IMPACT PROJECT

A Commonwealth Government inter-agency project in co-operation with the University of Melbourne, to facilitate the analysis of the impact of economic demographic and social changes on the structure of the Australian economy

MARRIAGE AND DIVORCE IN AUSTRALIA :

A TIME SERIES OF FITTED DISTRIBUTIONS,

1921/22 TO 1975/76

by

Pamela Williams

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IMPACT PROJECT RESEARCH CENTRE 153 Barry Street, Carlton 3053

Postal Address: Impact Centre, University of Melbourne, Parkville, Vic., 3052, Australia

Phones: (03) 345 1844 extensions 7417 & 7418
After hours (03) 341 7417 or 341 7418.

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1. INTRODUCTION

The IMPACT Project[1] is an inter-agency initiative of the Australian Government in co-operation with the University of Melbourne. Through the development of a suite of integrated economy-wide policy-analytic models, it has attempted to provide a systematic framework for the analysis of the impact of economic, demographic and social change on the structure of the Australian economy. One such model is BACHUROO, a large economic demographic model of population and labour supply, which is intended to model the size and skill composition of the Australian labour force. The demographic core of the BACHUROO model[2] has the task of tracking the evolution through time of the age, sex and marital status compositions of the Australian population and workforce.

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1. For a full discussion of the IMPACT Project and the BACHUROO module see Alan A. Powell, The IMPACT Project : An Overview, First Progress Report of the IMPACT Project, Volume 1 (Canberra: AGPS, 1977), and Alan A. Powell, "Aspects of the Design of BACHUROO, an Economic-Demographic Model of Labour Supply", in A.C. Kelley, W.G. Sanderson and J.G. Williamson (eds), Modelling Growing Economies in Equilibrium and Disequilibrium : Proceedings of an IIASA Meeting, 10-13 November 1980 (Oxford : Pergamon Press, 1981).

2. For discussion of the Demographic Core, see Dennis Sams, "The Demographic Core of the IMPACT Project : An Overview", IMPACT Preliminary Working Paper No. BP-18, Industries Assistance Commission, Melbourne, September 1979, and Dennis Sams and Pam Williams, "The IMPACT Project's Facility for Disaggregated Population Projections : A Brief Exposition and Progress Report", IMPACT Preliminary Working Paper No. BP-22, University of Melbourne, Melbourne, May 1980.

When attempting to model and project demographic phenomena, there are several aspects of demographic change which should be recognised. Firstly, there are well-defined relationships existing between some demographic variables. For instance, the stock of population by age, sex and marital status at the end of the year is simply the stock at the beginning of the year adjusted for the numbers of first marriages, divorces, remarriages, widowings, migrant arrivals, migrant departures, births, deaths and ageing which have occurred during the year. The demographic core ensures that such identities are maintained through its use of an integrated framework of demographic accounting, which allows for the achievement of consistency between demographic stocks and flows at a high level of disaggregation by age, sex and marital status. Secondly, there are some changes in demographic events which are directly influenced by the preceding history of demographic events via the current age and marital status profile of the population. For example, the number of nuptial births will be influenced by the number of married women (that is, the population "at risk" of a nuptial birth), which in turn will be influenced by the number of marriages, which in turn would have been influenced by the numbers "at risk" of marriage, in previous periods. The demographic core takes this into account by modelling and projecting demographic variables in terms of rates per numbers of persons "at risk". Finally, there are changes in demographic phenomena which are not explained by such direct relationships. They derive from changes in the economic and social structure of society, which are in themselves influenced by past demographic, economic and social changes. The demographic core accounts for these influences by allowing its projections of population and workforce to be derived from an econometric model of fertility, marriage, divorce and labour force participation. This econometric model takes into account the interrelationships between the demographic variables and explicitly incorporates

the effects upon them of important economic and social influences within an integrated model of the entire Australian economy. These novel features of the demographic core are discussed more fully in Sams and Williams.[1]

This paper concentrates upon one small part of the demographic core, namely, the preliminary data handling techniques which allow the modelling and projection of marriage and divorce. If the demographic core is to project the population by age, sex and marital status, it will require projections of the flows between marital states -- that is, the numbers of first marriages, divorces, remarriages of divorced persons, remarriages of widowed persons and widowings within the population. In this paper we consider the first four but not the last of these marital flows. Sufficiently disaggregated Australian data are available[2] to allow the calculation of age specific rates of first marriage, divorce, remarriage of divorces and remarriage of widows for single years of age from 15 to 100+ for financial years from 1921/22 to 1975/76, with further, but less reliable, data available for 1976/77 and 1977/78. These rates can be calculated, for each sex and for each single year of age, as the rates per number of persons "at risk"; that is, the ratio of the number of first marriages to

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1. See Dennis Sams and Pam Williams, op. cit..

2. The Australian Demographic Databank was used to provide these data. The Databank is documented in H.P. Brown and A.R. Hall, Australian Demographic Databank, Volume 1 : Recorded Vital Statistics 1921-1976 (Canberra: Research School of Social Sciences, Australian National University, 1978), and H.P. Brown and A.R. Hall, Australian Demographic Databank, Volume 2: Population Estimates and Demographic Rates 1921-1976 (Canberra: Research School of Social Sciences, Australian National University, 1980), and has been supplemented by unpublished information kindly provided by Alan Hall. The methods used to derive the data series actually used are detailed in Pam Williams, Clive Brooks and Dennis Sams, "The Data Requirements of the Population Submodule of the Demographic Core", IMPACT Research Memorandum, BACHUROO Module, May 1980.

the number of never marrieds, the ratio of the number of divorces to the number of marrieds, and the ratio of the number of remarriages of divorcees and of widows to the number of divorcees and widows respectively. It is these rates which the demographic core attempts to model and project in terms of their economic and social determinants. However, they represent an enormous amount of information which would be extremely difficult to model accurately or consistently. In order to maintain the high level of disaggregation required in the demographic core, it is therefore necessary to condense the age specific rates of marriage and divorce into a manageable number of interpretable descriptive statistics, which capture changes in the underlying determinants of demographic change and are amenable to econometric estimation. This is achieved by approximating the age specific rates for first marriage, divorce and remarriage of divorced and widowed persons in each year by a smooth curve across the age distribution, which can be determined in each case by a few descriptive statistics.[1] Each of these eight smooth distributions across age (one each for first marriages, divorces, remarriages of divorcees and remarriages of widows for each sex) in each year is parameterized by three variables; the mean and variance of, and the area under, the smooth approximating age distribution. The fitting of these smooth approximating distributions therefore enables the eighty-six individual age specific rates for any one marital status flow for each sex in any one year to be condensed to three descriptive parameters. It is the time series of these descriptive parameters which are modelled econometrically. Essentially, therefore, projections of marriage and divorce in a given period will require projections of the numbers at risk of marriage and divorce at the beginning of the period (which are available from the population projections of the

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1. A similar approach has been applied by Coale to marriages and fertility; see Ansley Coale, "The Development of New Models of Nuptiality and Fertility" in Population, S1 (1977).

previous period) and projections of the age specific rates of marriage and divorce (which can be calculated from a knowledge of the functional form of the smooth approximation to the age distribution of, and projections of the descriptive parameters for, marriage and divorce). Some adjustments to these projected numbers of marriages and divorces are then necessary to ensure that the marriages and divorces of females and males coincide.

This paper documents only the first stage in this process of modelling and projecting marriage and divorce -- the derivations of the initial smooth approximations to the age distributions of, and the time series of descriptive parameters for, first marriage, divorce and remarriage of divorced and widowed persons of each sex. The time series of these descriptive parameters must then be modelled and projected, using an econometric model which relates marriage and divorce to their economic and social determinants. For females, the parameters are modelled as part of the model of marriage and divorce estimated originally by Filmer and Silberberg[1] and revised and reestimated by Brooks, Sams and Williams.[2] The specification of the model derives from the "new home economics" and the Becker model of marriage, which applies the framework of constrained choice to the marriage decision.[3] Briefly, Filmer and Silberberg assert the following:

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1. R. Filmer and R. Silberberg, "Fertility, Family Formation and Female Labour Force Participation in Australia, 1922-74", IMPACT Preliminary Working Paper No. BP-08, Industries Assistance Commission, Melbourne, 1977.

2. Clive Brooks, Dennis Sams and Lynne Williams, "An Econometric Model of Fertility, Marriage, Divorce and Labour Force Participation for Australian Women, 1921/22 to 1975/76", IMPACT Draft Preliminary Working Paper, November 1981.

3. The seminal articles are G.S. Becker, "A Theory of Marriage, Part 1", Journal of Political Economy, Vol.81, July/August 1973, pp. 813-816, and "A Theory of Marriage, Part 2", Journal of Political Economy, Vol.82, March/April 1974, pp. S11-S33. Also, for a useful collection of papers defining the scope of the "new home economics", see T.W. Schultz (ed.) Economics of the Family, A Conference Report of the National Bureau of Economic Research (Chicago and London: University of Chicago Press, 1973).

> "The decision to marry can then be viewed in two stages. First, a person decides when to enter the marriage market. The age of entry into the marriage market would be earlier the larger the demand for child services and the higher the expected life-time income. On the other hand, as alternatives to marriage become more attractive to women, they will postpone entry at the margin. Obvious alternatives are schooling and labour force participation. Second, once in the marriage market, a person searches for an appropriate partner. The length of period of search will be influenced by the perceived additional benefits of searching to find an improvement in the prospective mate relative to the cost of time and other inputs necessarily involved in further search. The model of marriage concentrates on the factors which might influence the age of entry into the marriage market and the length of the period of search."[1]

Filmer and Silberberg also assert that

> "The factors which influence the divorce decision are basically asymmetrical to the decision to get married."[2]

Details of the final specifications are given in Brooks, Sams and Williams.[3] A similar approach is used for the modelling of the marriages and divorces of males. Once these projections of the parameters of marriage and divorce have been made, the first approximations to female and male marriage and divorce can be calculated. These approximations must then be adjusted, using a two-sex model of marriage and divorce,

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1. R. Filmer and R. Silberberg, op. cit., p. 24.
2. Ibid., p. 31.
3. Clive Brooks, Dennis Sams and Lynne Williams, op. cit., p.4ff.

to ensure consistency between the numbers of marriages and divorces of females and males.[1]

The following section, which may be omitted by those less mathematically inclined, provides details of the approximating technique for fitting smooth functions to the age distributions of first marriage, divorce and remarriage. The remainder of the paper gives a discussion of the changes which have occurred over time in the numbers and rates of first marriage, divorce and remarriage in Australia; an evaluation of the success of the smooth approximation technique for representing the age specific rates and their changes over time; and a discussion of the time series of descriptive parameters.

1. Details of the two-sex marriage and divorce model are given in Dennis Sams, "A Two-sided Marriage Model for the IMPACT Population Projection Facility", IMPACT Research Memorandum, BACHUROO Module, November 1981.

2. THE APPROXIMATING TECHNIQUE

After examining several alternative smooth mathematical distributions, the gamma distribution was chosen to approximate the age distributions of the age specific rates of first marriage,[1] of remarriage and of divorce.[2] The probability density function of the gamma distribution is

$$(1) \qquad f(x) = \begin{cases} \frac{1}{\beta^{\alpha}\Gamma(\alpha)} \, x^{\alpha-1} \, e^{-x/\beta} & , \quad \text{for } x \geq 0 \ , \\ 0 & , \quad \text{for } x < 0 \ , \end{cases}$$

where α and β are the parameters of the gamma distribution and are related to its mean, M, and variance, V, as follows:

$$(2) \qquad M = \alpha\beta \ ,$$

and

$$(3) \qquad V = \alpha\beta^2 \ .$$

$\Gamma(\alpha)$ is the gamma function,

$$(4) \qquad \Gamma(\alpha) = \int_0^{\infty} x^{\alpha-1} \, e^{-x} \, dx \qquad (\alpha > 0) \ ,$$

which has the properties that

$$(5a) \qquad \Gamma(\alpha) = (\alpha-1) \, \Gamma(\alpha-1) \ ,$$

and

$$(5b) \qquad \Gamma(n) = (n-1)! \ .$$

---

1. Unfortunately, a simple gamma distribution was not adequate for capturing the age distribution of the age specific rates of first marriage. Instead, a variation to the approximating technique was applied for first marriages. For ease of comprehension, this variation is ignored in the following description of the approximating technique and is discussed at the end of the section.

2. The gamma function is discussed in M. Abramowitz and I.A. Stegun (eds), Handbook of Mathematical Functions (New York: Dover Publications Inc., 1965), p. 255ff.

if n is an integer. In Figure 1, graphs of gamma densities for several values of α and β give some indication of the dependence of the shape of the gamma function on these parameters.

From (1), the gamma approximations to the age specific rates of first marriage, of divorce or of remarriage at time t are given by

$$(6) \qquad p_t(x) = P_t \left\{ \frac{1}{\beta_t^{\alpha_t} \Gamma(\alpha_t)} (x-x_0)^{\alpha_t - 1} e^{-(x-x_0)/\beta_t} \right\} ,$$

where

$p_t(x)$ is the ratio of first marriage, or of divorces, or of remarriages, to numbers at risk for persons aged x in year t.

P_t is the index of propensity to first marry, or to divorce, or to remarry in year t. (This index is required as a scaling factor since the gamma distribution has a probability density with area equal to unity.)

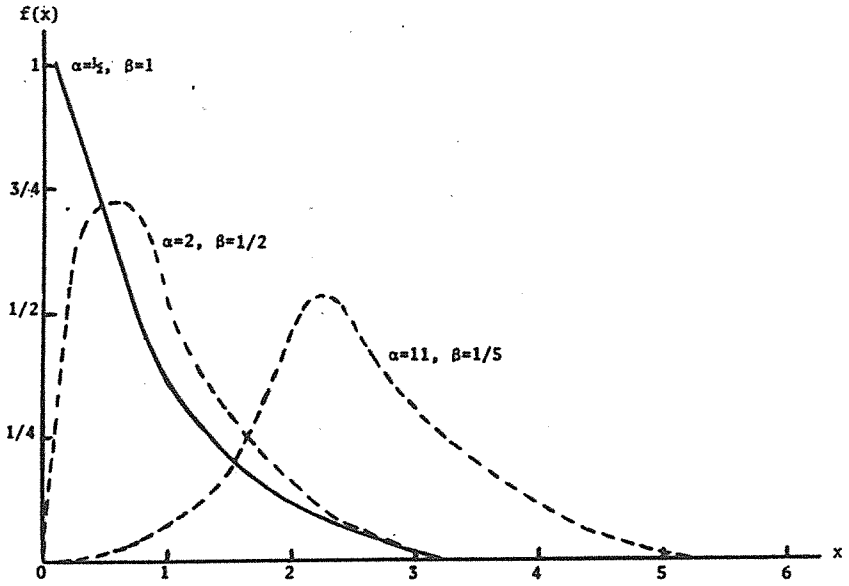
x_0 is the starting point of our gamma approximation. (For legal and social reasons, first marriage, divorce and remarriage rates will be zero before a certain age is reached, and x_0 corresponds to the last age at which a zero rate occurs.[1])

1. x_0 was chosen by observation of the data and takes the following values:

	First Marriage		Divorce		Remarriages of Divorcees		Remarriages of Widows	
	Female	Male	Female	Male	Female	Male	Female	Male
Pre-World War II	14	15	16	18	16	18	16	17
Post-World War II	15	15	15	17	15	17	15	17

FIGURE 1

TYPICAL GAMMA DISTRIBUTIONS



Source: J.E. Freund, Mathematical Statistics, Second Edition (London: Prentice-Hall International Inc., 1970), p. 114.

The parameters of the gamma approximation, α_t and β_t, are directly related to the mean, M_t, and the variance, V_t, of the age distribution of the age specific rates of first marriage, or of divorce or of remarriage in any given year t.[1] The relationship is

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1. The propensity, mean and variance used in this analysis are derived from the age distribution of age specific rates per number of people at risk. The index of propensity to first marry, divorce or remarry is a measure of the area beneath the age distribution of age specific rates of first marriage, divorce or remarriage and is given by

$$P_t = \sum_{x=x_0}^{100} p_t(x) \quad .$$

The mean of the age distribution of age specific rates is given by

$$M_t = \sum_{x=x_0}^{100} x.p_t(x)/P_t \quad ,$$

and the variance of the age distribution of age specific rates is given by

$$V_t = \left\{ \sum_{x=x_0}^{100} x^2 \, p_t(x)/P_t \right\} - M_t^2 \quad .$$

These measures are used because they summarise the age distribution of age specific rates. However, these measures are not directly comparable with other commonly used measures. For example, the average age at, say, divorce is usually calculated as

$$\frac{\sum_x (x.D(x))}{\sum_x D(x)} \quad ,$$

where $D(x)$ is the number of divorces of persons of age x. However, the mean of the age distribution of the age specific rates of divorce, is calculated as

$$\frac{\sum_x \left(x.\frac{D(x)}{n(x)} \right)}{\sum_x \left(\frac{D(x)}{n(x)} \right)} \quad ,$$

where $n(x)$ is the number of persons of age x at risk of divorce. These two measures will be equivalent for arbitrary $D(x):(D(x) \leq n(x))$ only if the number of people at risk is the same for all ages.

