degrees.[15]

[14] NCHS life tables do not condition on education. Bound et al. (2015) estimate mortality probabilities by education categories, conditional on survival to age 25, for non-Hispanic white men and women and for black men and women. We provide estimates for four education categories -- less than high school, high school graduate, some college, and college graduate. We have extended the Bound et al. estimates in two ways. First, we convert their five-year estimates to one-year age estimates using a cubic spline. Second, we extend their estimates for ages above age 85 using the NCHS data for the full population and assuming that all four education groups follow the proportional increases in mortality for ages above 85.

[15] The estimates from Bound et al. (2015) are based on administrative data that have been criticized for underestimating education. Rostron (2010), Hendi (2015), and Sasson (2016) have shown that when education is reported by next-of-kin (as in administrative data) there is substantial undercounting of the population with high school diplomas and an over-counting of the population with less than high school, compared to the self-reports in survey data. Use of administrative data to code education leads to greater reported disparities in life expectancy by education, compared to the results using self-reported survey data. However, the discrepancies in reported education are concentrated at the lower end of the education scale (a high proportion of those with high school diplomas are listed as less than high school). Since we combine these two groups and focus on the differences between college graduates and non-college graduates, the concerns about the administrative data used in Bound are less relevant.

Table 2 presents the life expectancy measures by education. For both men and women, education is associated with lower mortality and substantially greater life expectancy.[16] Due to positive assortative marriage on education, the education differences in individuals' life expectancies translate into substantial differences in joint and survivor life expectancies. Consider first the joint life expectancy measure. For both non-Hispanic white couples and black couples, as we move from low-power couples, to half-power-her, to half-power-him, to power couples, joint life expectancy increases steadily. For non-Hispanic white couples, joint life expectancy increases across education categories from 15.5 to 19.0 years; for black couples, joint life expectancy increases from 13.6 to 16.4 years.

While the joint life expectancies are approximately three years longer for non-Hispanic white couples in each category, the survivor life expectancies are slightly higher for black men and women compared with non-Hispanic white men and women. For non-Hispanic white couples and for black couples, the husband's survivor life expectancy is highest when he has a college degree and she does not (10.1 and 10.5 years). For these half-power-him couples, his life expectancy is higher than average and hers is lower than average, which results in a higher expected years of widowerhood for the husband. The husband's survivor life expectancy is lowest when she has a college degree and he does not (9.0 for non-Hispanic white couples and 9.4 years for black couples). For these half-power-her couples, his life expectancy is lower than average and hers is higher than average, resulting in lower expected years of widowhood for the husband.

[16] For more discussion on this topic, see Meara, Richards, and Cutler (2008), Olshansky et al. (2012), Bound et al. (2015), and Chetty et al. (2016). We do not speculate on what portion of this association is causal and what portion reflects correlations between education and other factors, both genetic and environmental.

We find that the differences in life expectancies by education are, in all cases, greater than the racial differences. Similarly, the difference in the probability that the husband dies first is greater across education categories than the differences between blacks and non-Hispanic whites. For black couples and for non-Hispanic white couples, the probability that the wife will die first is lowest for couples in which only the husband has a college degree (half-power-him couples, at 0.59), and highest for couples in which only the wife has a college degree (half-power-her couples, at 0.68). Although these numbers reflect both differences in life expectancy and age gap across education groups, this pattern continues to hold when we fix the age gap at two years and consider only differences in life expectancies between blacks and non-Hispanic whites.

## 3. Trends in the Life Expectancies of Older Couples and Surviving Spouses: 1930-2010

We next describe the trends in joint and survivor life expectancies for white and black couples from 1930-2010.[17] Our discussion here differs from our discussion of trends in section 2 because, unlike the 2010 life tables, the NCHS life tables for earlier census years do not include mortality distributions for Hispanics. We analyze couples consisting of 60 year old women and their husbands, so that the changes we report in joint and survivor life expectancy between 1930 and 2010 reflect both changes in age-specific mortalities and changes in the age gaps between spouses.[18] In Table 3a we present joint and survivor life expectancies for white couples in which the wife was aged 60, and in Table 3b we present the corresponding life expectancies for black couples.[19] Figure 2

[17] We begin in 1930 because the mortality data for older individuals from 1920 and before is not comparable with the data from 1930 and after. The difficulty is that prior to 1930, the survivor tables end at age 89 (i.e. the probability of death between ages 89 and 90 is one). The tables from 1930 onwards extend to 101.

[18] The gender differences in age-specific mortality have varied throughout the century. For a discussion of the determinants of the gap, see Goldin and Lleras-Muney (2018).

[19] The tables and figures are labeled by the race of the wife, but interracial marriages are rare for

shows the trends in individual life expectancies for 60 year old white women and their husbands and for 60 year old black women and their husbands. Life expectancy for women of this age has increased steadily over the decades, and the gap between white and black women has remained fairly constant. The life expectancy of their husbands has increased both because the age gap has fallen (so husbands in 2010 are on average younger than husbands in 1930) and because the life expectancy of older men has increased.

