ON ESTIMATING THE PERCENTAGE OF PEOPLE WHO WILL NEVER MARRY

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In 1997 the Australian Bureau of Statistics estimated that if current marriage rates continued, some 40 per cent of Australian men and women would not get married. Though subsequently revised, this estimate has since been widely cited in academic and media discussions of the issue. This paper reviews the methods available to project marriage levels and concludes that the proportion of young Australians who will never marry will not rise above about 23 per cent for women and 27 per cent for men over the next decade or so.

Writing recently in the Opinion section of *The Age* newspaper, the popular writer, Hugh Mackay, stated:

> Although some ABS estimates suggest that, in the future, as many as 40 per cent of us may never marry, that still leaves a majority who probably will.[1]

Forty per cent never marrying during their lifetime is a very high figure compared to our recent experience in Australia and even compared to any historical experience, so this is a number that commands our attention. Hugh Mackay has obtained the 40 per cent estimate from the following quotation:

Based on age-specific first marriage rates for 1997 (calculated on the total population in each age group from 15 years and above) it is estimated that 56 per cent of males and 58 per cent of females will marry.[2]

That is, 44 per cent of men and 42 per cent of women will never marry. However, in the equivalent publication in the following year, ABS wrote:

> The proportion of people who will marry is declining. This can be estimated from first marriage rates by age for never married persons. Based on these rates in 1995 to 97 it is estimated that nearly 72% of men and 77% of women will marry in their lifetime. The corresponding proportions based on 1985 to 87 are 79% of men and 86% of women marrying in their lifetime.[3]

Thus, with little fanfare, the ABS changed its estimates from one year to the next by a very considerable amount. By the 1998 publication, the ABS estimates of the percentages who will never marry had fallen to 28 per cent for men and 23 per cent for women, a long way below the '40 per cent' estimate. The lower estimates have been repeated in the recently published 1999 publication. Hugh Mackay seems to continue to prefer the 1997 estimate.

TWO WAYS OF MEASURING THE SAME THING

The estimates changed between the 1997 and 1998 ABS publications because the ABS changed its method of estimation. A careful reading of the two quotations indicates that the first is based on 'age-specific first marriage rates for 1997 calculated on the **total** population in each age group' while the second is based on 'first marriage rates by age for **never married** persons' for the years, 1995 to 1997. The difference is not due to the different years to which the estimates refer. It is due to the different rates that are used: rates based on the total population (all persons) versus rates based on the never married population (persons who have never married). Just over a decade ago, a controversy erupted in the United States over this very same difference in estimates of the percentage of people who will never marry. Neil Bennett and David Bloom, two academics from Harvard and Yale, published an estimate calculated from rates based on the total population. Their estimate was then challenged by the US Bureau of the Census which published an estimate calculated from rates based on the never married population. This methodological demographic debate reached the national newspapers and the national TV networks in the United States at that time. Precisely the same debate appeared in the *Economic Record* in Australia in the early 1970s.[4] My own contribution to the early 1970s' debate is not as well-educated as the contribution that I am making here.

The equivalent methodological debate, this time related to the percentage of people who never have a child (childlessness), appeared in an issue of *People and Place* earlier this year.[5] In this instance, ABS had estimated that 28 per cent of Australian women would never have a child using rates based on the total population while Merlo and Rowland estimated that the figure was more like 20 per cent using rates based on the population who had never had a child.

Thus, the issue here is the relative merits of two approaches to the measurement of the percentage of people who never do something (marry, have a child, etc.) during their lifetime. Of course, we estimate this quantity by observing the percentage who **do** marry or have a child; the remainder, the 'survivors', are those that do not marry or have a child.

THE TWO APPROACHES TO MEASUREMENT: A SIMPLE EXAMPLE

Neither the 1997 nor the 1998 ABS publication indicates who it is that we are talking about when the prediction is made that a given percentage will not marry. The answer to this is that, formally, both measurement approaches indicate the percentage of today's 15 year olds that would marry by age 50 if the rates of marriage at each age between 15 and 50 were to remain constant for the next 35 years. This, of course, is a very large assumption because marriage rates tend to be volatile and constancy over a 35 year period is very unlikely indeed. Thus, the first point to be made is that we are dealing with largely hypothetical measures. Nevertheless, as will be described below, if we calculate these measures each calendar year, the trend from year to year provides an indication of where marriage is heading. From this perspective, the measure is useful. However, our problem is that we have two measures, both of which purport to measure the same thing but provide very different results.