(7) $$M_t = \alpha_t \beta_t + x_0 \ ,$$

and

(8) $$V_t = \alpha_t \beta_t^2 \ .$$

The observed age specific rates of first marriage, divorce and remarriage are replaced by the gamma distribution with the "best" fit obtained by minimizing the normalized sum of the squares of the difference between the actual number of first marriages, divorces or remarriages respectively at each age and that given by the approximating curve, and the number of persons "at risk" of first marriage, divorce or remarriage respectively. Algebraically, the minimand for a given period is[1]

(9) $$R = \sum_{x=x_0}^{100} \left\{ [h(x) - p(x)] \cdot \frac{n(x)}{N} \right\}^2 \ ,$$

where

R is the normalized sum of the squared residuals

h(x) is the historical rate of first marriage, of divorce or of remarriage for persons of age x

n(x) is the number of persons of age x who are at risk of first marriage, of divorce or of remarriage

and

N is the total number of persons of all ages at risk of first marriage, of divorce or of remarriage.

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1. For typographical ease, t subscripts are omitted in (9) and elsewhere, provided there is no risk of resultant confusion.

This minimand was chosen as the criterion of fit because it was considered more important to minimize the errors in the number of marriages (or divorces) rather than errors in the age specific rates. The minimum of the sum of squares was determined by iterating on the parameters, α, β and $A = P/\beta^{\alpha}\Gamma(\alpha)$, following a search technique attributable to Peckham.[1]

The time series of these fitted approximations to the age distributions of age specific rates of first marriage, of divorce and of remarriage allow the calculation of time series of approximated means, $\tilde{M}_t$, variances, $\tilde{V}_t$, and propensities, $\tilde{P}_t$, of first marriage, of divorce and of remarriage. These parameters can then be modelled econometrically and projected according to an econometric model and chosen scenarios of economic and social variables. The projected values of the means and the variances of the age distributions can then be used to calculate projected values for α,

$$\bar{\alpha}_t = \frac{(\bar{M}_t - x_0)^2}{\bar{V}_t} \quad , \tag{10}$$

and β,

$$\bar{\beta}_t = \frac{\bar{V}_t}{(\bar{M}_t - x_0)} \quad . \tag{11}$$

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1. G. Peckham, "A new method for minimizing a sum of squares without calculating gradients" in Computer Journal, Vol.15, 1970, pp. 418-420.

$\bar{\alpha}_t$ and $\bar{\beta}_t$ can then be substituted into the gamma distribution given by equation (6),

$$(12) \qquad \bar{P}_t(x) = \bar{P}_t \left\{ \frac{1}{\bar{\beta}_t^{\bar{\alpha}_t} \Gamma(\bar{\alpha}_t)} (x-x_0)^{\bar{\alpha}_t - 1} e^{-(x-x_0)/\bar{\beta}_t} \right\} ,$$

to enable the calculation of $\bar{p}_t(x)$, which is the projected rate of first marriage, of divorce or of remarriage to numbers at risk for persons of age x in period t .

Unfortunately, the age distributions of the age specific rates of first marriages for females and males were not accurately captured by the simple gamma distribution described in this section. The gamma distribution was unable to capture the rates for both young and older persons, so it was necessary to use another smooth approximation. The smooth approximation adopted for first marriages is the sum of two gamma distributions; one which approximates the young and peak age rates and another which approximates the difference between the rates at older ages and those given by the peak rate approximation. In order to minimize the number of time dependent parameters necessary to specify the total distribution, the second distribution is held constant (except that the distribution used differs in the pre-war and post-war periods). As the parameters are fixed, and therefore known in projection, the projected rates of first marriage can be calculated from projected values of the mean age, variance in age and propensity of first marriage. Details of the approximating technique for first marriages are given in Appendix 1.

3. DATA AND RESULTS

Data on the first marriages, divorces and remarriages of Australian females and males for the period 1921/22 to 1975/76 are provided by the Australian Demographic Databank.[1] The age distributions of the age specific rates of first marriage, of divorce and of remarriage were approximated by gamma distributions according to the procedure outlined in Section 2. These gamma distributions provide time series of descriptive parameters which can then be modelled econometrically. The success of the proposed technique of characterizing the age distributions by gamma approximations can be measured by its ability to reproduce the historical age distribution, and by the gain in the precision of subsequent econometric time series estimates due to noise being filtered out of measured means, variances and propensities. The latter is not considered in this paper.

In this section, the historical data will be examined and comparisons will be made between the historical and gamma distributions. If the gamma approximation is seen as representing the underlying distribution of first marriage, divorce or remarriage rates, the rates given by the gamma distribution can be interpreted as the "expected" values of the historical rates. Hence, the historical rates for each age should vary randomly about the rates given by the gamma distribution. Whilst an exact fit to these historical rates is not expected, any consistent pattern of discrepancy would indicate misspecification. It should be kept in mind, however, that the gamma approximations were

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1. See footnote 2 on page 3 for details.

fitted by minimizing errors in the numbers of marriages or divorces at each age, rather than the age specific rates. Therefore, the fitted distributions of the age specific rates may not always closely approximate the historical distributions for those age groups in which there are very few first marriages, divorces or remarriages.

The reason for the special emphasis given to obtaining good approximations to the total numbers of first marriages, remarriages and divorces, relates to the ultimate use of the demographic model; namely, in simulations designed to track the stocks of various elements of the population. Given this emphasis the mean error between the historical and the approximated number of first marriages, divorces or remarriages should be close to zero, and there should be no consistent pattern of positive or negative mean errors over time.[1] The root mean squared

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1. The mean error in a given year between the historical and approximated numbers of first marriages, of divorces or of remarriages is calculated as

$$\bar{e} = \sum_{x=x_0}^{100} \{[p(x) - h(x)].n(x)\} \Big/ \sum_{x=x_0}^{100} N(x) \quad ,$$

where $h(x)$ is the historical rate of first marriage, of divorce or of remarriage to numbers at risk for persons of age x ,

$p(x)$ is the gamma approximation to the rate of first marriage, of divorce or of remarriage to numbers at risk for persons of age x ,

$n(x)$ is the historical number of persons of age x at risk of first marriage, of divorce or of remarriage ,

$N(x)$ is the historical number of first marriages, of divorces or of remarriages for persons of age x , and

x_0 is the starting point of the gamma approximation which was chosen by observation of the data and takes the values given in footnote 1 on page 9.

error for the number of first marriages, divorces or remarriages[1] is a measure of the accuracy with which the gamma distribution is able to approximate the number of first marriages, divorces or remarriages for each individual age. If the gamma approximation were such that there were only random differences between itself and the historical distribution, the root mean squared error would be attributable to sampling variation and would show no consistent trend over time. These two measures, the mean error and the root mean squared error, will therefore be useful in evaluating the performance of the approximations.

The crucial aspect of the modelling technique proposed is the parameterization of the age distributions by three descriptive parameters -- the index of propensity, the mean and the variance. As the gamma approximations represent the underlying age distributions of first marriage, divorce and remarriage, their parameters should capture the important movements in marital status change behaviour, without being unduly affected by the noise inherent in historical data. These parameters are to be modelled econometrically, so their time series are of interest; they are presented in tabular form in Appendix 2, and are illustrated and discussed later in this section.

In the balance of this section are presented the results of the implementation, over the period 1921/22 to 1975/76, of the approximating technique described in Section 2. For first marriages, divorces and

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1. The root mean squared error between the historical and approximated number of first marriages, of divorces or of remarriages is calculated as

$$\overline{e^2}^{\frac{1}{2}} = \sqrt{\left\{ \sum_{x=x_0}^{100} [(p(x) - h(x)).n(x)]^2 \right\} \Big/ \sum_{x=x_0}^{100} N(x)} \quad ,$$

where these symbols are defined in footnote 1 on page 16.

remarriages of divorcees and widows respectively, there will be, firstly, a discussion of data sources and reliability and of the effects of legislative change; secondly, an analysis of general trends over the sample period, including some discussion of the major demographic determinants of these trends; thirdly, a description of the age distributions of the age specific rates and of the numbers at each age and an analysis of the approximations to these age distributions; fourthly, an assessment of the accuracy of the approximations; and, finally, a description of the parameters of the approximations to the age distributions and some discussion of their demographic, economic and social determinants. As discussed in Section 2, first marriages were approximated using a modification of the simple gamma distribution. The final method for first marriages, which is described fully in Appendix 1, consisted of adding a time variant gamma distribution to the gamma approximation in order to improve the fit at older ages.

3.1 First Marriages

(a) Data and the effects of legislative changes

Australian marriage data are derived from compulsory registrations of marriage. Registration data are accurate and there is no evidence to suggest any substantial changes in the propensity to register marriages, or the timing of such registrations. Information concerning the previous marital status of both parties to the marriage has been collected for the entire sample period, so that accurate data on first marriages and remarriages are readily available.

First marriages have been subject to the influence of changing legislation. In 1963, the Marriage Act 1961 came into operation. The Act

stipulated minimum legal ages for marriages; 16 years for females and 18 years for males. This legislation, although already in force to greater or lesser degrees of effectiveness in the less populous states of Tasmania, Western Australia and South Australia, had a dramatic effect on first marriage rates for young people below the minimum ages. The dramatic lowering of first marriage rates at below minimum age has been sustained since 1963, suggesting that the legislation is retaining its force, despite provisions allowing for the minimum age to be waived in certain circumstances.[1] The legislation forces a discontinuity in the first marriage rates data for young females and males and this should be considered when attempting to simulate and project these rates. The likelihood of future legislation to change minimum ages at marriage seems slight, although the Royal Commission on Human Relationships recommended that the marriageable age for males be lowered to 16 years and that persons below marriageable age should not be given special permission to marry under any circumstances.[2] The possibility of such legislative change should therefore be considered when projecting first marriage rates for young persons.

More recently, in 1973, legislation lowered the minimum age at which a person could marry without parental consent from 21 to 18 years. McDonald, using first marriage data by age in years and months, showed that, prior to this legislative change, the rate of first marriage for brides

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1. For a full description of the effects of this legislation on marriage, see Peter F. McDonald, Marriage in Australia, Age at First Marriage and Proportions Marrying, 1860-1971, Australian Family Formation Project Monograph Number 2, Department of Demography, Institute of Advanced Studies, Australian National University, Canberra, 1974, p. 12ff.

2. See Royal Commission on Human Relationships, Final Report : Volume 1 (Canberra : Australian Government Publishing Service, 1977), p. 112.

and grooms aged 21 years and no months was significantly higher than that of those aged 20 years and 11 months.[1] This substantial difference is the result of parents refusing to consent to the marriage of children under 21 years and to persons voluntarily delaying marriage until consent is not required. According to McDonald,

> "Marriages, hitherto prevented by the absence of parental consent will, presumably, occur at the age at which the couple wish to marry now that the age of majority has been lowered to 18 years. This change will occur in the short term, but is difficult to estimate how much of the rise at age 21 results from this factor. In the long term, age 21 will lose some of its 'aura' and persons who preferred to wait until they were 21 before marrying may be induced to marry at a younger age."[2]

This suggests a relative increase in first marriages at ages below 21, and, ceteris paribus, a fall in the age at first marriage. This has in fact occurred for both females and males. For example, in 1965/66, 18.0% of all female, and 6.8% of all male, first marriages involved persons under 21 years of age, whereas in 1975/76, the relevant figures were 19.7% for females and 8.3% for males. Hence the relative contribution to the total number of marriages by persons under 21 years has increased. This has been experienced despite the fact that the legislative change occurred in a period when other economic and social forces were prompting increases in the age

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1. See Peter F. McDonald, op. cit., p. 25.

2. See Peter F. McDonald, ibid..

at first marriage for both females and males. Thus, even in the short term, only two years after the introduction of the legislation, the "aura" of age 21 has been mitigated to some extent. In the long term, this could be expected to continue.

(b) General trends

The major demographic, economic and social changes which have occurred between 1921 and 1976 in Australia have substantially affected first marriages. Some illustration of these effects is provided by Figures 2 and 3 which depict total numbers of first marriages and the overall first marriage rate[1] for females and males in each year. Following World War I there was a "catch-up" of marriages, so in the early 1920's the number and overall rate of first marriage for both females and males fell from formerly high levels. However, the prosperous economic conditions of the 1920's were soon reflected in a general upward trend in first marriages and the overall first marriage rate. The onset of the Depression of the 1930's reversed this trend. The overall first marriage rate (which is more instructive as an indicator of the broad changes in first marriage behaviour for it abstracts from changes in the population at risk of first marriage) plummetted and did not recover its pre-Depression level until the late 1930's. As the Depression receded, the numbers and overall rate of first marriage increased, suggesting that marriages deferred during the Depression were being "made up".[2] Both

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1. The overall first marriage rate is calculated as the total number of first marriages in a given period divided by the total number at risk of first marriage at the beginning of the period; that is, the number of never married persons aged 15 years and over.

2. See Geraldine Spencer, "Recent Trends in First Marriages in Australia" in Economic Record, Vol.45, No.110, June 1969, p. 206.

FIGURE 2

FIRST MARRIAGES OF AUSTRALIAN FEMALES (++)AND MALES (—), 1921/22 TO 1975/76

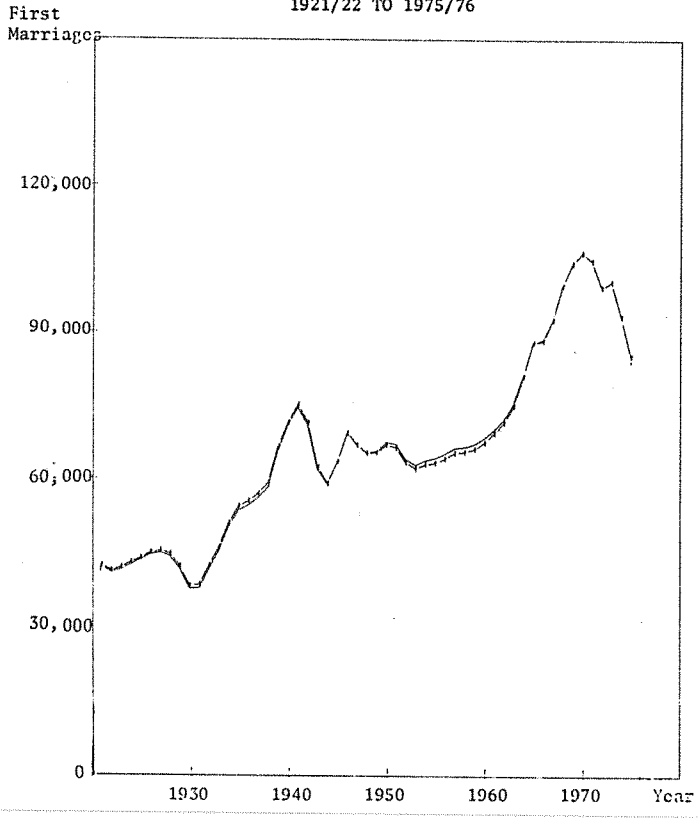
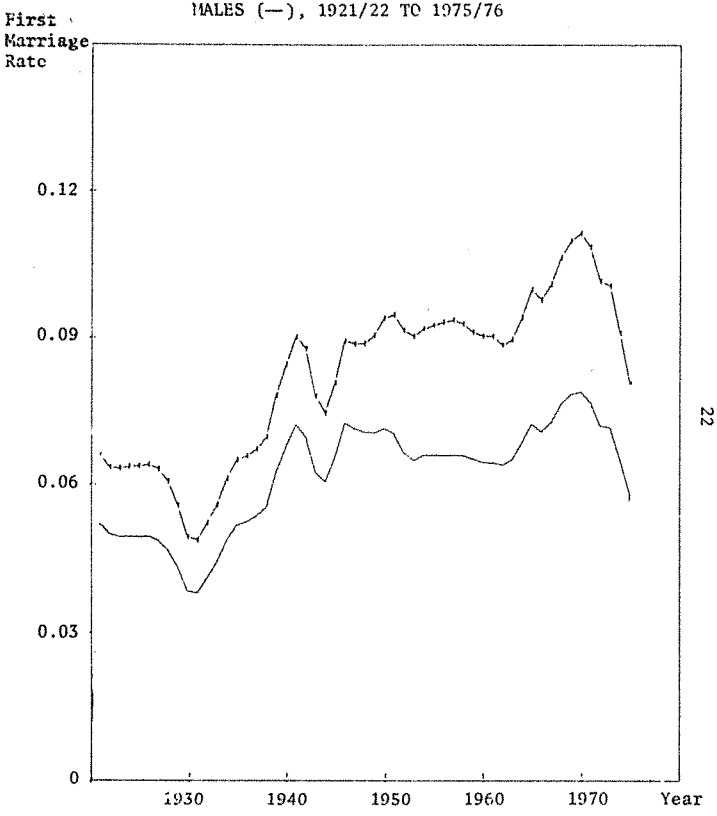


FIGURE 3

OVERALL FIRST MARRIAGE RATE FOR AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76



measures continued to increase beyond their pre-Depression levels and then increased more rapidly with the commencement of World War II, as marriages were brought forward.[1] Due to wartime difficulties and the absence of males abroad, the number of marriages fell during the war, and only began to increase again after its cessation. Whilst the overall rate of first marriages also fell during the war, it was surprising that it never fell below its pre-war levels before it rose again at the end of the war. It could reasonably have been expected that, after a period of catch-up at the end of the war, the number of first marriages and the overall first marriage rate would have fallen back to more "normal" pre-war levels. However, both measures continued to remain at high levels during the 1940's and 1950's, and then increased in the 1960's. An obvious shift towards more universal marriage occurred during the 1930's and 1940's. This was sustained during the 1950's and became more pronounced in the prosperous 1960's. However, since 1970, the number of first marriages and the overall first marriage rate for females and males has fallen dramatically. In 1975/76 the rates reached their lowest levels since World War II.