The effect of the increasing life expectancy of older men is evident in Figures 3a and 3b. Until 1980, a white woman of age 60 who outlived her husband could expect to spend as much of her remaining life in widowhood as years with her husband. From 1930 to 1980, joint life expectancy for white couples increased from 10.0 years to 14.0 years, and her survivor life expectancy followed a similar pattern, increasing from 10.9 years to 13.4 years. After 1980, the joint life expectancy of white couples continued to increase, while her survivor life expectancy fell. By 2010, joint life expectancy exceeded her survivor life expectancy by 5 years – joint life expectancy was 17.7 years and her survivor life expectancy was 12.5 years. For married black women of age 60, joint life expectancy did not exceed her survivor life expectancy until 2010. Between 1930 and 2000, joint life expectancy for black couples increased from 8.4 years to 13.4 years and her survivor life expectancy increased from 11.3 years to 13.3 years. In 2010, joint life expectancy (15.5 years) finally exceeded her survivor life expectancy (13.5 years).

The survivor life expectancy of the husbands of 60 year old women has slowly increased between 1930 and 2010. In 1930, a white (black) husband who outlived his wife could expect to live

these cohorts. For all years, the percentage of white married women aged 60 who are married to white men exceeds 99 percent. For black married women aged 60, the percentage married to black men exceeds 98 percent prior to 2010; for 2010 the percentage was 96.4 percent.

8.5 years (8.7 years) as a widower. By 2010, the survivor life expectancy for white (black) husbands increased to 9.5 years (10.1 years).

The probability that the wife will be the surviving spouse follows an inverted u-shaped pattern similar to her survivor life expectancy. In 1930, the probability that a 60 year old white woman would outlive her husband was 0.56. This probability increased steadily, reaching a peak of 0.69 in 1980 before falling to 0.63 in 2010. The pattern for black women is similar: the probability of being the surviving spouse was 0.58 in 1930, rose to 0.70 in 1990, and then fell to 0.63 in 2010.

Two factors underlie these observed patterns. In recent decades, the life expectancy of older men has increased faster than the life expectancy of older women, implying an increase in joint life expectancy and a decrease in her survivor life expectancy. The age gap between spouses has also fallen, and fell markedly between 2000 and 2010, but the change in the life expectancies of older men and women, not changes in the age gap, are the primary drivers of the observed patterns.[20]

**4. Dispersion**

Like individual life expectancies, joint and survivor life expectancies are summary measures of mortality distributions, and provide no information about the dispersion of these distributions.

[20] We performed counterfactual calculations of joint life expectancy holding the age gap fixed at its 2010 level. Because the average age gap exceeds two years in all census years except 2010, replacing the actual age gaps with the 2010 age gap raises the joint life expectancy and lowers survivor life expectancy. With one exception, however, the decade-to-decade patterns noted above remain. The only exception is for black couples between 2000 and 2010. For these couples, the change in the age gap is responsible for an increase in joint life expectancy of 2.2 years and a fall in survivor life expectancy of 0.1 years. Survivor years as a proportion of joint life expectancy as well as the probability that the husband will die first both fell slightly. When we hold the age gap constant, however, the increase in joint life expectancy is only 1.6 years and there is an increase in survivor life expectancy of 0.5 years. Applying the 2010 age gap would have resulted in an increase in ratio of survivor life expectancy to joint life expectancy, as well as the probability that the husband dies first.

Consider again our focal couple in which she is aged 60 and he is aged 62. Recall that for this couple, joint life expectancy is 17.7 years, the probability that she is widowed is 0.63, her survivor life expectancy is 14.6 years, and his survivor life expectancy is 8.6 years. To provide information about the dispersion of the mortality distributions around the joint life expectancy and survivor life expectancies, we calculate the probability that a couple will survive ten, twenty, thirty, or forty years and present the resulting 4×4 matrix in Table 4.[21]

If mortality were evenly distributed across the 16 element of the matrix, each would have a probability of 0.0625. Consider first the four corner elements, which correspond to the cases in which one or both spouses die in either the first decade or the last decade. (These are the lowest probabilities in the matrix). The probability that the wife will be a widow for approximately 30 years is 0.034; the probability that the husband will be a widower for approximately 30 years is 0.027. It is almost equally likely that they both die within the first decade (0.031), and that they will both live at least another 30 years (0.030). The most likely scenario is that both spouses live between 20 and 30 additional years, but even this probability is only 0.129. The wide dispersion of these distributions is due not to the differing mortality rates of men and women, nor to the age gap between spouses, but rather to the large overlap of the underlying mortality distributions. If we conduct the same calculation for a same-

[21] The 4×4 matrix shows the probabilities of various realizations of the timing of death for a non-Hispanic white couple in which the wife is 60 and the husband 62. For example, top left cell corresponds to the case in which both spouse die within the first decade; 3.1 percent of couples fall into this category. The bottom right cell corresponds to the case in which both spouses live into the fourth decade (i.e., both into their 90s); 3.0 percent of couples fall into this category. In these two cases, and in the other two cases on the principal diagonal, the wife or the husband may be the surviving spouse. In cells above the principal diagonal, the wife is the surviving spouse; in cells below, the husband is the surviving spouse. For example, the bottom left cell corresponds to the case in which the wife dies within the first decade and the husband lives at least until age 92; 2.7 percent of couples fall into this category.

sex couple consisting of two 60 year old women or of two 60 year old men, the resulting matrix is very similar.

The wide dispersion in mortality rates around joint and survivor life expectancies suggests the need for caution when interpreting these summary measures, but similar caution is also required when interpreting individual life expectancy.