Approach one: reduced events method

An understanding of the two measures can be obtained by using a simple example. Suppose there are 100 females aged 15 years and we follow this group until they reach age 50. None of them die and there are no additions or subtractions due to migration. That is, at age 50 there are still 100 women in the group. At each

Table 1

Age Range x	No. of marriages $M(x)$
From 15 to 19	2
From 20 to 24	22
From 25 to 29	28
From 30 to 34	14
From 35 to 39	6
From 40 to 44	2
From 45 to 49	2
TOTAL	76

year of age from 15 to 49, a certain number marry. To find the percentage who never marry, we would simply count up the number of marriages at each age and, at age 50, see how many of the 100 had not married. Suppose the numbers marrying in age ranges are as follows:

So, 76 of the 100 women marry, that is, 24 per cent remain never married. If the number marrying in each age range was indicated by the symbol, $M(x)$, then the total number of marriages is $\Sigma M(x)$.

So far, we have dealt just with numbers. The numbers in Table 1 can be converted to rates based on the total population by dividing the number of marriages in each age group by the total population at each age, $T(x)$, that is, 100. Thus, rates of first marriage based on the total population would be as shown in Table 2. These rates, to which I have given the symbol, $f_1(x)$, are sometimes referred to as first marriage frequencies. The proportion who ever marry is the sum of these rates across all ages, $\Sigma f_1(x)$. This is the method that the ABS has used to calculate its '40 per cent ' estimate in the 1997 publication. In the French demographic literature, this approach is referred to as the method of 'reduced events', because the number of events (marriages) at each age is 'reduced' to a common population size. In symbolic form, the proportion who ever marry using the 'reduced events' method is given by Equation 1:

Table 2

Age range	*M(x)*	*T(x)*	*fl(x)*
From 15 to 19	2	100	0.02
From 20 to 24	22	100	0.22
From 25 to 29	28	100	0.28
From 30 to 34	14	100	0.14
From 35 to 39	6	100	0.06
From 40 to 44	2	100	0.02
From 45 to 49	2	100	0.02
TOTAL			0.76

$$\Sigma f_1(x) = M(x) \,/\, T(x) \qquad \textbf{(1)}$$

Approach two: life table method

In the same example, as people marry we could take them out of the total population so that we were left only with the population who had never married. If we assume that the marriages in each age group (Table 1) are spread evenly through each age range, then the population who are never married at the mid point of each age range, $NM(x)$, is as shown in Table 3. If we then divide the number of marriages in each age group by the never married population at the mid point of the age range, we obtain the rates of first marriage based on the never married population to which I give the symbol, $m(x)$.

$$m(x) = M(x) \,/\, NM(x) \qquad \textbf{(2)}$$

These are the rates based on the never married population that the ABS used in its 1998 publication. We use life table methodology to convert these rates at each age to an estimate of the proportion of people who will ever marry. To make a life table (in this case, a nuptiality table), we convert the $m(x)$ values to probabilities of first marriage between the beginning and the end of each age range. In our example, the probability that a woman will marry between her 15th and her 20 birthday, q(15 to 19), is obtained from the equation:

$$q(x) = 2m(x) \,/\, [2+m(x)] \qquad \textbf{(3)}$$

The probability that she will not marry in the age range given that she was single at the beginning of the age range, $p(x)$, is given by the equation:

$$p(x) = 1 - q(x) \qquad \textbf{(4)}$$

The probability that she will not marry between her 15th and her 50th birthdays is the **product** of the *p(x)* values at each age, J *p(x)*. That is, if we multiply all the *p(x)* values successively by each other, we would find that the proportion of women who will never marry by age 50 is 0.2400. That is, 24 per cent of women would never marry. Thus using the more complex life table approach to estimation, we produce the same answer as simply counting up the number of marriages across the lifetimes of our 100 women (Table 1) or by adding up all the rates based on the total population (Table 2).