It is interesting to note the differences in the marriage behaviour of females and males over the period. The total number of marriages of females in any period must equal that of males, but the division of these marriages between first marriages and remarriages may differ between the sexes. The numbers of first marriages of females and males, as shown in Figure 2, exhibited similar trends over the entire period, except for an excess of female first marriages over male in the pre-war period, and an excess of male first marriages over female in the

1. For a discussion of the reasons for the bringing forward of marriages see Peter F. McDonald, op. cit., p. 116.

1950's and early 1960's. Overall first marriage rates for females and males, as shown in Figure 3, also exhibited similar trends but the female rate consistently and substantially exceeded the male rate, especially in the 1950's and early 1960's. Explanations for these differences between female and male marriage behaviour may lie in the imbalance between the numbers of eligible females and males and in the observed preferences of males and females for partners of a particular marital status.[1] For the greater part of Australia's history since European settlement, there has been a relative surplus of males, such that the marriages choices of females have been enhanced by the abundance of suitable partners, and the marriage choices of males have been constrained by the dearth of suitable partners. In the pre-war period, partly as a result of the deaths of Australian males during World War I, the surplus of males was at its lowest level for the entire period. Hence, women were relatively constrained in their choice of partners and men were more able to exercise their choice. Conversely, in the 1950's and early 1960's, as a consequence of the huge influx of marriageable aged migrant males, the surplus of males reached its highest level for the period. If we postulate that there is, in general, a preference to marry persons who have not previously been married, in the pre-war period we would expect the marriages of females to be more likely to be first marriages, and the marriages of males to be less likely to be first marriages, and the converse to occur in the 1950's and early 1960's. Whilst the data supports this simplistic hypothesis, marriage behaviour over the period was also affected by changes in the age distribution of persons at risk of first marriage and in the relative numbers of marriageable females and males of other marital states.

Future general trends in first marriages are difficult to predict. It is not possible to ascribe the recent decline in first marriages as totally due to changes in the demographic structure of the population at risk of

1. Ruth B. Dixon, "Late Marriage and Non-Marriage as Demographic Responses: Are They Similar" in Population Studies, Vol. 32, No.3 (November 1978) warns against placing too much emphasis on numerical imbalances as determinants of marriage behaviour; changing economic conditions are probably more important.

marriage or to changes in general economic conditions. The explanation is also likely to lie in the effects of the changing status of women, the improved educational opportunities of young people, the increased availability and effectiveness of contraception and changing social attitudes towards an ethic of the "proper time to marry", which have prompted young people to defer marriage in the 1970's.[1] The extent to which this deferment will be "made-up" remains to be seen. Current trends with respect to the delaying of marriage and increasing numbers of consensual unions suggest that the high rates of marriage experienced during the 1950's and 1960's will not be a feature of future marriage patterns.

(c) The age distributions and their approximations

In this study, the age distributions of the age specific rates of first marriage for females and males are approximated by modified gamma distributions for the period 1921/22 to 1975/76. For females, the age distributions of these rates in each year have changed markedly over the period. In the pre-war period, the rates increased to a peak at about age 24 years and then fell, slowly at first, and then more sharply over the ages from the mid-20's to early 30's. The rates of first marriage then decreased more slowly until rates were negligible in the older age groups. During World War II, the nature of the age distribution changed; age at first marriage for females fell to such an extent that the institutional restriction on the age at which persons may marry without the consent of their parents became an important factor. Consequently, throughout the remainder of the sample period the age distributions became sharply peaked at about 21 years of age. The age distributions for males, whilst

1. An excellent discussion of recent trends and attitudes towards marriage in Australia is given in Peter F. McDonald, "Marriage and Divorce in Australia", mimeograph, presented to the Economic and Social Commission for Asia and the Pacific Conference on "Population of Australia" held in Canberra, September 1980. Discussion of international trends can be found in Charles F. Westoff, "Some Speculations on the Future of Marriage and Fertility", Family Planning Perspective, Vol.10, No.2 (March/April 1978), and in Patrick Festy, "On the New Context of Marriage in Western Europe", Population and Development Review (June 1980).

being of similar shape to those for females, are less sharply peaked and peak at a later age. In the pre-war period, the male age distributions peak at about age 27, whilst, following the war, they peak at about age 23 or 24. The difference in peak ages is to be expected given the age distributions already described for females and the tendency for males to marry females several years younger than themselves. It could have been expected that, following the reduction in the legal age of consent from 21 to 18 years in 1973, the male and female age distributions might have shifted downward to some extent. However, this shift was obscured by the general trend towards later marriage. These two trends indicate that the first marriage rate distributions for females and males may become less sharply peaked in the future. In Figures 4 and 5, four typical age distributions with their gamma approximations, for females and males respectively, are given to illustrate these comments.

Approximations to these age distributions were made, in the manner described in Appendix 1, for each year of the sample period. In general, the approximations performed well in capturing the shape of the age distributions. By their very nature, approximations smooth through observed data, so it was expected that the approximations would not fully capture the sharp rise at young ages or the peak, especially when that peak was very sharp. In the pre-war period the age distributions for females and males were not sharply peaked, so the approximations were able adequately to capture the peaks without consistent over- or underestimation. First marriage rates at older ages were less closely approximated, with minor overestimation of female first marriages and underestimation of male first marriages for the 50's and 60's age groups. The approximations were slightly less successful in the wartime period when the distributions were, in general, more peaked. The approximations generally peaked higher and later, and for males there was some overestimation of the rates at older

ages. In the post-war period, with the exception of the last few years of the sample period, the approximation to the female rates of first marriage peaked lower and later than the historical age distribution. Then, in the last few years of the sample period, the approximations peaked slightly higher than the historical distributions. The post-war approximations adequately capture the first marriage rates for older females, although in the 1960's there was some overestimation for ages above the late 20's, and in the 1970's there was underestimation for ages from the mid 20's to the late 30's and overestimation for ages thereafter. For males, the approximations in the post-war period generally peaked higher and later than the historical distributions, and the rates for older males were slightly underestimated until the 1960's, after which rates for the late 20's to 30's ages were underestimated and the rates for ages above 40 years were overestimated. This pattern of under- and overestimation for older males worsened for the later years of the sample period. However, in general, the approximations were satisfactory, and it is interesting to speculate upon the long term effects on the approximations of the lifting of the age of majority constraint and the tendency for age at marriage to rise. If the observations of MoDonald[1] are correct and the trends already observed continue, the alteration of the institutional constraint will prompt a flattening of the peak of the female, and consequently the male, age distribution. The approximation may then perform even more satisfactorily in the future (as it did in the pre-war period).

When the numbers, rather than the rates, of first marriage are

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1. See Peter F. McDonald, "Marriage in Australia ..." op. cit., p.25.

FIGURE 4

TYPICAL AGE DISTRIBUTIONS OF THE RATES OF FIRST MARRIAGE OF AUSTRALIAN FEMALES (⇔) AND THEIR GAMMA APPROXIMATIONS (—)
1921/22, 1950/51, 1965/66 AND 1975/76

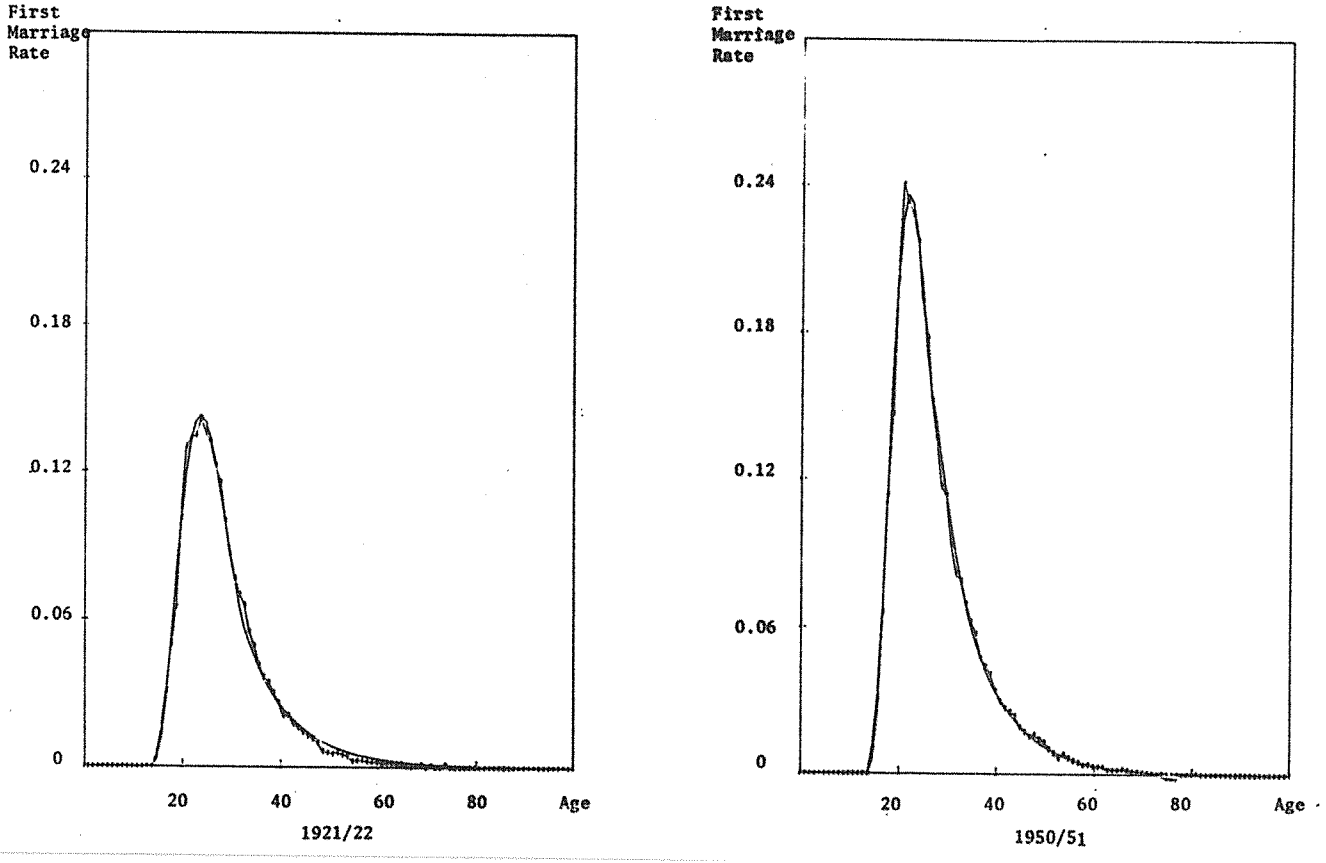
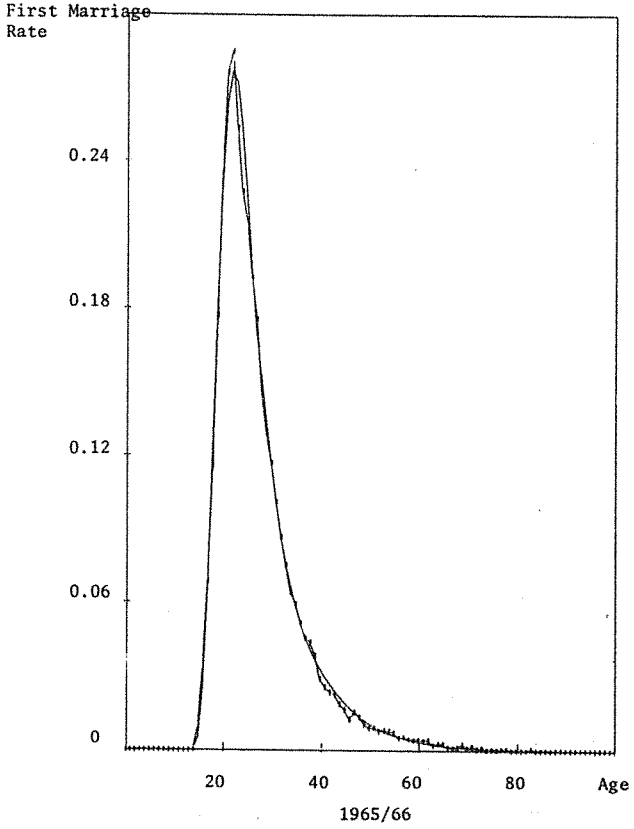


FIGURE 4 *continued*



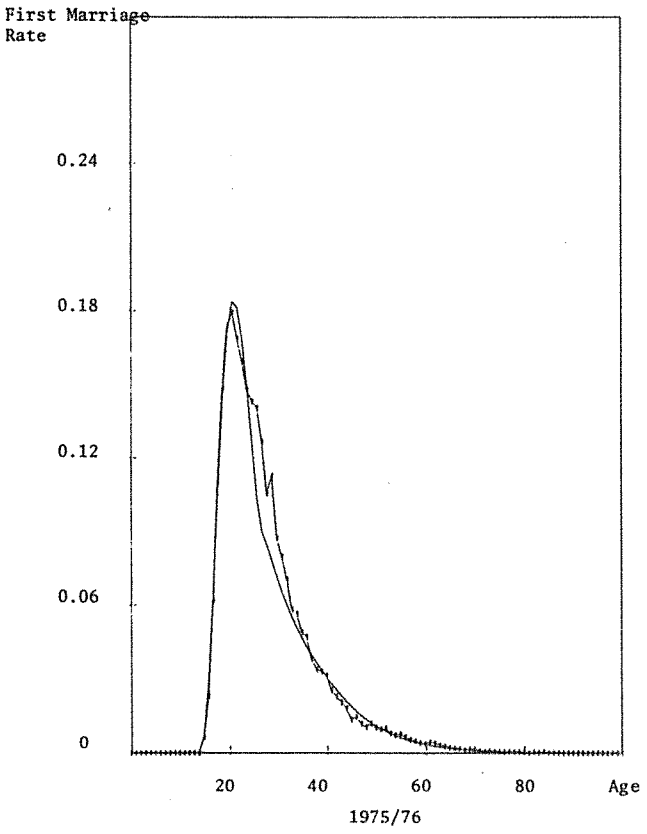
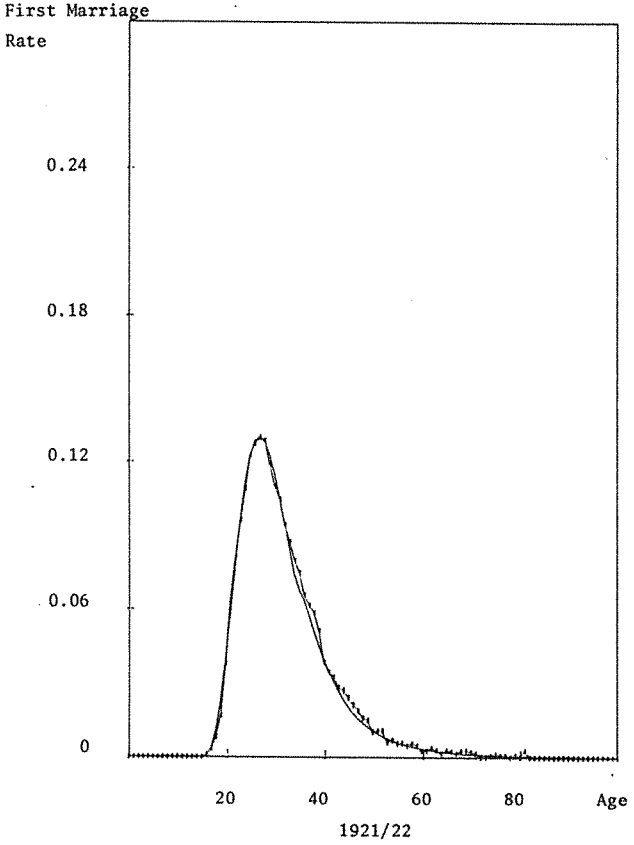