## 5. Conclusion

We have defined and calculated measures of the joint and survivor life expectancies of older couples. Although it is intuitively appealing to calculate couple-based measures of life expectancy directly from men's and women's life expectancies, such calculations are misleading because they fail to take account of the substantial overlap in spouses' mortality distributions. The resulting measures overstate joint life expectancy and dramatically understate survivor life expectancy. We calculate joint and survivor life expectancy using 2010 data disaggregated by race and ethnicity and by education, and using historical data from 1930 to 2010. Because we base our calculations on individual life tables, we cannot take account of the possibilities that (a) healthier individuals may select into marriage, (b) marriage may itself increase life expectancy, and (c) mortality rates of husbands and wives may be correlated. Because taking account of these possibilities requires richer data, we leave these refinements for future research.

Measures of joint and survivor life expectancy are potentially useful to those designing or evaluating policies affecting older couples and to couples making savings, retirement, and long-term care decisions. Policy makers need to forecast future social security claims and assess future demand for nursing home care. To do this they need estimates of the number of years both spouses will be alive and the number of years the widow or widower will survive after the spouse's death. Couple life

expectancy matters for long-term care because when one spouse becomes disabled, the other typically provides care; after the death of one spouse, adult children or nursing homes paid for by Medicaid usually provide care for the disabled surviving spouse. Couples making saving and retirement decisions and deciding when to claim social security benefits need estimates of their joint life expectancy and the life expectancy of the surviving spouse. With the exception of Goldman and Lord (1983), demographers, economists, gerontologists, and sociologists have generally ignored the joint life expectancies of married couples and the life expectancies of surviving spouses.

For definiteness, we have focused on trends affecting women aged 60 and their husbands but our analytical structure applies to couples regardless of age, or, more generally, to pairs or larger groups of individuals.[22] Although the measures are tedious to calculate, tools such as the "Life Expectancy Calculator" on the Social Security website could easily be augmented to allow individuals and couples to calculate their joint and survivor life expectancies.[23]

[22] For example, to the probability that a child will pre-decease a parent. Lotka (1931) provides an early discussion. Jiang et al (2014) and Noymer (2010) provide more recent analyses.
[23] https://www.ssa.gov/oact/population/longevity.html

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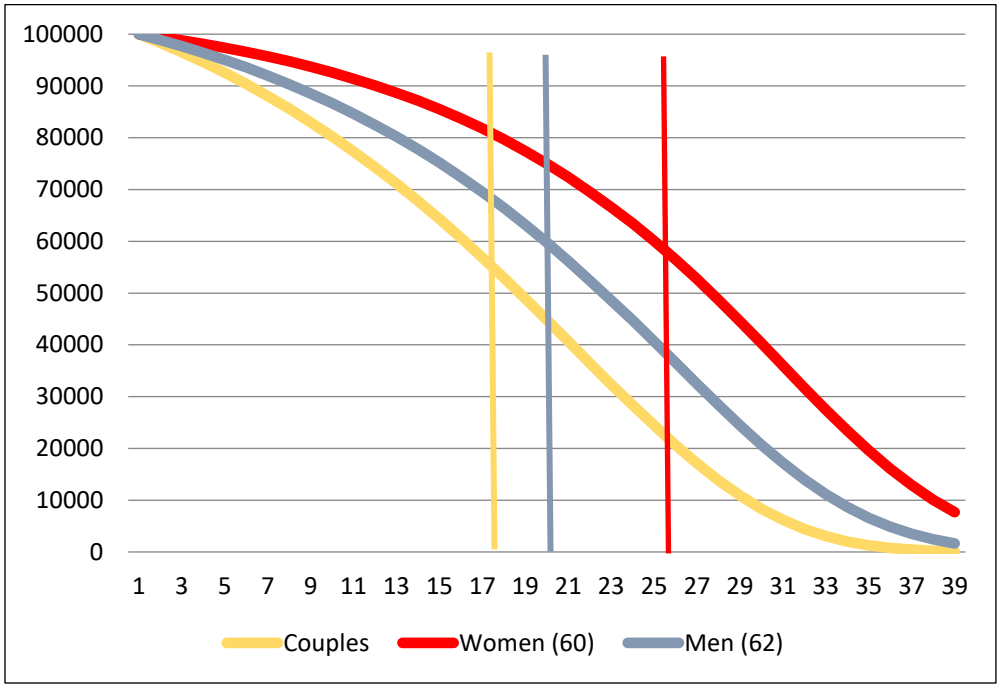
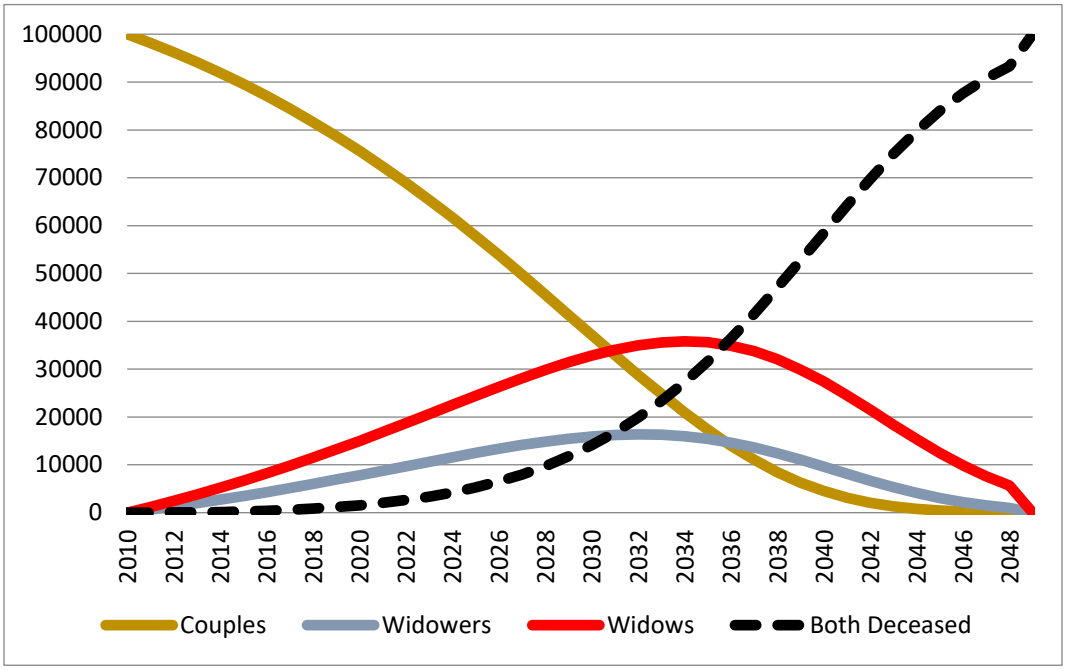
**Figure 1a: Individual and Focal Couple Survival Probabilities: Woman 60 Years Old and Man 62 Years Old in 2010.**