This demonstration shows that, the two measures used by the ABS, under the assumptions that we have made here, are equivalent. They are equally valid. So why did ABS get such different results from two equally valid methods? The answer lies in the assumptions behind the methods. The differences between the two measures arise *when the assumptions we have made here are not valid*. There are two assumptions made in the above simple example, one of which is the prime cause of the two different results.

THE IMPACT OF THE ASSUMPTIONS

The first and least troublesome assumption is that the size of the total population is not changed by death or migration. In a real population, these changes will occur. This is the reason that, in practice, we use rates, rather than simply adding up the number of marriages as was done in Table 1 above. Rates standardise numbers to a common denominator. We can then legitimately use the rates as we have done in Tables 2 and 3. The relaxation of the assumption that there are no deaths or migration does produce a difference between the two measures that we are investigating but it can be shown that this difference is trivial. The difference arises through the extent to which deaths and migration change the percentage of people at a given age who have never married. As deaths are very small in number under age 50 and as death rates do not vary greatly between never married and ever married persons under age 50, deaths have little impact on the percentage of the population who are never married at any age. Migration is selective of marital status with migrants being more likely to have never married than to have married. Nevertheless, the level of migration in any year is very small compared to the numbers in the population in that year, so that again the impact of migration on the percentage of the population who have never married is small.

It is the second assumption that causes all the trouble. The simple example in Tables 1 to 3 follows a group of women across their lifetimes as they age from 15 to 50 years (an age cohort). The estimates that the ABS published in their 1997 and 1998 do not do this. Instead, in the case of both measures, the rates at each age are the rates that apply to women at different ages in the same calendar year (an age cross-section). With the cohort assumption, women at age 30 have the

Table 3

Age range	*M(x)*	*NM(x)*	*m(x)*	Probability of marriage *q(x)*	Probability of not marrying *p(x)*
From 15 to 19	2	99	0.0202	0.0200	0.9800
From 20 to 24	22	87	0.2529	0.2245	0.7755
From 25 to 29	28	62	0.4516	0.3684	0.6316
From 30 to 34	14	41	0.3415	0.2917	0.7083
From 35 to 39	6	31	0.1935	0.1764	0.8236
From 40 to 44	2	27	0.0741	0.0715	0.9285
From 45 to 49	2	25	0.0800	0.0769	0.9231

same marriage experience up to age 30 as do women at age 50, because they are the same women. When cross- sectional data are used, women at age 30 have had a different marriage experience up to age 30 (the previous 15 years) than women at age 50 have had (20 to 35 years ago). If rates of marriage have been changing across time, the two methods will produce different estimates, as is described in the next section.

THE DIFFERENCE BETWEEN THE TWO MEASURES MADE EXPLICIT

In life table methodology, the probabilities of marriage at each age, $q(x)$, when applied successively to an initial standard population (say, 100,000 people), produce a number of people at each age who are still never married. Those surviving (still never married) at each birthday are designated by the symbol, $l(x)$, in the life table, and $l(x)$/100,000 provides an estimate of the proportion of the population who have never married. In a population, we record the population in terms of age at last birthday, not at the birthday itself. On average, age last birthday is $x + 0.5$. The population at age $x + 0.5$ in a life table is denoted by the symbol, $L(x)$ where:

$$L(x) = 0.5\ [l(x) + l(x+1)] \qquad \textbf{(5)}$$

In any population, the number of marriages at each age is obtained by multiplying the marriage rate based on the never married population, $m(x)$, by the number of people who are never married. In standardised form, rather than using the number of people never married at each age, we would use the proportion never married. Thus the standardised number of marriages in the nuptiality table population is:

$$f_2(x) = m(x)L(x)/100{,}000 \qquad \textbf{(6)}$$

and the percentage of people who ever marry is the sum of these values:

$$\Sigma f_2(x) = \Sigma\ m(x)L(x)/100{,}000 \qquad \textbf{(7)}$$

Equation 7 could be used to produce the estimate that the ABS used in its 1998 publication. In this form, its relationship to the method used in the 1997 publication can be made explicit. The method used in the 1997 ABS publication, the 'reduced events' method calculates the future percentage who will ever marry as in Equation 1, that is, as the sum of the $f_1(x)$ values. But we can rewrite $f_1(x)$ as follows:

$$\begin{aligned} f_1(x) &= M(x)/NM(x) \times NM(x)/T(x) \\ &= m(x) \times pnm(x) \qquad \textbf{(8)} \end{aligned}$$

where $pnm(x)$ is the proportion of people at age x in the actual population who have never married and, hence:

$$\Sigma\ f_1(x) = m(x) \times pnm(x) \qquad \textbf{(9)}$$

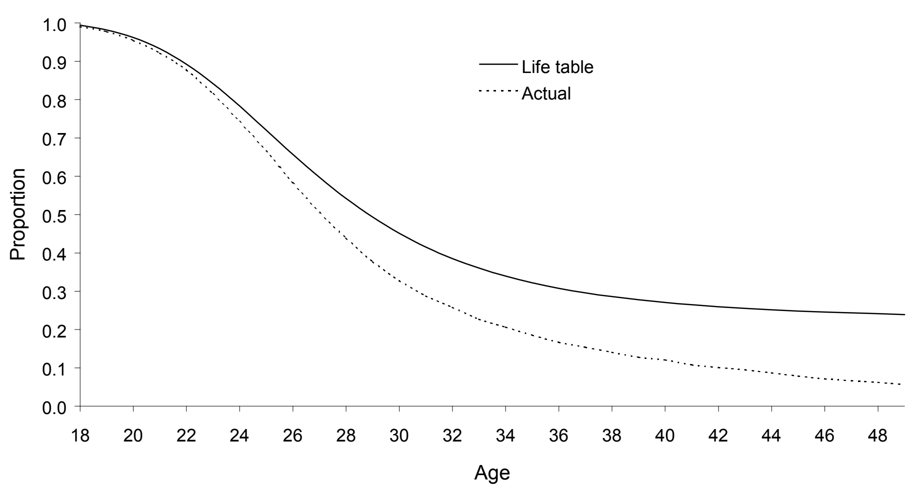
Equations 7 and 9 have a very similar form that enables us to give an explicit interpretation to the difference between the two methods. In Equation 7, the 'life table' method, the first marriage rates based on the never married population, $m(x)$, are weighted by the proportions never married at each age in the life table that is generated from the $m(x)$ values. These are the proportions never married that would be obtained at a **future** time in the population *if today's age specific first marriage rates were to remain constant over a long period of time* (about 35 years). In contrast, in Equation 9, the 'reduced events' method, the first marriage rates based on the never married population are weighted by the proportions never married at each age in the actual population in the year in which the marriage rates are calculated (1997, in this instance). The proportions never married at each age in the current or actual population are *the outcome of marriage rates over the* ***past*** *35 years*. Thus, the difference in the two measures is a result of the differences between these two distributions of the proportion never married at each age. The two distributions will only be the same if rates of first marriage at each age have been near to constant for a very long time.

PROPORTIONS NEVER MARRIED IN THE ACTUAL POPULATION AND IN THE LIFE TABLE

Figure 1 provides an example of the difference between the two distributions. The dashed, lower line shows the proportion never married at each age in the actual population of Australian women in 1999. The unbroken, upper line shows the proportions never married at each age that would emerge in a future population if the age specific first marriage rates at each age in 1999 were to remain constant for a long period into the future. It is evident that, particularly above age 30, the future or 'life table' proportions are considerably above those that apply in the actual population in 1999. It is this gap that causes the difference between the two measures. The very low proportions never married at older ages in the actual 1999 population are the result of the much higher rates of first marriage at younger ages that applied in the past in Australia.

The low actual 1999 proportions are clearly inappropriate as estimates of the proportions never married that will apply in Australia in the future. On the other hand, the high 'life table' estimates are indeed the proportions that will apply in Australia in the future if the 1999 first marriage rates at each age were to remain

Figure 1: Estimated proportion of the population never marrying by age, Australia, females, 1999



constant. In other words, the 'reduced events' approach (the '40 per cent estimate') is an extremely poor estimate of the likely future proportion of people who will never marry. On the other hand, the 'life table' approach provides an internally consistent estimate of the future proportion who will never marry *so long as age-specific first marriage rates remain constant at their current level*. However, a possible caveat to this statement is considered in the next section.