FIGURE 5
TYPICAL AGE DISTRIBUTIONS OF THE RATES OF FIRST MARRIAGE OF AUSTRALIAN MALES (↔) AND THEIR GAMMA APPROXIMATIONS (—)
1921/22, 1950/51, 1965/66 AND 1975/76



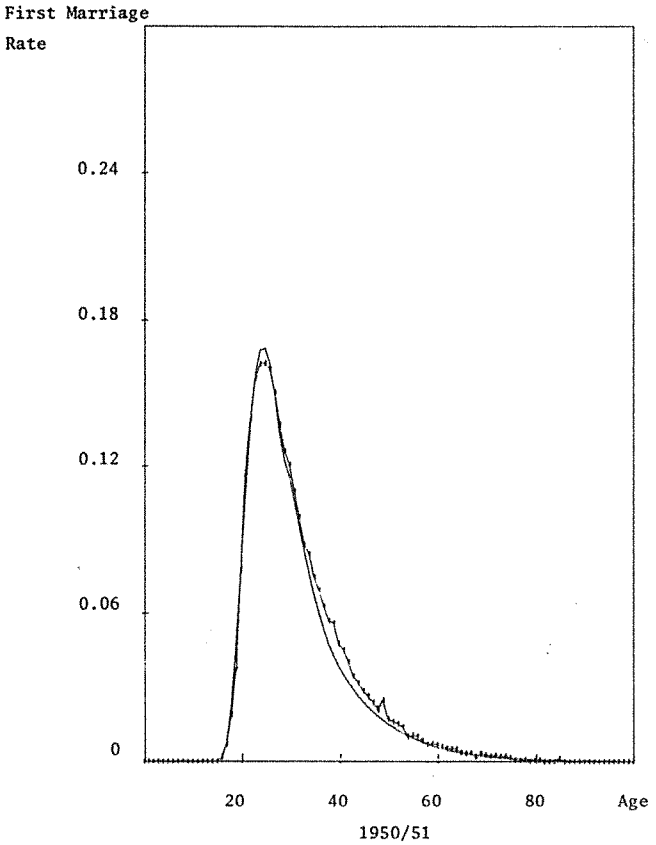
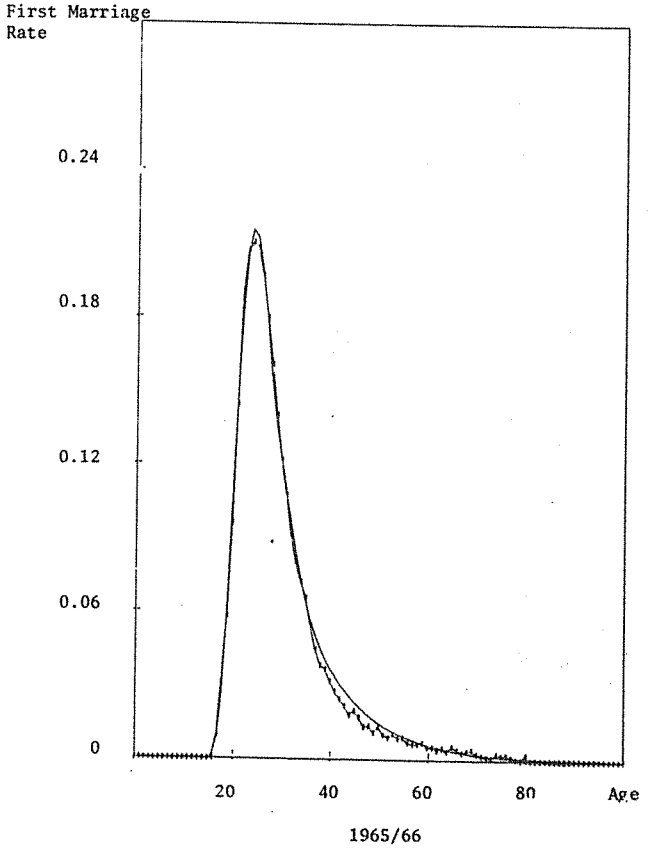
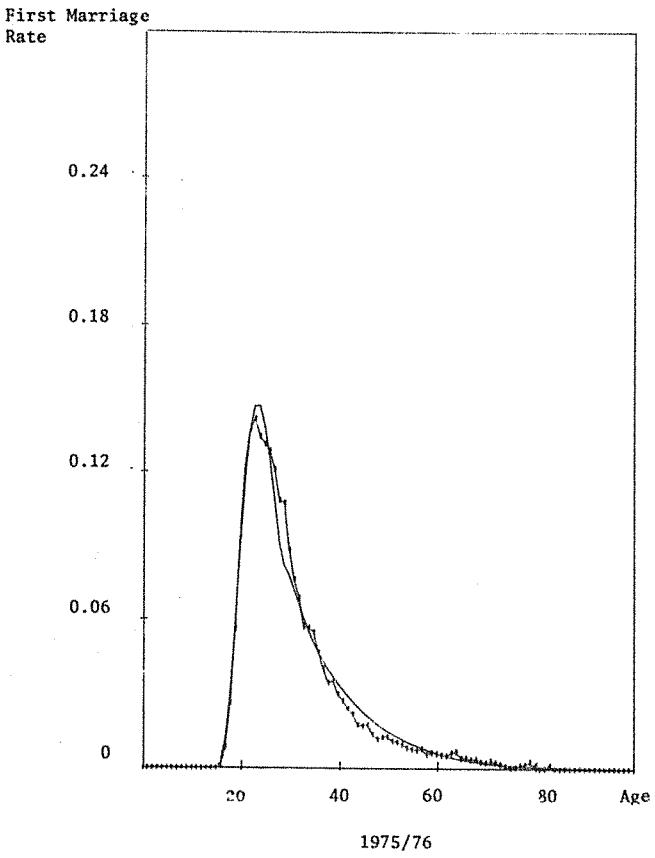


FIGURE 5 *continued*





considered, the results are even more satisfactory. In Figures 6 and 7 four typical age distributions of the numbers (rather than rates) of first marriages and their approximations are given for females and males respectively. The differences between these distributions and those for the rates of first marriage arise from variations in the population at risk of first marriage at each age. For both females and males the age distributions of the numbers of first marriages are similar in shape to those for the rates of first marriage, except that they tend to peak between one and two years earlier and are much narrower, with most of the distribution concentrated in ages below 30 years; this is because the population at risk of first marriage is concentrated in the younger ages. The approximations have performed adequately, which is to be expected since the criterion by which the best approximation was chosen sought to minimize the differences between the historical and approximated numbers of first marriages at each age. The relative inadequacy of the approximations to the rates at older ages are of little consequence to the numbers of first marriages, for the numbers at risk at these older ages are few. Capturing the number of first marriages at the peak ages presents some difficulty, but in general the technique has been highly successful in approximating the age distributions of first marriages.

d) The accuracy of the approximations

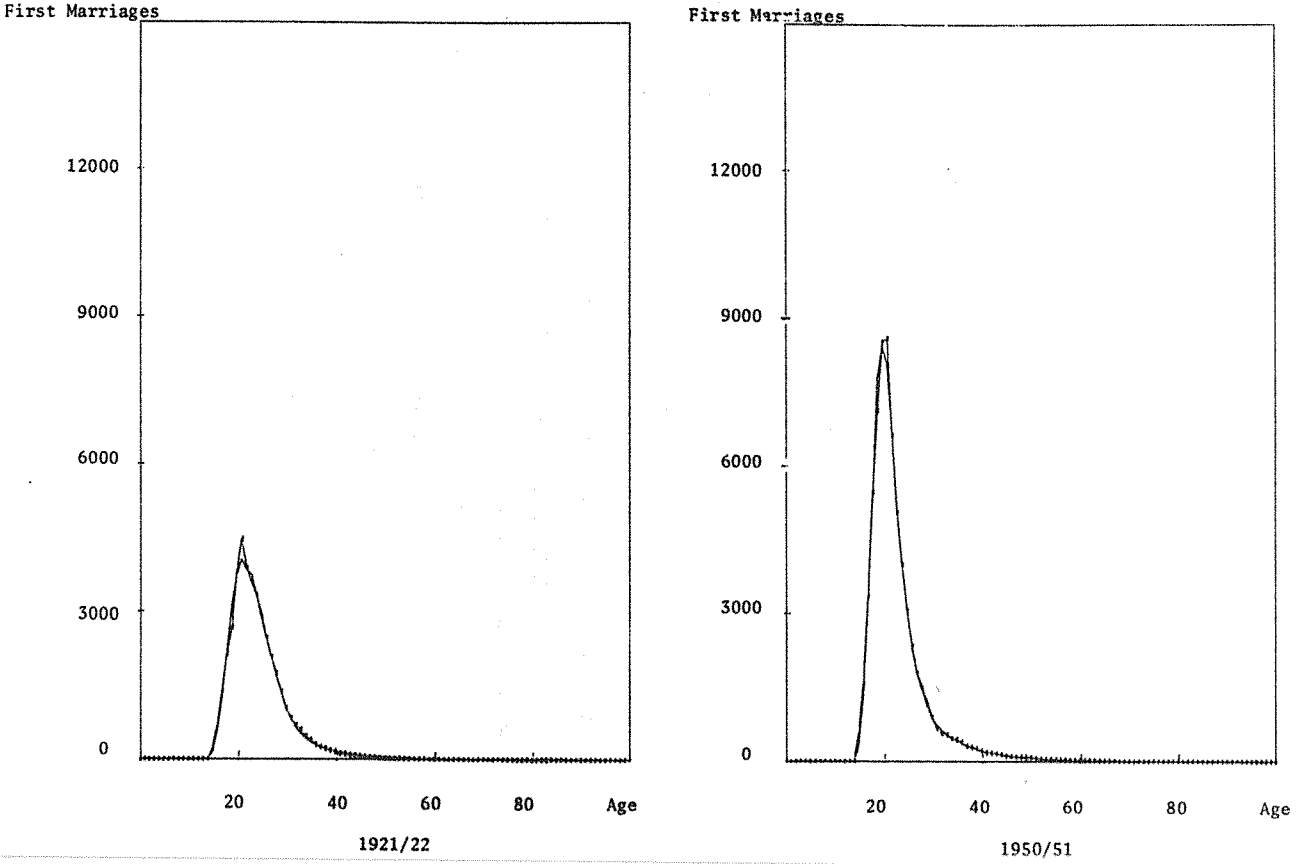
A succint measure of the adequacy of the approximation technique is the mean error between the approximated and historical numbers of first marriages, which is given for each year of the sample period for females and males in Figure 8. For females the total number of first marriages were generally overestimated in the pre-war period and underestimated in the post-war period, except for a few years in the 1960's. The increased underestimation of female first marriages at the end of the sample period

derived from underestimation just prior to the peak ages and for the 30's age group and is a little disturbing. However, the size of the mean errors was not substantial, with errors exceeding ± 1.0% in only three years. The total number of first marriages of males were generally underestimated over the entire period, except for some overestimation in the early 1960's and in the last few years of the sample period. Again, the underestimation derived from underestimation at ages before the peak and for the 30's to 40's ages. In the last few years of the sample period, the overestimation also derived from the overestimation at very young and at peak ages. As with females, these errors were not substantial, although they did exceed ± 1.0% in thirteen of the fifty-five years of the sample period.

Relative differences in the adequacy of the approximation for female and male first marriages pose some difficulty. For instance, in the last few years of the sample period, female first marriages are underestimated by about 1.0%, whereas male first marriages are overestimated by about 0.4%. Ceteris paribus, these errors would imply that male marriages would exceed those of females, which is clearly unsatisfactory. Over the sample period, the errors are positively correlated, so it is unlikely that substantial imbalances between female and male marriages will occur. However, when the marital status flows are used in the Population Projection Facility, it is necessary to make adjustments to ensure that the number of marriages (that is, first marriages plus remarriages of divorced and widowed persons) for females equates the number of males.[1]

1. Consistency in numbers of marriages between females and males is ensured by the two-sex marriage model described in Dennis Sams, op. cit..

FIGURE 6
TYPICAL AGE DISTRIBUTIONS OF THE NUMBERS OF FIRST MARRIAGES OF AUSTRALIAN FEMALES (++) AND THEIR GAMMA APPROXIMATIONS (—)
1921/22, 1950/51, 1965/66 AND 1975/76



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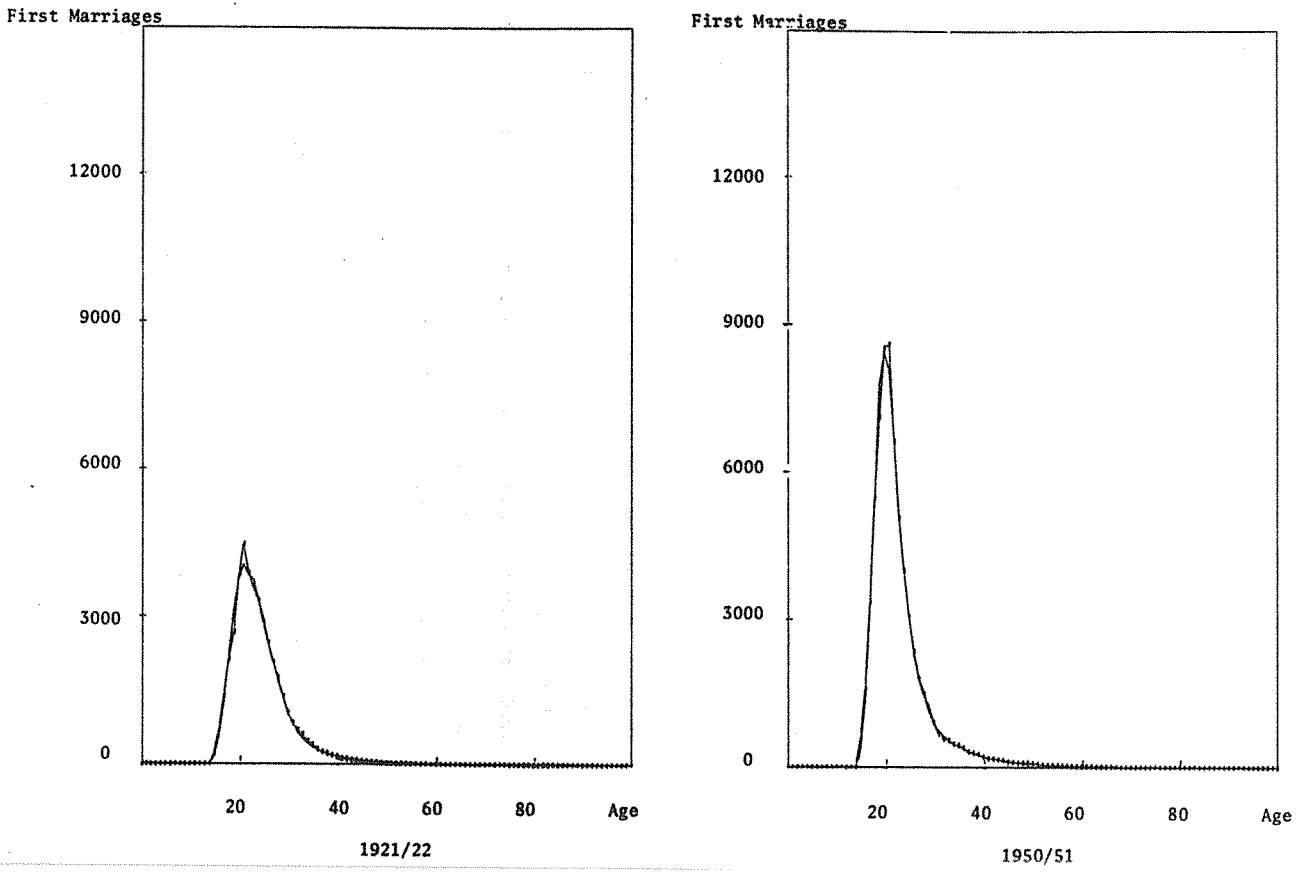
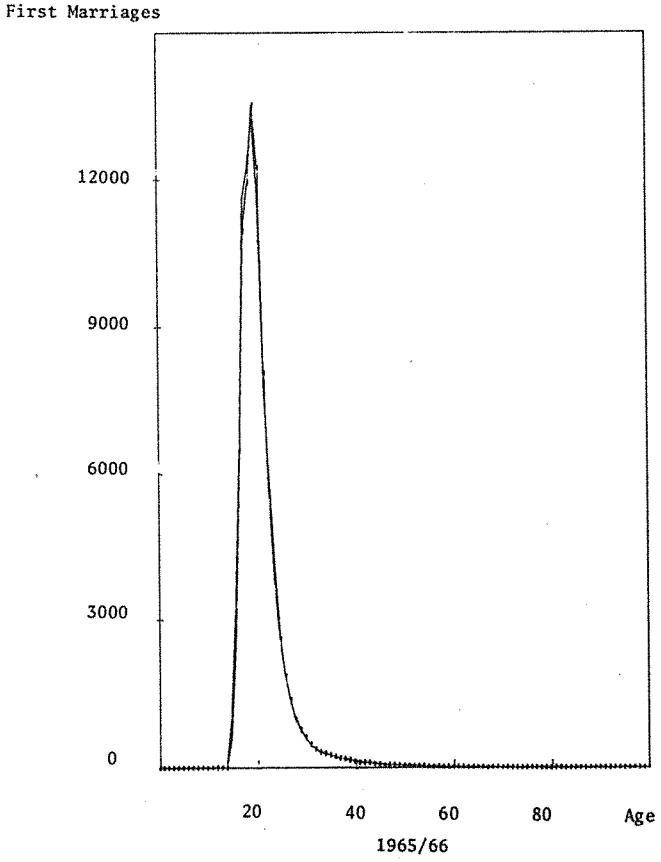