The figure shows the joint survival probabilities of a focal couple consisting of a 60 year old non-Hispanic white woman and a 62 year old non-Hispanic white man as well as their individual survival probabilities. The calculations are based on the 2010 NCHS life table.

**Figure 1b: Projected Mortality Experience, 2010-2048, of Focal Couple: Woman 60 Years Old and Man 62 Years Old in 2010.**




The figure shows the projected mortality experience each year from 2010 to 2048 of a focal couple consisting of a 60 year old non-Hispanic white woman and a 62 year old non-Hispanic white man. The calculations are based on the 2010 NCHS life table.

**Figure 2: Individual Life Expectancies 1930-2010. Women aged 60 and their spouses.**

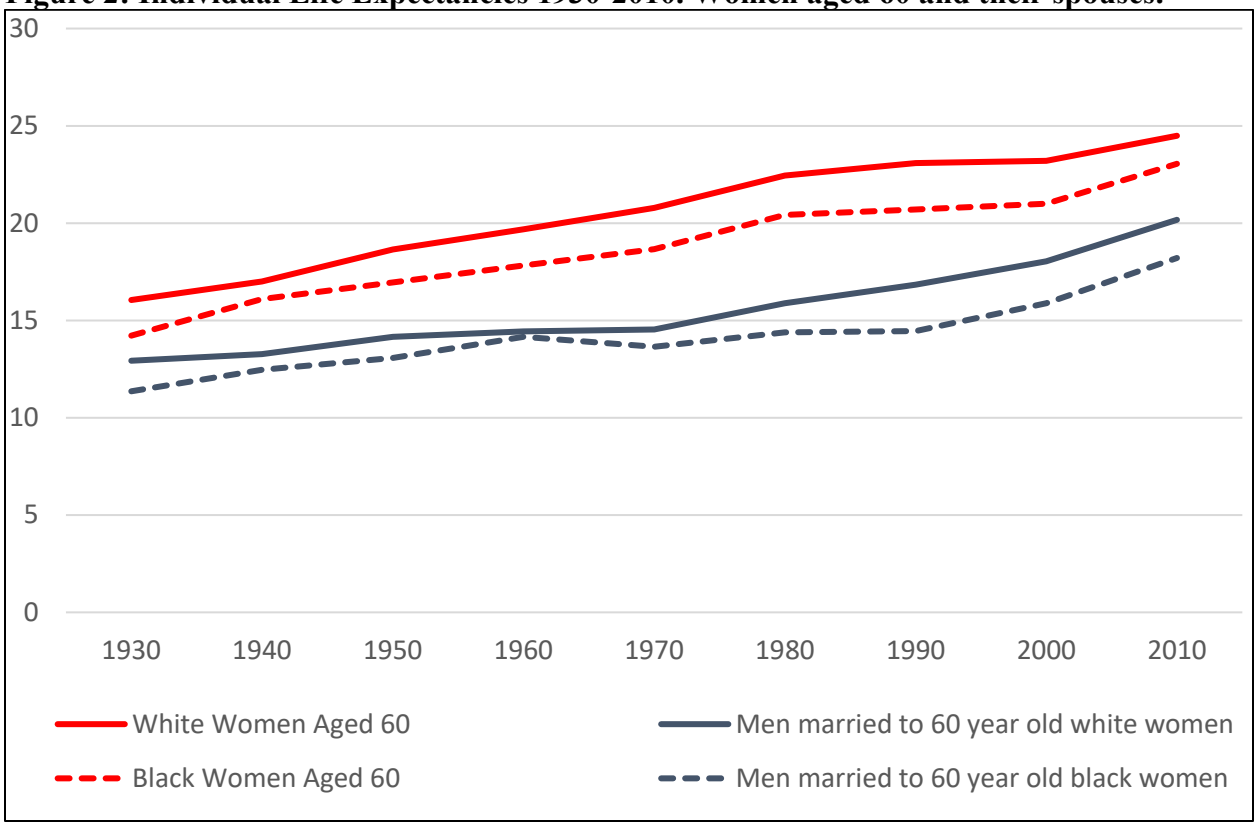


**Figure 3a: Joint and survivor Life Expectancies, 1930-2010. White couples, wife is aged 60.**

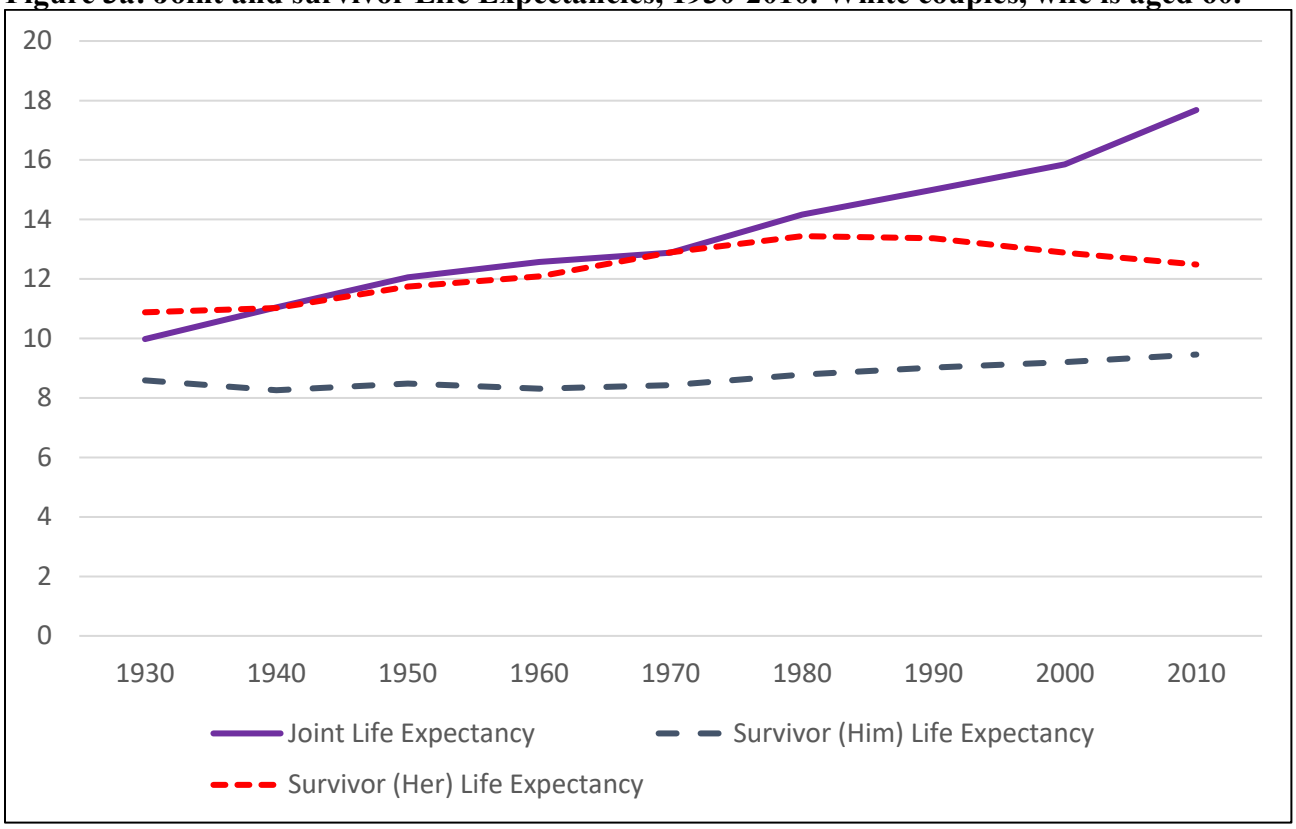


**Figure 3b: Joint and survivor Life Expectancies, 1930-2010. Black couples, wife is aged 60.**

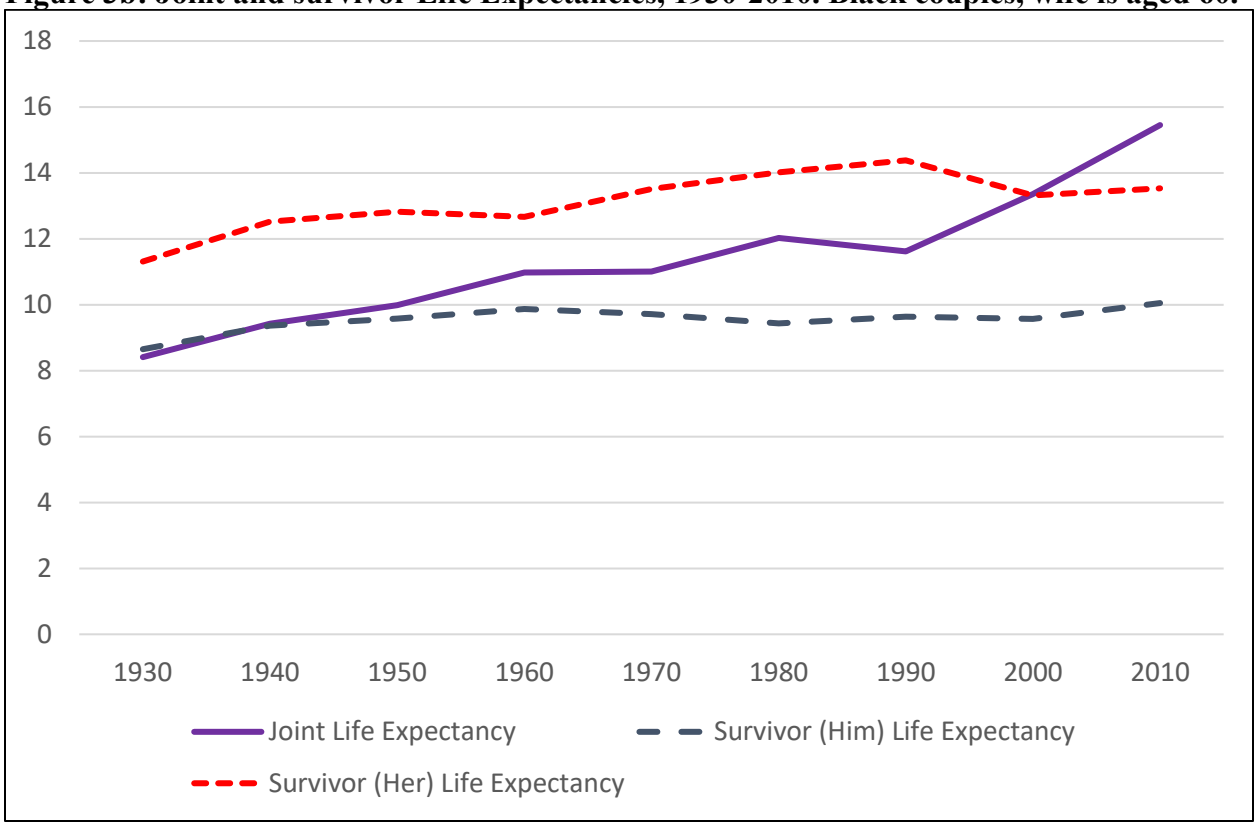


**Table 1: Life Expectancy Measures, 2010, by Race and Ethnicity, Wife is Aged 60**

| | Non-Hispanic White | Black | Hispanic |
|---|---|---|---|
| **Wife's Life Expectancy** | 24.40 | 23.05 | 26.40 |
| | (0.00) | (0.00) | (0.00) |