THE RELATIONSHIP BETWEEN CROSS-SECTIONAL AGE-SPECIFIC FIRST MARRIAGE RATES AND THE PROPORTION NEVER MARRIED IN THE POPULATION.

The age-specific first marriage rates in a given calendar year, *m(x)*, apply in a population in which the proportion never married is as it is in the actual population, *pnm(x)*. For example, at age 35 in 1999, the age-specific first marriage rate for Australian women was 0.050, that is, five per cent of 35 year-old women available to marry for the first time did so in that year. At that time, 18.5 per cent of 35 year-old Australian women had never married and, hence, were available for first marriage. There is a question that the rate of marriage at age 35 in 1999 may have been influenced by the proportion of women who remained never married at that age. That is, suppose the proportion never married in the population was higher, say 25 per cent , would this higher percentage have an effect on the marriage rate at age 35? Is the rate of marriage at a given age a function of the proportion who remain never married at that age? If this were to be the case, then, as the proportions never married increased at ages above 30 for each succeeding cohort because of more recent lower marriage rates at younger ages, the marriage rates at older ages may change consequently. This would mean that the assumption that marriage rates at all ages would remain constant into the future is invalid.

In fact, using 1999 age-specific first marriage rates held constant for many years into the future, the proportion of women who never marry by age 35 years in the population would rise from its present level of 18.5 per cent to 32.2 per cent . Would the movement from 18.5 per cent to 32.2 per cent stimulate a change in the marriage rate and hence affect whether or not the 32.2 per cent figure actually occurred? This is an empirical question that can be addressed by observing the changes over time in age-specific first marriage rates as proportions never married also change. Here, I have been able to examine only the years from 1992 to 1997. The age-specific first marriage rates for Australian women in this period are graphed in Figure 2. Two conclusions are evident. First, the rates at younger ages have fallen substantially across time reflecting the continuing shift to later ages of marriage. This trend leads to higher percentages being never married at older ages in later years. For example, at age 35, the percentage never married increased from 13.3 per cent in 1992 to 18.5 per cent in 1999. However, the second conclusion is that, from about age 30 onwards, the rates remained relatively unchanged across the period. For example, in 1992, the first marriage rate at age 35 was 0.047 compared with a rate of 0.050 in 1999. A similar picture was evident for men (not shown here). Hence, on the basis of these data, we would conclude that first marriage rates at older ages are relatively independent of the proportion of the population who remain never married. The relative independence conclusion was further confirmed by an examination of age specific first marriage rates for Australian women at ages 30 to 49 years from 1921 to 1965.[6] While there was some variation, rates of first marriage at older ages did not vary very much over this period of time and they were also close to those applying in the 1990s.

If there is any trend at all evident in Figure 2, it is that marriage rates at older ages tend to be higher in 1999 than in the earlier years. That is, first marriage rates at older ages tend to rise a little as marriage rates fall at younger ages in earlier years. The implication of this is that the 'life table' method may also produce an estimate of the future proportion that will never marry that is a little too high.

Finally, from Figure 2, it is important to note also that there has been very little change in age-specific first marriage rates in the past four years, 1996 to 1999. This suggests that the 25-year trend to later marriage and to higher percentages never marrying may be reaching its end point. Given this recent stability of marriage rates and the relative independence issue that I have just discussed, we can have greater confidence in the reliability of predictions of the future proportion who will never marry based on the 'life table' approach (Equation 7). We have shown this estimate to be less hypothetical in fact than was suggested above.

TRENDS IN THE TWO MEASURES, 1992 TO 1999

As intimated earlier in the paper, an examination of the trend in the two measures provides the final evidence that we can use to assess estimates of the likely proportion of people who will never marry. These trends are shown for both the 'reduced events' and the 'life table' methods for men and women in Australia from 1992 to 1999 (Figure 3). Throughout this period, there is a substantial difference for both men and women between the results deriving from the two measures. The difference between the measures arises because of the substantial and long-term nature of the shift to later