First Marriages
12000
9000
6000
3000
0
20
40
60
80
Age
1965/66

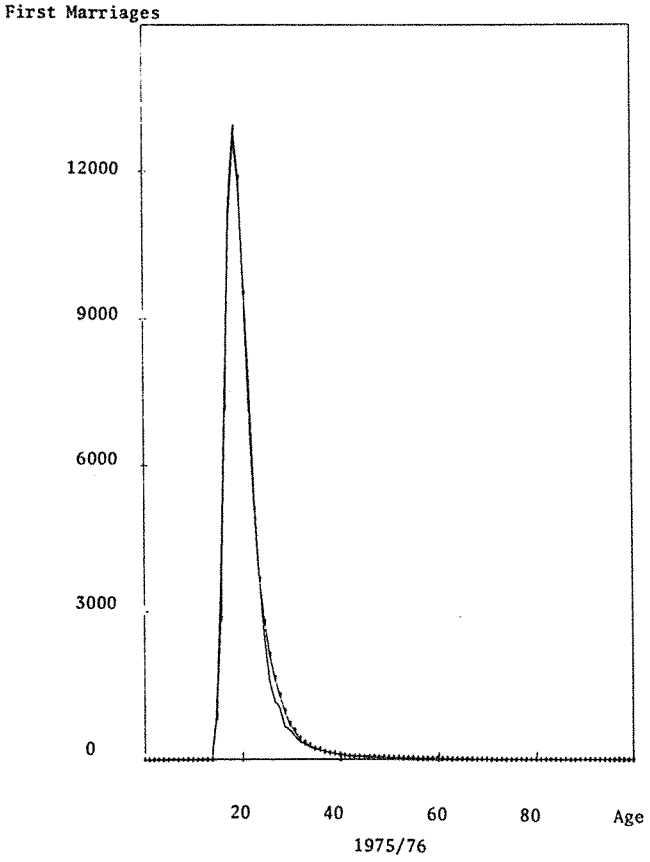
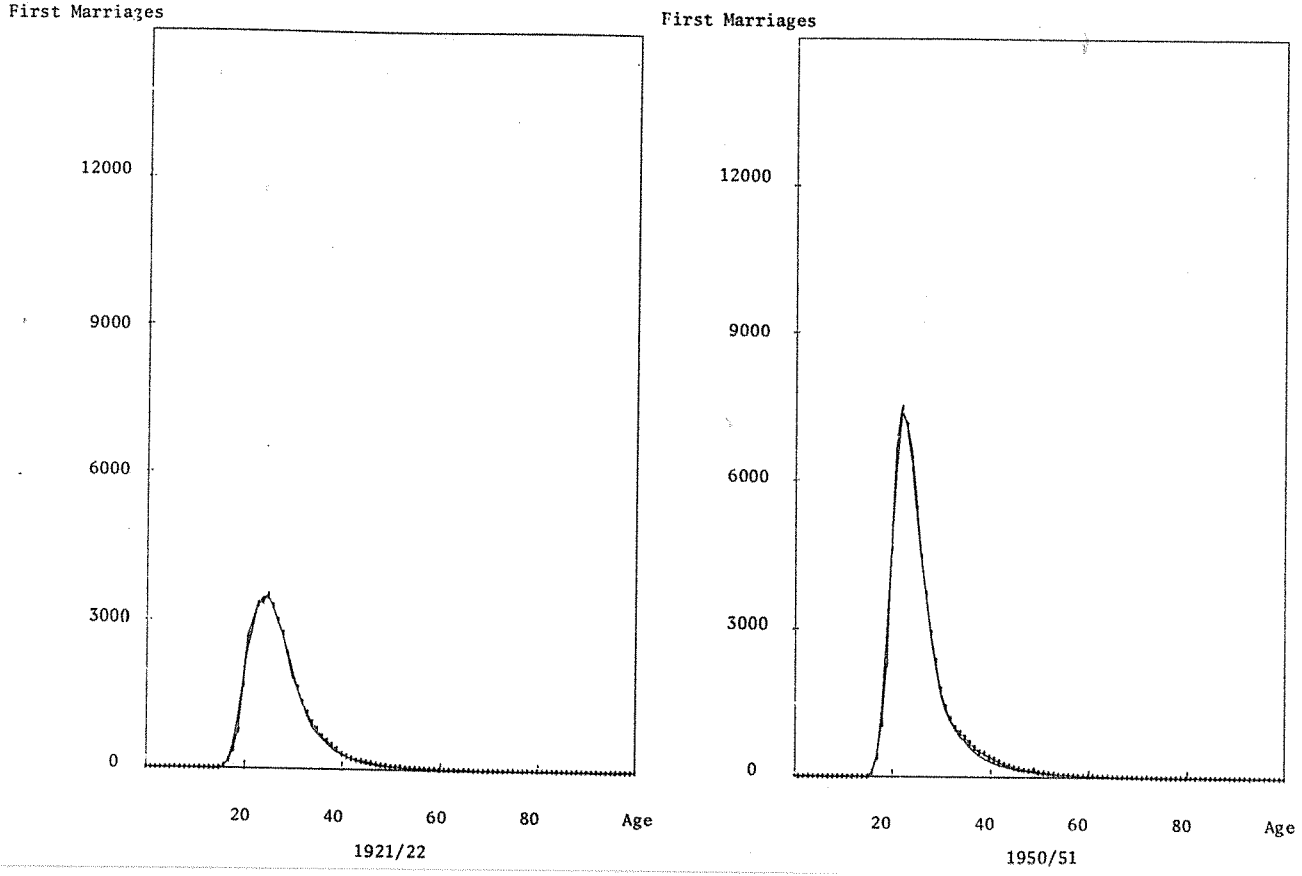
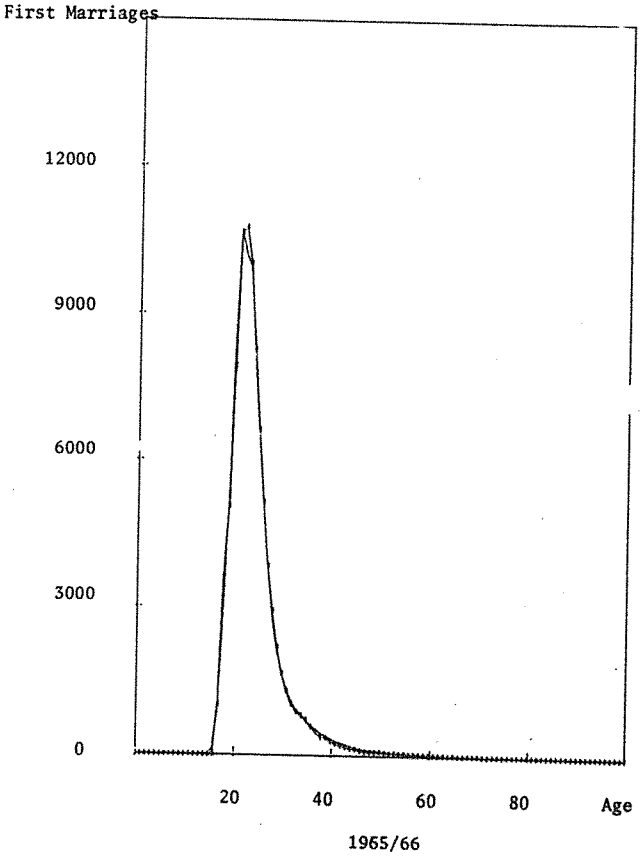

First Marriages
12000
9000
6000
3000
0
20
40
60
80
Age
1975/76

FIGURE 7
TYPICAL AGE DISTRIBUTIONS OF THE NUMBERS OF FIRST MARRIAGES OF AUSTRALIAN MALES (↔) AND THEIR GAMMA APPROXIMATIONS
1921/22, 1950/51, 1965/66 AND 1975/76




First Marriages
12000
9000
6000
3000
0
20
40
60
80
Age
1965/66

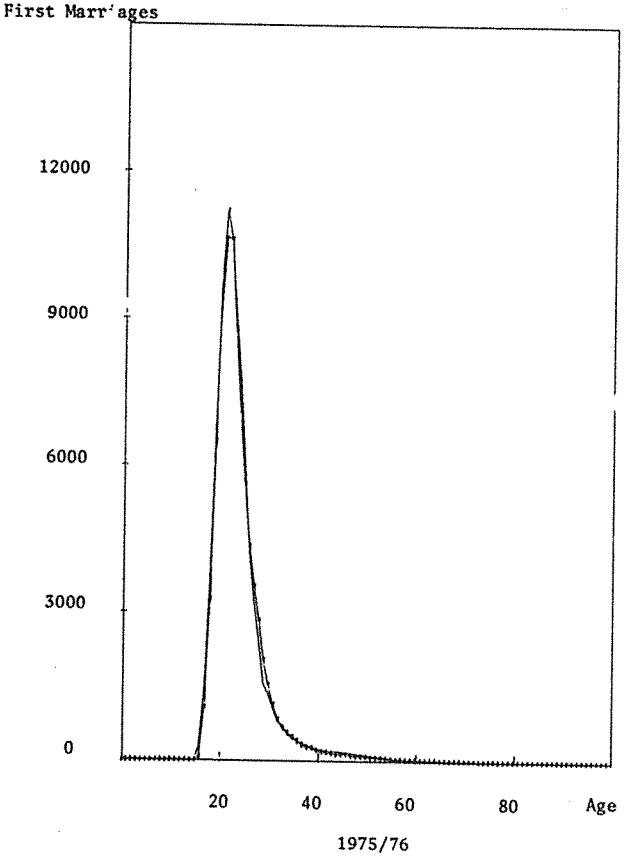

First Marriages
12000
9000
6000
3000
0
20
40
60
80
Age
1975/76

FIGURE 8

MEAN ERROR BETWEEN THE NUMBER OF FIRST MARRIAGES AND ITS GAMMA APPROXIMATION FOR AUSTRALIAN FEMALES (↔) AND MALES (—) 1921/22 TO 1975/76

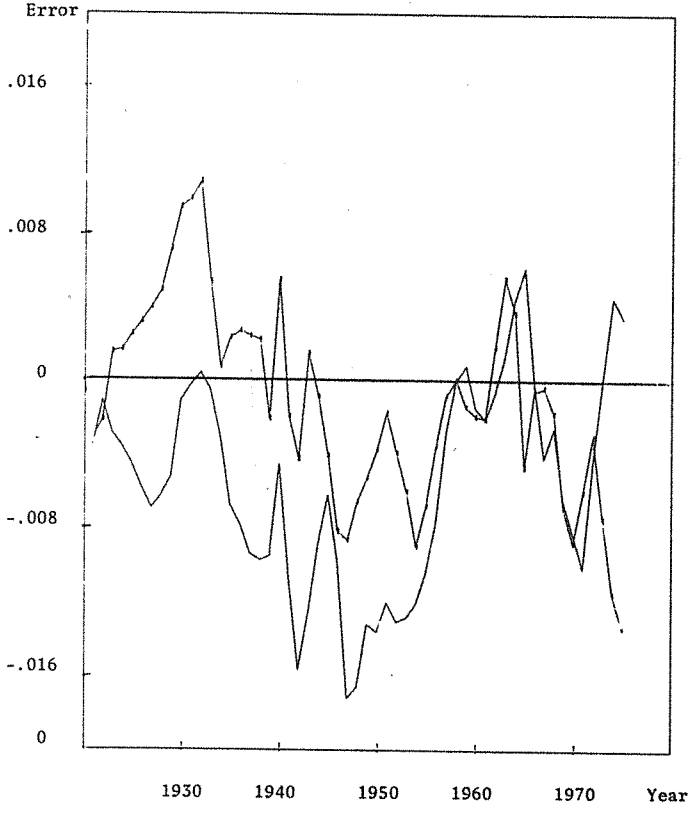
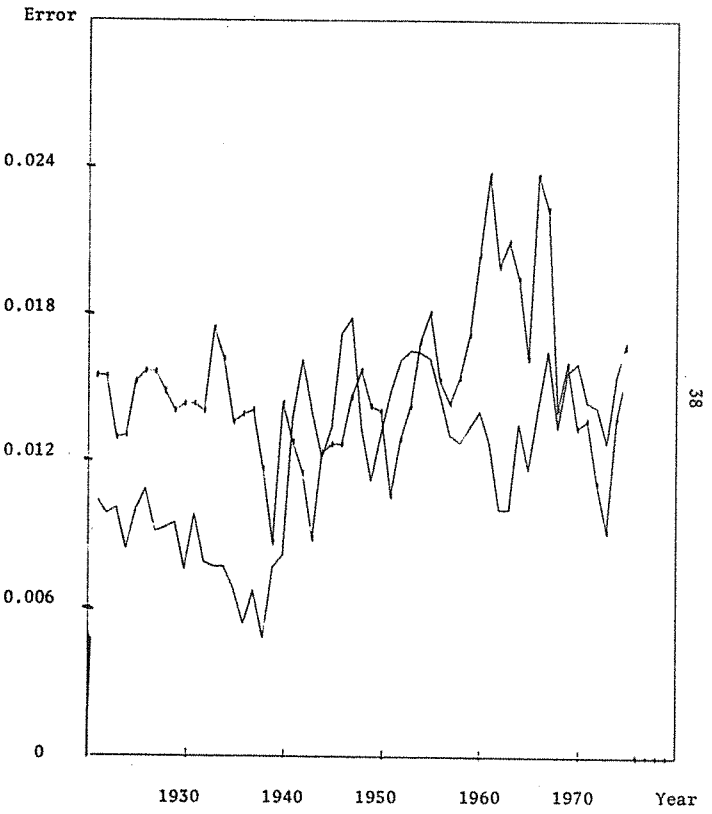


FIGURE 9

ROOT MEAN SQUARED ERROR BETWEEN THE NUMBER OF FIRST MARRIAGES AND ITS GAMMA APPROXIMATION FOR AUSTRALIAN FEMALES (↔) AND MALES (—), 1921/22 TO 1975/76



The root mean squared error between the number of first marriages of females and males and their respective gamma approximations for each period are given in Figure 9. This measure is highly variable for both females and males and shows markedly different behaviour in the pre-war and post war periods. These observations are disturbing since the former suggests that there is a good deal of fluctuation in the ability of the gamma distribution to adequately approximate the number of first marriages at each individual age, and the latter suggests that the use of two sets of parameters for the constant function, which is added on to the first marriage approximation, has forced some discontinuity in the final approximations. This is especially obvious for males, where the root mean squared error declined in the pre-war period, increased rapidly to a level well above that of the pre-war period and then fluctuated about that level for the remainder of the sample period. It is encouraging to note, however, that for both females and males there is no obvious trend of decrease over time in the ability of the approximations to adequately capture single ages.