| **Husband's Life Expectancy** | 20.17 | 18.22 | 21.05 |
| | (3.59) | (3.74) | (4.59) |
| **Joint Life Expectancy** | 17.66 | 15.45 | 18.79 |
| | (2.08) | (2.12) | (2.82) |
| **Survivor Life Expectancy (Wife)** | 12.48 | 13.52 | 13.13 |
| | (1.21) | (1.19) | (1.77) |
| **Survivor Life Expectancy (Husband)** | 9.48 | 10.05 | 9.34 |
| | (1.51) | (1.77) | (1.85) |
| **Probability that Wife is the Surviving Spouse** | 0.63 | 0.63 | 0.65 |
| | (0.10) | (0.10) | (0.12) |
| **Age Gap (Husband – Wife)** | 1.91 | 1.81 | 2.25 |
| | (4.79) | (5.61) | (5.90) |
| **Sample** | 10,967 | 848 | 620 |

Calculations by authors. Standard errors in parentheses.

**Table 2: Life Expectancy Measures, by Education 2010. Wife is Aged 60**

| | Non-Hispanic White Couples | | | | | Black Couples | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low Power | Half Power (Her) | Half Power (Him) | Power | All | Low Power | Half Power (Her) | Half Power (Him) | Power | All |
| **Wife's Life Expectancy** | | | | | | | | | | |
| | 23.68 | 26.07 | 24.73 | 26.07 | 24.61 | 21.70 | 23.79 | 22.51 | 23.79 | 22.26 |
| | (1.79) | (0.00) | (1.84) | (0.00) | (1.83) | (1.43) | (0.00) | (1.50) | (0.00) | (1.53) |
| **Husband's Life Expectancy** | | | | | | | | | | |
| | 18.71 | 19.82 | 22.06 | 22.12 | 20.13 | 16.95 | 17.46 | 19.45 | 19.76 | 17.57 |