Figure 2: Age-specific first marriage rates, Australia, females, 1992 to 1999

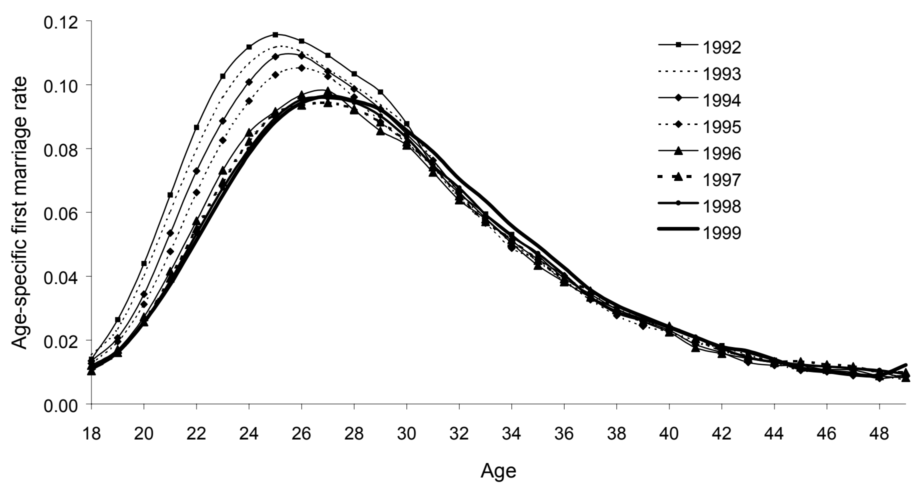
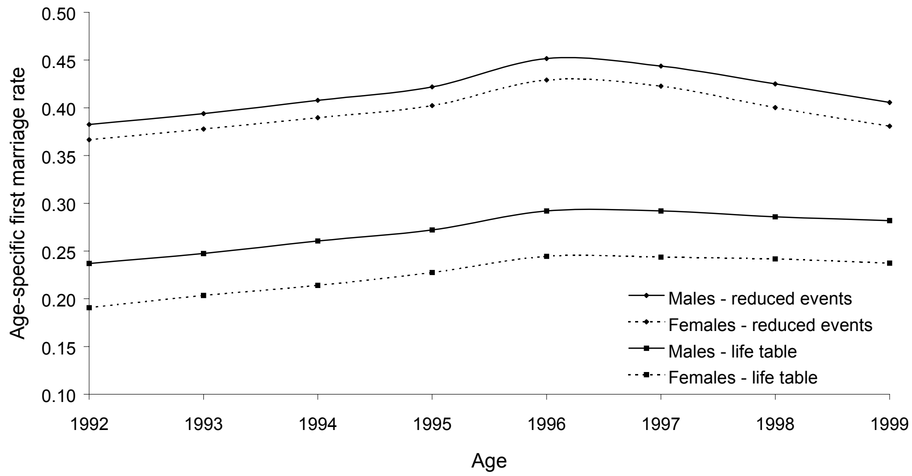


Figure 3: Estimated proportion of the population never marrying, Australia, 1992 to 1999



marriages in Australia. That is, far from the constancy required for the two meth ods to provide the same estimate, Australian first marriage rates below age 30 have changed enormously in the past 25 years. This means that present proportions never married at ages above 30 are very much lower than they will be in the near future and this leads to unreasonably high estimates of the proportion who will never marry in the future using the 'reduced events' method.

Estimates based on the 'reduced events' approach rise to 1996 and then turn downwards. By 1999, these estimates are falling sharply and, in a relatively short period of time, with relative constancy of age-specific first marriage rates, we would expect these rates to fall to meet the lower lines based on the 'life table' approach. The 'life table' estimates also have a point of inflexion at 1996. They rise to that point and then flatten out,even falling a little. The leveling out of these estimates indicates that rates of marriage at younger ages are no longer falling and that a relative level of constancy applies to these rates in recent years.

So, what percentage of Australians will never marry? The analysis above suggests, that on current trends, we would expect that the proportions of young Australians who never marry will not rise above about 23 per cent for women and 27 per cent for men in the next decade or so. At the 1921 census, 17 per cent of women aged 45 to 49 years had never married. By the 1981 census, this percentage had fallen to just four per cent. I am predicting here that within 20 years or so, this percentage will have risen to over 20 per cent. Hence marriage rates in the 20th century went through a long run swing from low to very high and are heading back to being low again. Can we expect to be free of these long-run swings in the 21st century?

References

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6 These rates were calculated by the author as part of his PhD thesis work.