(e) The parameters of the age distribution

The parameters of the approximated age distributions, the index of propensity, the mean and the variance, are to be modelled econometrically, so we are interested in their movements over time. In Figure 10, the index of propensity to first marry for females and males is illustrated. In the pre-war and war-time periods, the propensities showed a similar pattern to the respective overall first marriage rates given in Figure 3;[1] any differences relate to variations in the age

1. As explained in Section 2, in the footnote on page 11, the propensity used in the analysis characterizes the age distribution of the age specific rates of first marriage. It can be compared with the overall first marriage rate. The two measures will differ according to the number at risk in each age group.

FIGURES 10, 11 AND 12

THE PARAMETERS OF THE APPROXIMATED AGE DISTRIBUTIONS OF AGE SPECIFIC RATES OF FIRST MARRIAGES FOR AUSTRALIAN FEMALES AND MALES, 1921/22 TO 1975/76

FIGURE 10

INDEX OF PROPENSITY TO FIRST MARRY FOR AUSTRALIAN FEMALES (⇿) AND MALES (—), 1921/22 to 1975/76

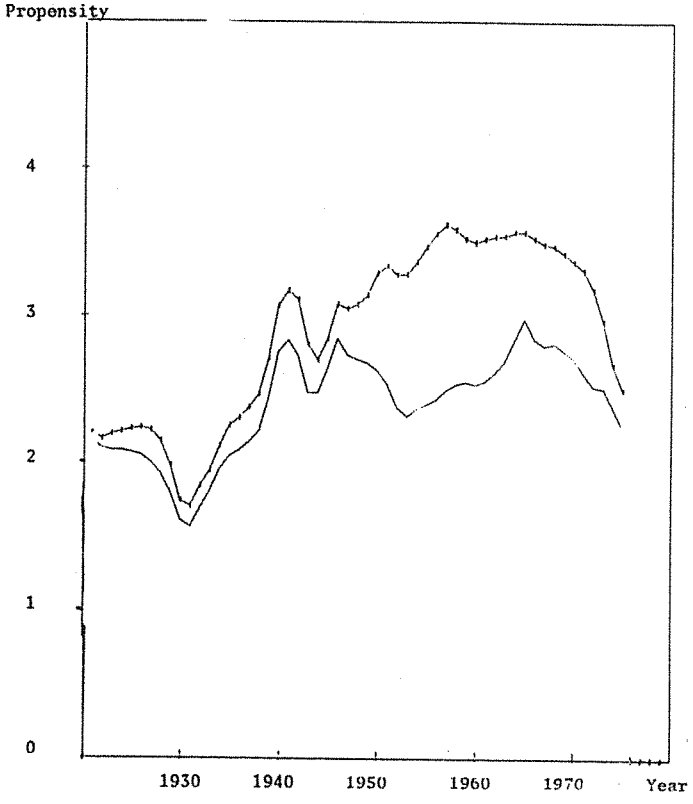
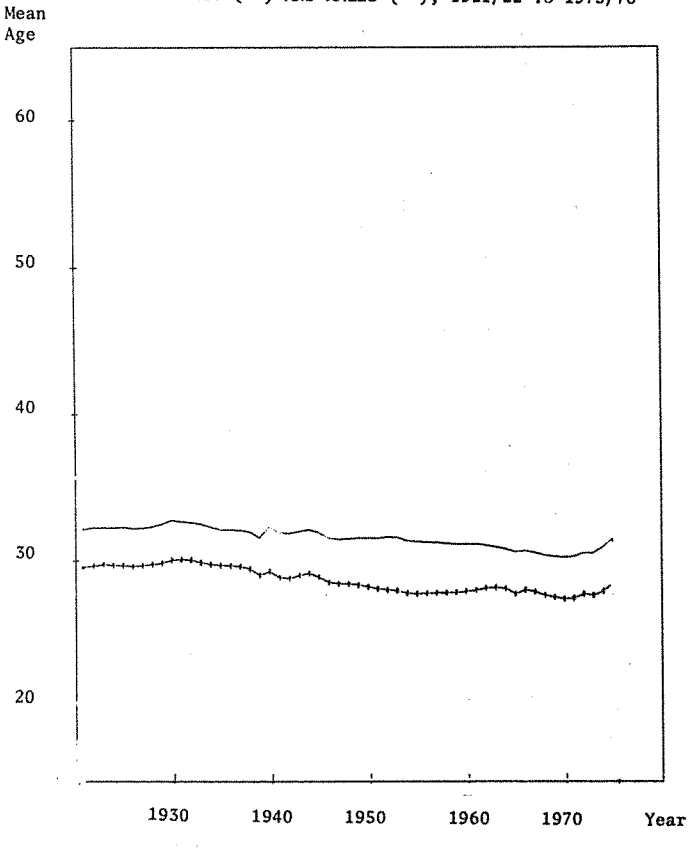
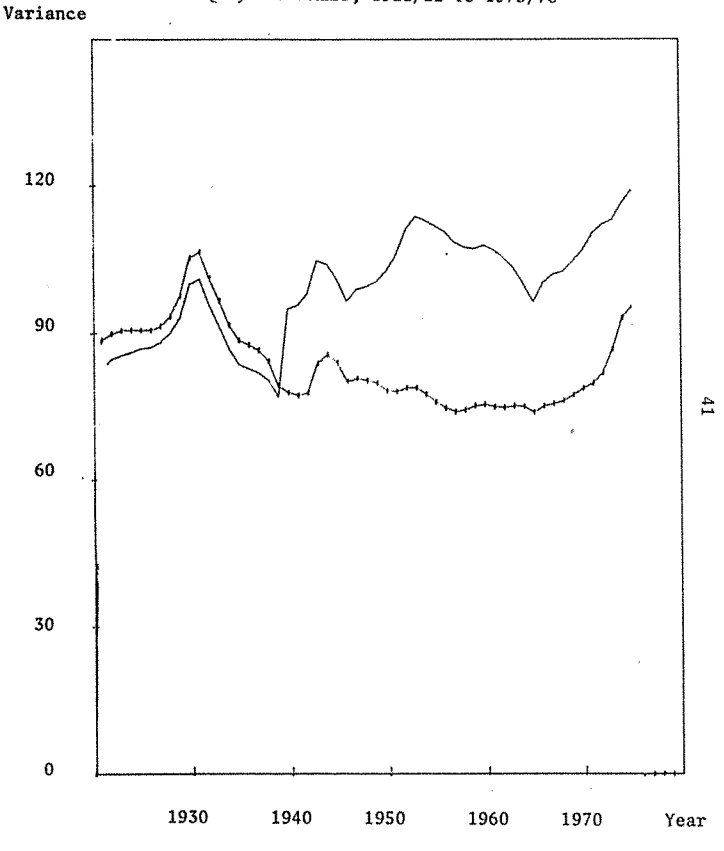


FIGURE 12

MEAN AGE AT FIRST MARRIAGE FOR AUSTRALIAN FEMALES (+-+) AND MALES (—), 1921/22 TO 1975/76



VARIANCE OF AGE AT FIRST MARRIAGE FOR AUSTRALIAN FEMALES (+-+) AND MALES, 1921/22 TO 1975/76



distribution of the population at risk. Propensities declined during the Depression but rose soon after as marriages were "made up" and continued to rise at the outbreak of war, with some decline during the war itself. Obviously, in the pre-war periods, Australian marriage behaviour was strongly influenced by economic conditions, with marriages being delayed and possibly deferred altogether in periods of economic decline. The outbreak of war provided a catalyst to marriage but of more interest is the fact that marriages did not return to more "normal" levels after the war; there was a shift in marriage behaviour towards younger and more universal marriage, partly as a result of changing social attitudes and partly as a result of the improved economic expectations of the post-war period. Following the war, the propensity to first marry for females increased steadily until the mid-1950's, when it stabilized at a level with very high rates of first marriage. From the late 1960's, however, the propensity has fallen dramatically and continually. For males, however, the propensity to first marry declined until the early 1950's and then increased steadily until the middle of the 1960's, when it again fell. The decline in propensity for males and concomitant increase for females following the war was due to the imbalance in the marriage market, as discussed earlier. Over this period, the females of prime marriage age had been born during the Depression when fertility was low, whereas the males of prime marriage age had been born in the more fertile years of the late 1920's, and their numbers had been substantially augmented by migration. Males were therefore in abundant supply and it was not until after the mid 1960's that this imbalance returned to a more stable lower level. The decline in propensities for both females and males since the late 1960's have been assigned a number of causes. The combined effects of increased independence, income, education and career

opportunities for women,[1] and improved contraceptive technology may have led to substantial deferment of marriage over the late 1960's and 1970's.[2] Some authors have suggested that there is a reversion to the marriage patterns experienced in the late nineteenth and early twentieth centuries, where young people delayed marriage until the "proper time to marry" and, as a result, the age at marriage was high and a substantial proportion of men and women never married.[3] In the past, however, such behaviour was more likely to be related to fertility control; late marriage was used as a contraceptive technique.[4] Contraceptive technology is such that this is unlikely to occur. Other authors[5] suggest that the current declines in marriage propensities could indicate an increasing acceptance

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1. Several econometric studies have supported the negative relationship between propensity to marry and employment opportunities for women; for example, using Australian data, Glenn A. Withers, "Economic Influences on Marriage Behaviour: Australia, 1954-1984" in Economic Record, Vol.55, No.149 (June 1979), and using United States data, Samuel H. Preston and Alan Thomas Richards, "The Influence of Women's Work Opportunities on Marriage Rates" in Demography, Vol.12, No.2 (May 1975), and Alan Freiden, "The United States Marriage Market" in Journal of Political Economy, Vol.82, No.3 (May/June 1974).

2. The econometric model used to estimate these propensities concentrates on these determinants of first marriage propensity; see Clive Brooks, Dennis Sams and Lynne Williams, op. cit..

3. This view has been supported by Peter F. McDonald, "Social Change and Age at Marriage", mimeograph, Department of Demography, Australian National University, Canberra, 1981, p.19ff and Alisa Burns, "Comments on Marriage and Divorce in Australia", mimeograph, presented to the Economic and Social Commission for Asia and the Pacific conference on "Population of Australia" held in Canberra, September 1980.

4. See H.J. Heeren, "Marriage as a Demographic Variable" in Proceedings of the International Population Conference, Liege, 1973.

5. See Charles F. Westoff, op. cit., p.80ff, and Patrick Festy, op. cit..

of cohabitation and a rejection of traditional marriage. It is, however, difficult to determine whether the current marriage trends represent a rejection of marriage itself or merely a postponement of marriages with the institutionalization of trial marriages. In either event, the importance of non-legal forms of marriage is clear; the data to enable its measurement is unfortunately not as yet available.[1]

The mean of the approximation to the age distribution of age specific rates of first marriage is shown in Figure 11. Whilst there has not been substantial movement in the mean, it has shown a general decline, except for the last few years of the sample period. One could have expected the reduction in the propensity to first marry during the Depression to have been achieved by the delaying of young marriages. In that case, the mean of the age distribution of first marriage rates would have been expected to rise. However, no such rise occurred, as first marriages of all ages were postponed. In fact, first marriages of older persons decreased more than young marriages during the Depression. At the onset of World War II, it was expected that the mean would fall as marriages were brought forward. Whilst young marriages did comprise an increasing proportion of all marriages during the war, the mean fell for the last few years of the 1930's, rose substantially in 1940/41, fell for a few years and then increased to a peak in 1944/45. Unfortunately, the peak in 1940/41 was largely an artifact of the approximating technique used; the constant distribution which was used to improve the approximation to rates at older ages was changed in 1940/41. Following the war, the rise in propensity to first marry for females coincided with a continual fall in the mean age. This was because the increased numbers of first marriages comprised an increasing proportion of marriages of younger females. The propensity to first marry began to fall in the mid-1960's and at this

1. The Institute of Family Studies is undertaking studies which may provide data on informal marriages; see Margaret Harrison, "Informal Marriages", Working Paper No.1, Institute of Family Studies, Melbourne (February 1981).

time the mean age stabilized and then began to rise again in line with the rapidly declining propensity to marry for females at the end of the sample period. For males, the mean age at first marriage has followed a similar pattern to that for females despite different movements in their propensities. It is, however, interesting to observe that the mean for females has varied from 2½ years below that for males in the pre-war period (when there was relatively less imbalance in the marriage market) to 3 years over the wartime period, to 3½ years during the 1950's (when women were in scarce supply) and to 3 years since the late 1960's. The general decline in age at marriage has been attributed to improvements in economic conditions and the gradual transition from the "European" marriage pattern, where late marriage was used as a form of birth control. Since the late 1960's, however, these trends have been counteracted by the effects of increased equality for women and its concomitant improvements in income and career prospects, which have enhanced the options available to women outside of marriage. Whilst in the 1960's improved contraceptive technology enabled early marriage (since there was no need to delay marriage as a contraceptive technique), by the 1970's contraception allowed cohabitation to take the place of the early childless years of marriage.[1] If the economic and social trends experienced during the 1970's continue and mass migration programs do not resume, the mean age at marriage can be expected to increase and the difference between male and female ages to continue to decline. However, in the context of the limited movements in mean age in the past, these changes would not be substantial.[2]

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1. See Peter F. McDonald, "Marriage and Divorce in Australia", op. cit., p.13ff.

2. See Peter F. McDonald, "Changing Patterns of Nuptiality in Australia", National Population Inquiry, Commissioned Paper No.3, Canberra, 1974,p.16.

In Figure 12, the variance of the approximated age distributions of the age specific rates of first marriage for females and males are given. The variance for males is discontinuous in 1940/41 as a result of the addition of different constant distributions to the gamma approximation before and after that date. Whilst this indicates a problem with the use of this technique (which is only applied for first marriages), there are reservations in general about the adequacy of the approximations over the wartime period. Consequently, the pre-war and post-war periods should perhaps be considered separately. The most interesting observation regarding the variance in age at first marriage relates to its uncanny mirroring of the trends observed for the propensity to first marry. Whilst the propensity to first marry fell during the 1920's and then more substantially during the Depression, the variance in age for females and males increased. Following the Depression, the variance for females declined, except for a small increase in wartime, until the 1960's. For males, similar but more exaggerated trends occurred, with the exception of the late 1940's, when the variance in age rose. Since the late 1960's, the changing social and economic position of women and changes in the demand for marriage have lead to dramatic falls in propensity to first marry and increase in mean age and variance in age at first marriage. If these trends continue, it is likely that the uniformity in marriage behaviour will continue to decline and the variance in age to increase.[1]

(f) Summary

The performance of the approximation to the first marriage rate distribution is not entirely satisfactory. Whilst the total number of

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1. This view is supported by Peter F. McDonald, "Marriage and Divorce in Australia", op. cit., p.17.

first marriages is closely approximated, first marriages for any particular age may not be. At the peak of the distribution, first marriages are smoothed across ages, so the approximation to the number of first marriages for individual peak ages will be poor. It is not expected that this will substantially bias the approximation in the long run, especially since the peak rates can be expected to be captured more easily in the future, if the first marriage rate distribution becomes flatter. The overestimation of first marriage rates at older ages is of particular concern; not only because these rates could fall in the future,[1] but because they point to an inadequacy in the approximating technique used. The constant distribution which is added to the gamma approximation to improve the fit to rates at older ages implies a lower limit to the values of first marriage rates at older ages, which may be too high in the future. The graphs of the mean and variance of the approximated age distribution also indicate discontinuity at the year when the constant distribution is changed, 1940/41. Hence, the use of this constant distribution will have to be reviewed when projections are made. Movements in the propensity to first marry, and the mean age and variance in age at first marriage have been attributed to changes over time in legislation relating to minimum ages at marriage and age of majority, the imbalance of males and females at risk of first marriage, general economic conditions, the social dislocation caused by wartime, the increased independence, income and career opportunities for women, the acceptability and adequacy of contraception, and the social attitudes towards cohabitation. The econometric model of the parameters of first marriage behaviour should incorporate these variables if it is

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1. See A.R. Hall, "Of Baby Booms and Marriage Slumps", in Economic Record, Vol.52, No.137 (March 1976), p.41 and Glenn A. Withers, op. cit., p.124.

to provide an adequate explanation of Australian first marriage behaviour.