| | (4.17) | (4.39) | (3.47) | (3.46) | (4.25) | (4.36) | (4.22) | (3.77) | (3.68) | (4.36) |
| **Joint Life Expectancy** | | | | | | | | | | |
| | 15.53 | 17.17 | 18.31 | 18.99 | 16.91 | 13.61 | 14.84 | 15.59 | 16.39 | 14.26 |
| | (3.04) | (3.42) | (2.52) | (2.82) | (3.32) | (2.68) | (2.59) | (2.23) | (2.26) | (2.78) |
| **Survivor Life Expectancy (Wife)** | | | | | | | | | | |
| | 13.24 | 13.50 | 11.70 | 11.93 | 12.71 | 13.40 | 13.99 | 12.61 | 12.87 | 13.33 |
| | (1.58) | (1.79) | (1.36) | (1.38) | (1.68) | (1.45) | (1.52) | (1.36) | (1.44) | (1.49) |
| **Survivor Life Expectancy (Husband)** | | | | | | | | | | |
| | 9.69 | 8.96 | 10.07 | 9.27 | 9.59 | 9.89 | 9.36 | 10.47 | 10.05 | 9.90 |
| | (1.71) | (1.48) | (1.43) | (1.28) | (1.59) | (2.06) | (1.70) | (1.76) | (1.42) | (1.94) |
| **Probability that Wife is the Surviving Spouse** | | | | | | | | | | |
| | 0.65 | 0.68 | 0.59 | 0.63 | 0.64 | 0.64 | 0.68 | 0.59 | 0.62 | 0.64 |
| | (0.12) | (0.12) | (0.11) | (0.10) | (0.12) | (0.12) | (0.12) | (0.11) | (0.10) | (0.12) |
| **Age Gap (Husband – Wife)** | | | | | | | | | | |
| | 1.96 | 1.93 | 1.89 | 1.83 | 1.91 | 1.47 | 2.28 | 2.79 | 2.59 | 1.81 |
| | (5.14) | (5.16) | (4.18) | (4.20) | (4.79) | (5.81) | (5.10) | (5.31) | (4.85) | (5.61) |
| **Sample** | 5,828 | 994 | 1,703 | 2,442 | 10,967 | 573 | 89 | 72 | 114 | 848 |

Calculations by authors. Standard errors in parentheses.

**Table 3a: Life Expectancy Measures, White Couples, Wife is Aged 60**

| | Her Life Expectancy | His Life Expectancy | Couple Life Expectancies: Joint | Survivor (Him) | Survivor (Her) | Probability that She is Survivor | Age Gap | Sample |
|---|---|---|---|---|---|---|---|---|
| **1930** | 16.05 | 12.93 | 9.98 | 8.59 | 10.88 | 0.56 | 3.35 | 12,638 |
| | (0.00) | (3.23) | (1.48) | (1.93) | (0.73) | (0.10) | (5.71) | |
| **1940** | 17.00 | 13.27 | 11.05 | 8.26 | 11.02 | 0.63 | 3.22 | 3,172 |
| | (0.00) | (3.16) | (1.69) | (1.76) | (0.82) | (0.10) | (5.59) | |
| **1950** | 18.64 | 14.16 | 12.06 | 8.48 | 11.74 | 0.65 | 2.85 | 3,587 |
| | (0.00) | (3.03) | (1.71) | (1.61) | (0.87) | (0.09) | (5.25) | |
| **1960** | 19.69 | 14.43 | 12.57 | 8.31 | 12.09 | 0.67 | 2.89 | 22,264 |
| | (0.00) | (3.46) | (1.99) | (1.73) | (1.05) | (0.10) | (5.75) | |
| **1970** | 20.79 | 14.54 | 12.88 | 8.43 | 12.90 | 0.69 | 2.71 | 11,537 |
| | (0.00) | (3.28) | (2.00) | (1.70) | (1.10) | (0.10) | (5.72) | |
| **1980** | 22.45 | 15.88 | 14.16 | 8.79 | 13.44 | 0.69 | 2.73 | 35,164 |
| | (0.00) | (3.22) | (2.02) | (1.47) | (1.18) | (0.09) | (5.08) | |
| **1990** | 23.09 | 16.83 | 15.00 | 9.02 | 13.37 | 0.68 | 2.77 | 36,509 |
| | (0.00) | (3.26) | (1.99) | (1.70) | (1.18) | (0.09) | (5.04) | |
| **2000** | 23.20 | 18.04 | 15.85 | 9.20 | 12.88 | 0.65 | 2.85 | 34,381 |
| | (0.00) | (3.54) | (2.12) | (1.53) | (1.25) | (0.10) | (5.00) | |
| **2010** | 24.49 | 20.17 | 17.68 | 9.46 | 12.49 | 0.63 | 1.92 | 11,589 |
| | (0.00) | (3.65) | (2.12) | (1.57) | (1.23) | (0.10) | (4.92) | |

Calculations by authors. Standard errors in parentheses.