3.2 Divorces

(a) Data and the effects of legislative changes

Data on divorce in Australia are derived from Court records which offer an accurate source of statistics. Changing legislation has, however, limited the availability of consistent statistics. Prior to the Matrimonial Causes Act 1959, which came into operation in 1961, each State of Australia operated its own divorce Act. Thereafter, a single divorce law became applicable throughout Australia. It is difficult to quantify the effect of this legislation on the incidence of divorce in particular States; there is a possibility of some discontinuity in the data. However, the graph of total number of divorces from 1921/22 to 1975/76 in Figure 13 does not support the existence of any significant discontinuity at that date, and time series analysis has indicated that the impact of the Act was negligible.[1]

Of more importance, however, is the Family Law Act 1975, which made extensive changes to the grounds upon which a divorce could be decreed. The Act, which came into operation in 1976, has increased the speed and ease with which a divorce can be obtained and has greatly reduced the pecuniary and non-pecuniary costs of divorce actions. The short-run impact of this legislation has been to increase substantially the numbers of divorces decreed annually, originally because of the efforts to clear the backlog before the introduction of the new Act and later because of the rush of new applicants who had been awaiting the introduction

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1. A time series analysis of the impact of both the Matrimonial Causes Act and the Family Law Act on the divorce rate in Australia is reported in Seweryn A. Ozdowski and John Hattie, "The Impact of Divorce Laws on Divorce Rate in Australia: A Time Series Analysis" in Australian Journal of Social Issues, Vol.16, No.1 (1981). The insignificant effect of the Matrimonial Causes Act has also been supported by other commentators, such as Peter F. McDonald, "Marriage and Divorce in Australia", op. cit., p.25.

FIGURE 13

DIVORCES OF AUSTRALIAN COUPLES,
1921/22 TO 1975/76

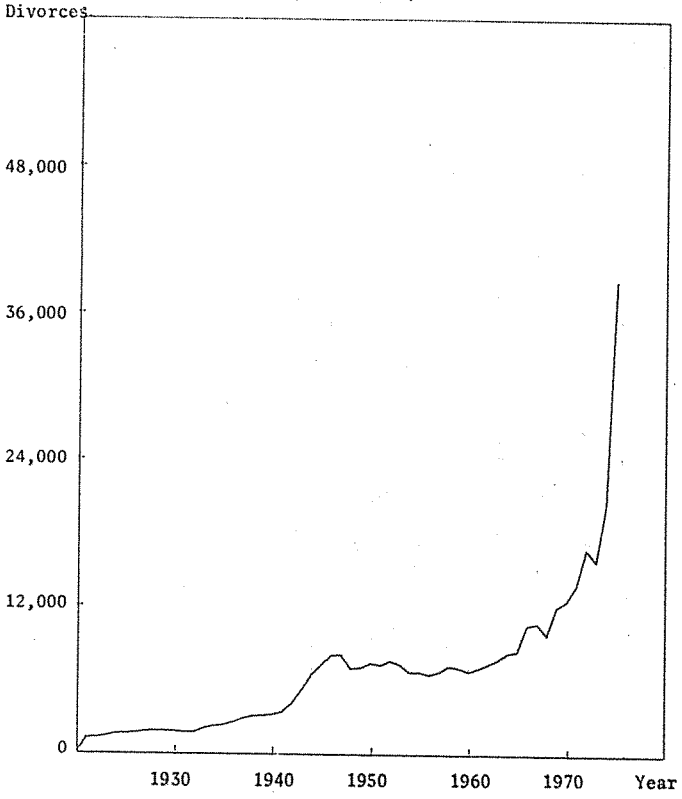
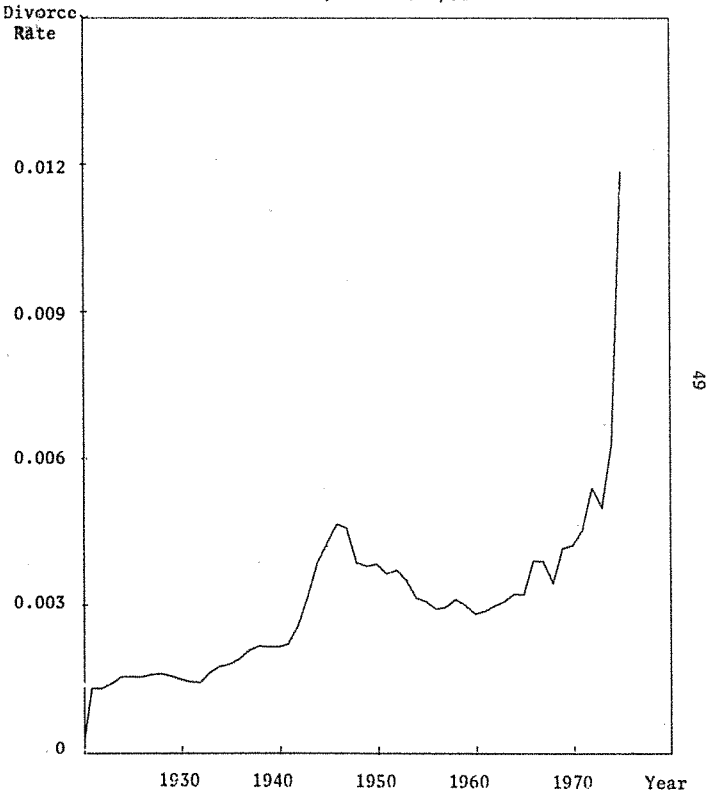


FIGURE 14

OVERALL DIVORCE RATE OF AUSTRALIAN COUPLES,
1921/22 TO 1975/76



of the Act.[1] Increases in the numbers of divorces and the rates of divorce (to numbers of married persons) have been experienced for all age groups, but in particular for young persons. Legislative restrictions on the accessibility of divorce and its high cost appear to have kept the divorce rates of young Australians artificially low when compared with their counterparts in the United States and elsewhere.[2] The long term effect of this legislation is not yet clear; although more recent data indicate that the total number of divorces fell in the late 1970's, until the initial backlog of divorce applicants cleared, and has begun to rise again from 1980. Thus, divorce rates are not likely to fall back to those levels experienced before the introduction of the Family Law Act. The reduced cost and the increased access to and speed, ease and social acceptance of divorce can be expected to lead to long term increases in divorce rates at all ages, and, in particular, at young ages.[3]

In this study, data on divorces by the age of the females involved is required. However, only the total number of divorces were recorded prior to 1946 and, between 1946 and 1949, age specific information was available only in quinquennial age groupings. The Databank provides estimates of the age distribution of divorces for the entire sample period, but the age distributions prior to 1950 were manufactured and provide little

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1. See W.D. Borrie, et al., Population and Australia, Recent Demographic Trends and their Implications, Supplementary Report of the National Population Inquiry (Canberra : Australian Government Publishing Service, 1978), p.28ff.

2. See Lincoln H. Day, "Patterns of Divorce in Australia and the United States", in American Sociological Review, Vol.29, No.4 (1964), p.512.

3. Some commentators have suggested that the divorce rate has already returned to its pre-Family Law Act trend, and that the Act provided only a temporary alteration to that trend (see Seweryn A. Ozdowski and John Hattie, op. cit., p.11). However, this conclusion does not allow for the effect that the Act will have upon the formalization of marital breakdown. Couples, especially those whose marriages are of short duration, will now be more likely to seek the legal dissolution of an unsatisfactory marriage. Divorce rates can therefore be expected to increase above the trend set in the late 1960's and early 1970's. This view is supported by Peter F. McDonald, "Marriage and Divorce in Australia", op. cit., p.27.

insight into divorce behaviour. Between 1946 and 1949, the quinquennial age groupings were spread over single ages by osculatory interpolation. Before 1946, the proportionate single age distribution for each year was assumed to be identical with the average for 1946 to 1949. Therefore, little confidence can be held in these age distributions, especially since the period 1946 and 1949 could be regarded as atypical. In these years immediately following World War II the overall divorce rate, as shown in Figure 14, was higher than at any other time during the sample period. Since marriages of relatively short duration were a substantial component of these high divorce rates, the age distributions of divorces during this period were skewed towards the younger ages when compared to the distributions of earlier and later periods.[1] Hence, whilst the results for the years prior to 1950 will be reported, little emphasis should be placed upon them.

(b) General trends

The total number of divorces and the overall rate of divorce,[2] as depicted in Figures 13 and 14, illustrate the relationship between divorce behaviour and prevailing economic and social conditions over the sample period. During the boom conditions of the 1920's, the total number of divorces and the overall divorce rate rose. The Depression had the expected effect of reducing the number of divorces, although only slightly. When the effect of changes in the population at risk is taken into account,

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1. Lincoln H. Day, "Divorce in Australia", in Australian Quarterly, Vol. 35, No.2 (1963), p.59.

2. The overall divorce rate is calculated as the total number of divorces in a given period divided by the total number of married persons aged 15 years and over, at the beginning of that period.

via the overall rate of divorce, the reduction in divorce is more pronounced. Following the Depression, the total number, and the overall rate, of divorces increased steadily until World War II when both measures increased dramatically. The increases in divorces following World War II was probably a direct result of the disruption of wartime and of the relative instability of those marriages which were hurriedly brought forward at the commencement of the war.[1] After the war, the total number of divorces fell slightly, but stabilized until the early 1960's at a level approximately 250% higher than that experienced before the war. From the early 1960's, there has been an almost continual increase in the total number of divorces, with a phenomenal increase in 1974/75 and again in 1975/76. As mentioned above, the total number of divorces has fallen after 1975-76 and in 1980 appears to have stabilized at a much higher level than prior to the introduction of the Family Law Act. The overall rate of divorce decreased for most of the post-war period to the late 1950's, suggesting that the stable numbers of divorce over this period occurred at a time when the population at risk was increasing. This indicates a trend of general reduction in divorce over that period. From the late 1950's, the overall rate of divorce increased almost continuously, with an unprecedented increase occurring with the introduction of the Family Law Act. The earlier increases in divorce were probably related to the improved economic conditions of the 1960's and early 1970's, which increased the ability of couples to afford divorce actions and of women to survive outside the conjugal arrangement, and the increased social acceptance of divorce. It is also interesting to speculate on the extent of the positive effect that the increase in the social acceptance of

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1. Peter F. McDonald, "Marriage and Divorce in Australia", op. cit., p.25.

divorce had upon the leniency with which the divorce laws were applied in the courts prior to the introduction of the Family Law Act.[1] The Family Law Act prompted enormous increases in divorce rates at the end of the sample period. As discussed previously, this could be seen as a reflection of the latent demand for divorce which had been thwarted by earlier legislative restrictions, and also as an indication that divorce rates are unlikely to fall back to the levels experienced before the introduction of the Act. If divorce rates in countries such as United States and Sweden can be used as a guide,[2] it is possible that the recent fall in divorce rates, after 1975-76, will not continue but that divorce rates may, in the long term, rise substantially.

(c) The age distributions and their approximations

The historical and approximated age distributions of the age specific rates of divorce for females and males for four typical years are given in Figures 15 and 16. The historical age distributions show that, for both females and males throughout the sample period, divorce rates have been low at young ages and have risen rapidly with age, until peaking over a wide age range from the mid to late 20's for females and from the late 20's to early 30's for males. In the later part of the sample period, however, the peak age range narrowed substantially, with divorce rates at older ages declining more quickly than they had in the

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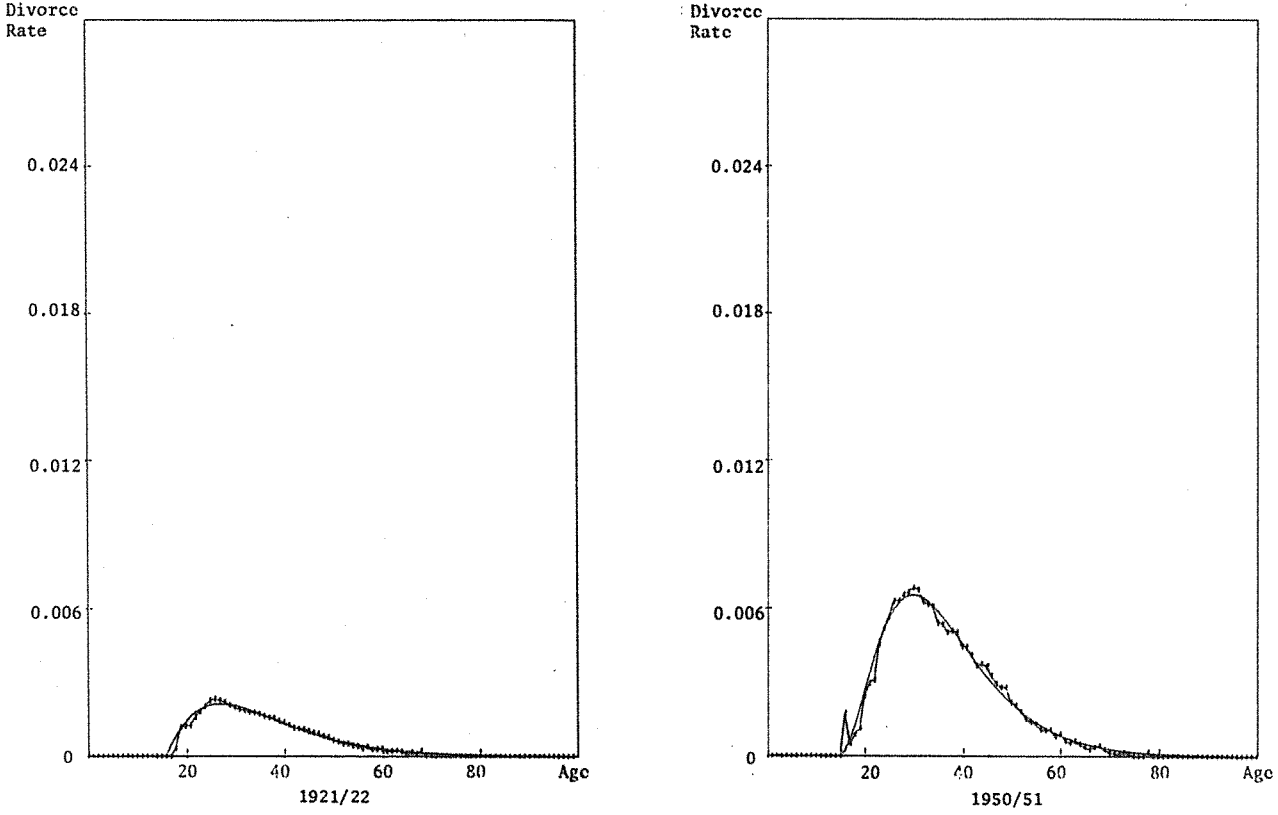
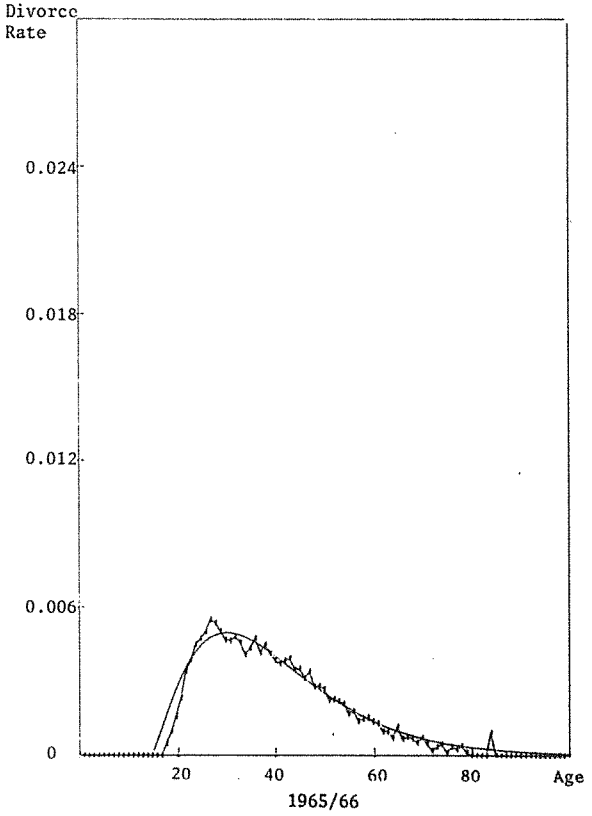
1. The increased leniency in enforcement of the Matrimonial Causes Act in the 1970's is also noted by Seweryn A. Ozdowski and John Hattie, op. cit., p.12.

2. For information on divorce in the United States see Lincoln H. Day, "Patterns of Divorce in Australia and the United States", op. cit., and Arthur J. Norton and Paul C. Glick, "Marital Instability: Past, Present and Future" in Journal of Social Issues, Vol.32, No.1, 1976; in Sweden, see Robert Schoen and William Urton, "Marriage, Divorce and Mortality: The Swedish Experience" in Proceedings of the General Conference of the International Union for the Scientific Study of Population, Vol.I, 1977; and for some international comparisons, see Alisa Burns, "Marital Breakdown and Divorce" in Search, Vol.5, No.7, July 1974.

FIGURE 15

TYPICAL AGE DISTRIBUTIONS OF THE RATES OF DIVORCE FOR AUSTRALIAN FEMALES (++) AND THEIR GAMMA APPROXIMATIONS (—), 1921/22, 1950/51, 1965/66 AND 1975/76.