**Table 3b: Life Expectancy Measures, Black Couples, Wife is Aged 60**

| | | | Couple Life Expectancies | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Her Life Expectancy | His Life Expectancy | Joint | Survivor (Him) | Survivor (Her) | Probability that She is Survivor | Age Gap | Sample |
| **1930** | 14.22 | 11.36 | 8.41 | 8.65 | 11.31 | 0.58 | 4.30 | 981 |
| | (0.00) | (3.01) | (1.38) | (2.13) | (0.52) | (0.09) | (7.38) | |
| **1940** | 16.10 | 12.47 | 9.42 | 9.37 | 12.52 | 0.60 | 4.49 | 240 |
| | (0.00) | (3.02) | (1.42) | (2.15) | (0.57) | (0.09) | (7.71) | |
| **1950** | 16.95 | 13.08 | 9.99 | 9.58 | 12.82 | 0.61 | 4.69 | 270 |
| | (0.00) | (3.21) | (1.45) | (2.19) | (0.61) | (0.08) | (7.08) | |
| **1960** | 17.83 | 14.15 | 10.98 | 9.87 | 12.67 | 0.61 | 2.95 | 1,424 |
| | (0.00) | (3.70) | (1.75) | (2.35) | (0.83) | (0.10) | (7.34) | |
| **1970** | 18.66 | 13.64 | 11.01 | 9.71 | 13.51 | 0.63 | 2.80 | 845 |
| | (0.00) | (3.00) | (1.70) | (2.00) | (0.82) | (0.09) | (7.63) | |
| **1980** | 20.42 | 14.38 | 12.03 | 9.43 | 14.02 | 0.67 | 3.28 | 2,439 |
| | (0.00) | (3.23) | (1.79) | (1.83) | (0.90) | (0.08) | (6.23) | |
| **1990** | 20.71 | 14.45 | 11.62 | 9.64 | 14.38 | 0.70 | 3.09 | 2,128 |
| | (0.00) | (3.28) | (1.91) | (1.97) | (1.01) | (0.09) | (6.44) | |
| **2000** | 21.00 | 15.89 | 13.36 | 9.57 | 13.32 | 0.65 | 2.99 | 2,315 |
| | (0.00) | (3.39) | (1.90) | (1.77) | (1.01) | (0.09) | (5.81) | |
| **2010** | 23.05 | 18.21 | 15.45 | 10.05 | 13.53 | 0.63 | 1.81 | 848 |
| | (0.00) | (3.72) | (2.11) | (1.77) | (1.19) | (0.10) | (5.61) | |

Calculations by authors. Standard errors in parentheses.

**Table 4: Distribution of Expected Mortality, She is aged 60, he is aged 62.**

| | | WIFE | | | | |
|---|---|---|---|---|---|---|
| | | **61-70** | **71-80** | **81-90** | **91-100** | **Total** |
| **HUSBAND** | **63-72** | 0.031 | 0.057 | 0.078 | 0.034 | 0.200 |
| | **73-82** | 0.045 | 0.084 | 0.114 | 0.050 | 0.293 |
| | **83-92** | 0.051 | 0.094 | 0.129 | 0.056 | 0.331 |
| | **93-102** | 0.027 | 0.050 | 0.068 | 0.030 | 0.175 |
| | **Total** | 0.154 | 0.285 | 0.390 | 0.170 | 1.000 |

**Appendix 1: Outline of Joint Life Expectancy Calculation for our Focal Couple: A Non-Hispanic White Woman aged 60 and a Non-Hispanic White Man aged 62.**

| Years | Wife's Age | Husband's Age | FQX | HQX | CQX | CMX | CLX | CDX | CL*X | CTX | CEX |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 60 | 62 | 0.006 | 0.012 | 0.018 | 0.019 | 100000 | 1837 | 99081 | 1659363 | 16.594 |
| 2 | 61 | 63 | 0.006 | 0.013 | 0.020 | 0.020 | 98163 | 1946 | 97190 | 1560281 | 15.895 |
| 3 | 62 | 64 | 0.007 | 0.014 | 0.021 | 0.022 | 96217 | 2067 | 95183 | 1463091 | 15.206 |
| 4 | 63 | 65 | 0.008 | 0.015 | 0.023 | 0.024 | 94150 | 2202 | 93049 | 1367908 | 14.529 |
| 5 | 64 | 66 | 0.008 | 0.017 | 0.026 | 0.026 | 91948 | 2349 | 90773 | 1274860 | 13.865 |
| 6 | 65 | 67 | 0.009 | 0.018 | 0.028 | 0.028 | 89599 | 2502 | 88348 | 1184086 | 13.215 |
| ….. | ….. | ….. | ….. | ….. | ….. | ….. | ….. | ….. | ….. | ….. | ….. |
| 34 | 93 | 95 | 0.164 | 0.262 | 0.395 | 0.502 | 1312 | 518 | 1053 | 2284 | 1.740 |
| 35 | 94 | 96 | 0.181 | 0.282 | 0.425 | 0.553 | 794 | 337 | 625 | 1231 | 1.550 |
| 36 | 95 | 97 | 0.199 | 0.303 | 0.455 | 0.607 | 457 | 208 | 353 | 605 | 1.326 |
| 37 | 96 | 98 | 0.218 | 0.325 | 0.485 | 0.664 | 249 | 121 | 189 | 253 | 1.015 |
| 38 | 97 | 99 | 0.238 | 0.346 | 0.515 | 0.724 | 128 | 128 | 64 | 64 | 0.500 |
| 39 | 98 | 100 | 0.258 | 1.000 | | | | | | | |

FQ(X): Female probability of dying between ages X and X+1 (from CDC Life Tables)
MQ(X): Male probability of dying between ages X and X+1 (from CDC Life Tables)
CQ(X) = Probability that the couple (i.e. either or both spouse) dies
= FQ(X)*MQ(X)+ FQ(X)*(1-MQ(X)) + (1-FQ(X))*MQ(X)
CM(X) = Couple Mortality rate = -ln(1-CQ(X))
CL(X) = Cohort Size. CL(X+1) = CL(X)*EXP(-CM(X))
CD(X) = Deaths per year = CL(X) – CL(X+1)
CL*(X) = Number of Cohort Couples lived between X and X+1 = CL(X+1) + 0.5CD(X)
T(X) = Person years remaining = $\sum_{X=1}^{X=39} CL * (X)$
CEX = Joint life expectancy = T(X)/L(X)