Divorce
Rate
0.024
0.018
0.012
0.006
0
20
40
60
80
Age
1965/66

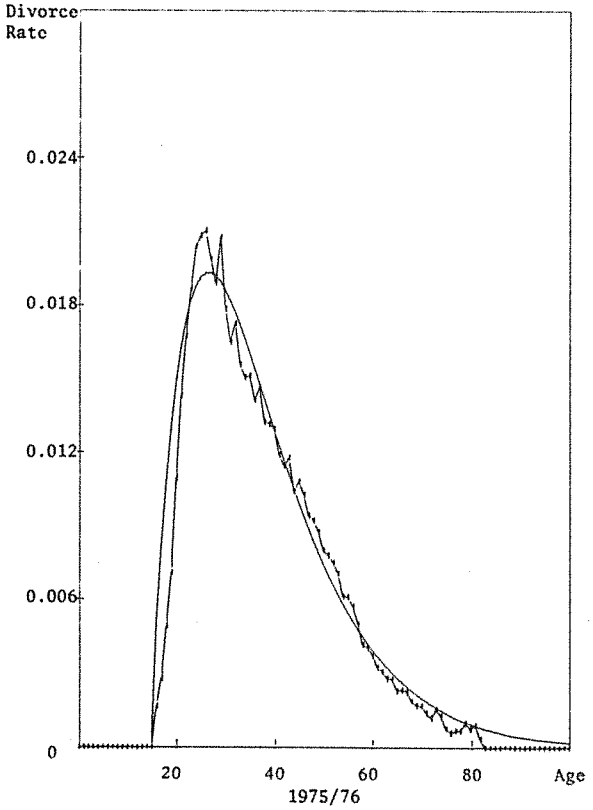
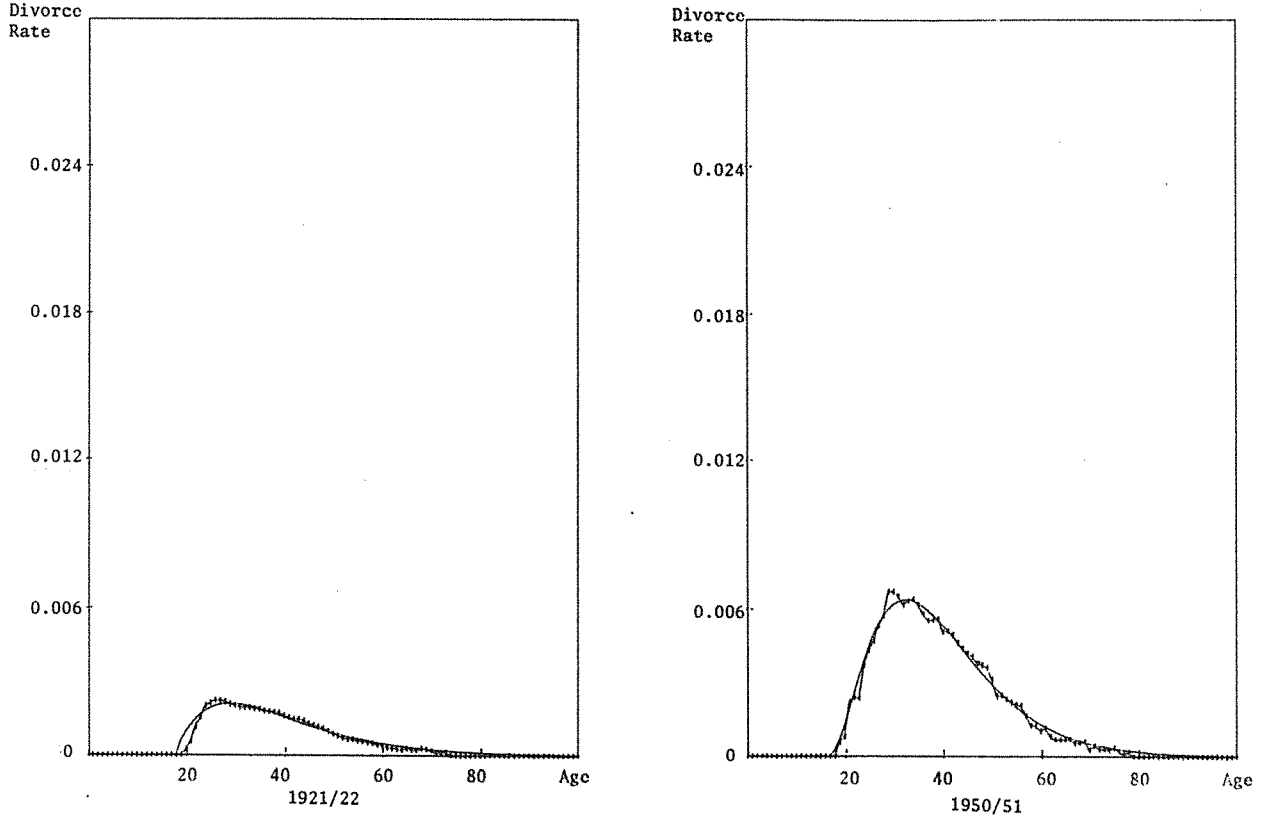
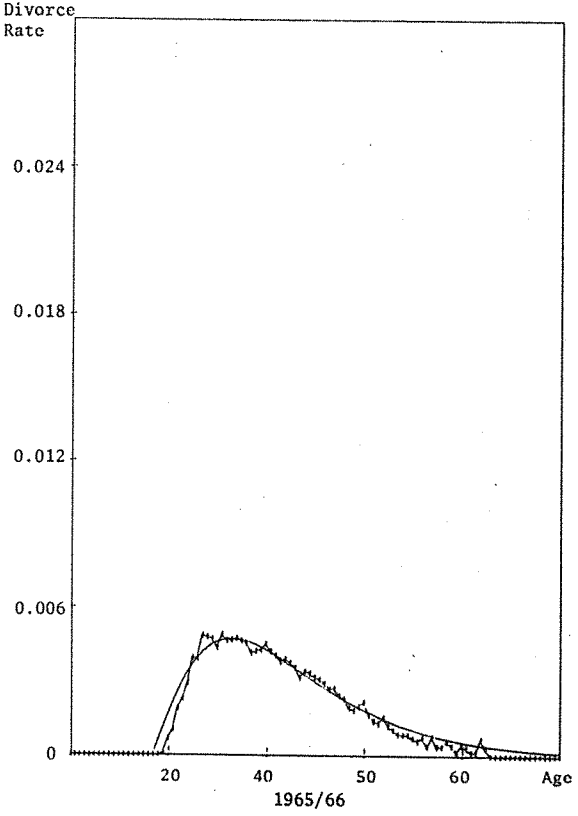

Divorce
Rate
0.024
0.018
0.012
0.006
0
20
40
60
80
Age
1975/76

FIGURE 16

TYPICAL AGE DISTRIBUTIONS OF THE RATES OF DIVORCE FOR AUSTRALIAN MALES (++) AND THEIR GAMMA APPROXIMATIONS (—), 1921/22, 1950/51, 1965/66 AND 1975/76




Divorce
Rate
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0.012
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20
40
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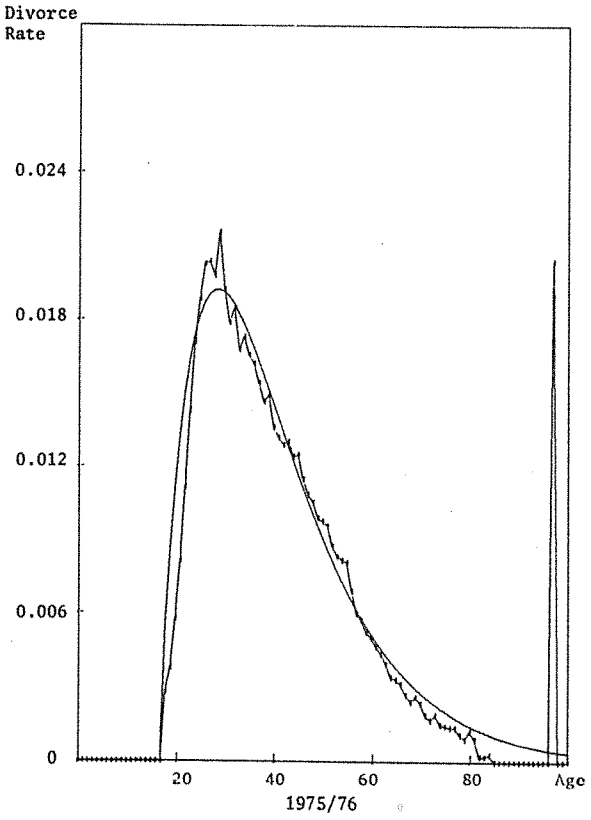
60
Age
1965/66


Divorce
Rate
0.024
0.018
0.012
0.006
0
20
40
60
80
Age
1975/76

past. The approximations to these age distributions smooth out the often erratic age specific rates of divorce, capturing their general shape. However, smoothing was such that the rates were consistently overestimated at younger ages, underestimated at the peak of the distribution and occasionally in the 40 to 60 age group, and overestimated at older ages. Consequently, the approximation has the effect of reducing divorce rates at the peak ages and increasing them for the young and older ages. For both females and males, these problems worsened in the later years of the sample period.

Figures 15 and 16 refer to the age specific rates of divorce, whereas it may be more useful to consider the numbers, rather than rates, of divorces. In Figures 17 and 18, four typical age distributions of the numbers of divorces and their approximations are given for females and males respectively. Differences between these distributions and those for the rates of divorce arise from variations in the population at risk of divorce at each age. The age distributions of the numbers of divorces show a similar pattern to that of the rates of divorce, although the peak ages are slightly later, and the distributions in the later years of the sample period are more sharply peaked. The approximations to these distributions have performed adequately; they have been able to capture most of the changes in divorce over the age distribution and over time. The overestimation of rates of divorce at young and older ages has not lead to substantial overestimation of the numbers of divorces at these ages, because the population at risk of divorce is smaller. The robustness of the approximation technique is clearly indicated by its ability to capture the substantially different age distribution in 1975/76 for both females and males.

(d) The accuracy of the approximations

The adequacy of the approximation technique can be summarized by the mean error between the historical and approximated number of divorces, as given in Figure 19, for females and males. Since the total number of divorces for females and males is by definition equal, it is crucial that the approximation technique does not give substantially different estimates of the total number of divorces for each sex. Thus it is preferable that the mean errors be similar for females and males and that they be as close as possible to zero. Comparisons of the trends in the mean errors for females and males show that in the earlier periods the errors are positively correlated, but the extent of overestimation is generally smaller and the extent of underestimation is generally greater for females than males, whilst in the later periods the errors are more erratic, although still positively correlated for females and males. . Prior to 1950, divorces were variously overestimated and underestimated; the smooth pattern exhibited by these errors over time indicates the inadequacy of the data which were constructed for the age distribution of divorce in the Australian Demographic Databank. The movements in these errors do not, therefore, offer any firm evidence as to the accuracy of the approximations prior to 1950. From 1950/51, when reliable data is available, the mean errors are more erratic. They indicate that the gamma approximation has consistently overestimated the total number of divorces by from 0.3% to 1.8% for females and by from 0.5% to 1.8% for males. Over the last few years of the sample period there has been less overestimation of the number of divorces, indicating that the approximation technique is capturing the total number of divorces more accurately. The technique appears to be performing with similar accuracy for both sexes, but the consistent overestimation of the number of divorces, although quite small,

FIGURE 17

TYPICAL AGE DISTRIBUTIONS OF THE NUMBERS OF DIVORCES FOR AUSTRALIAN FEMALES (++) AND THEIR GAMMA APPROXIMATIONS (—), 1921/22, 1950/51, 1965/66 AND 1975/76

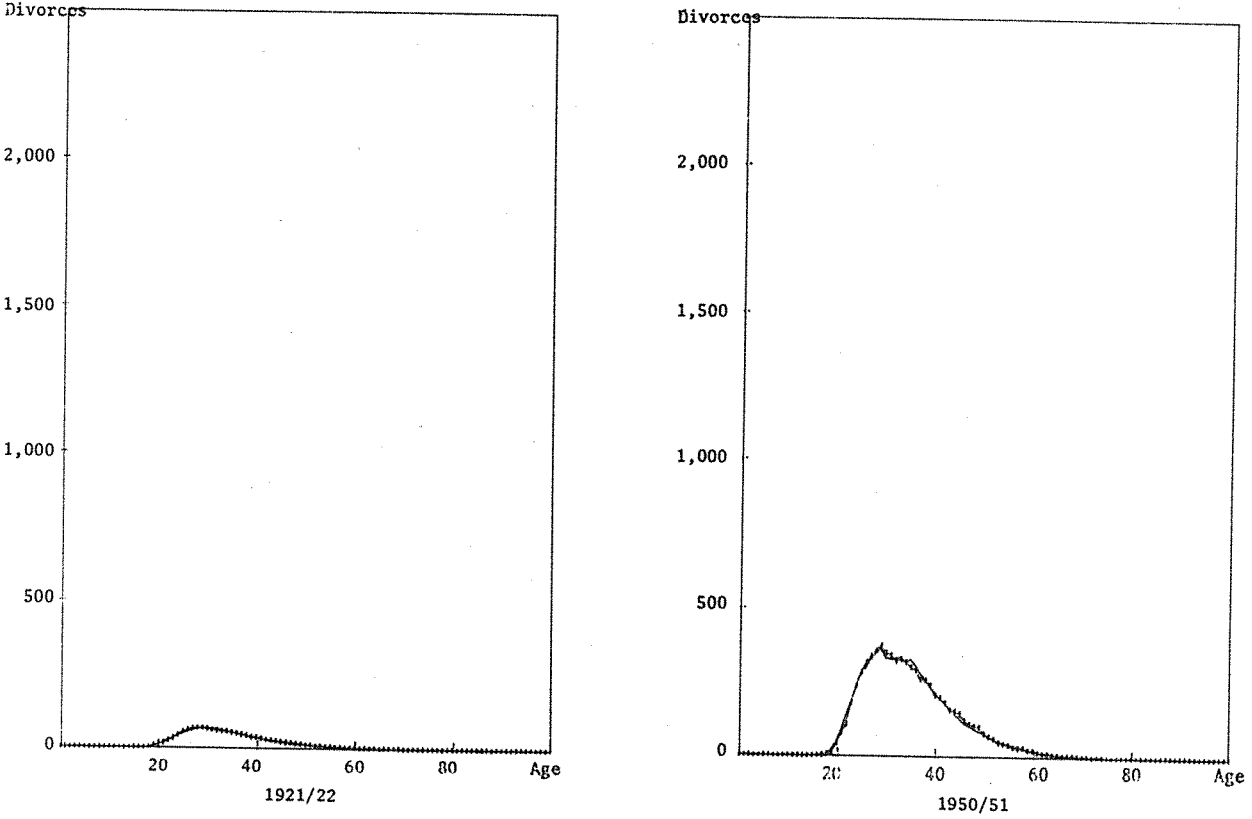
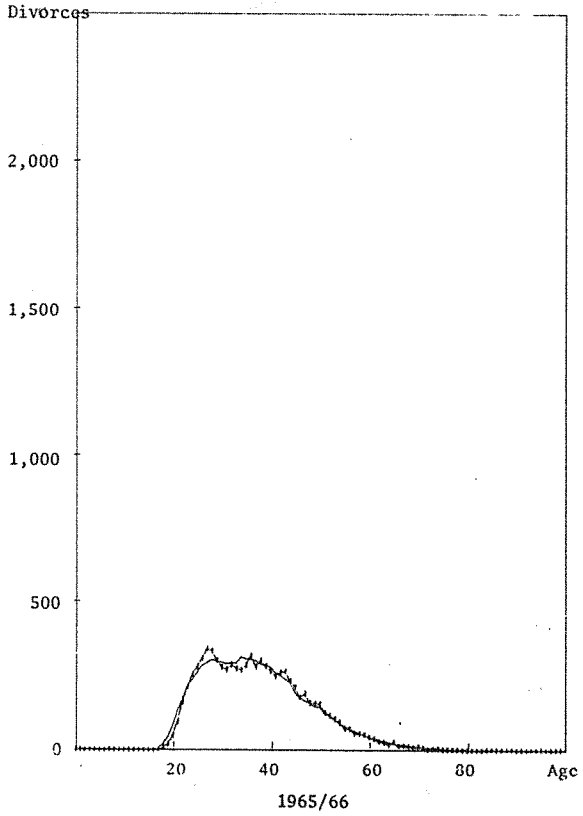


FIGURE 17 *continued*



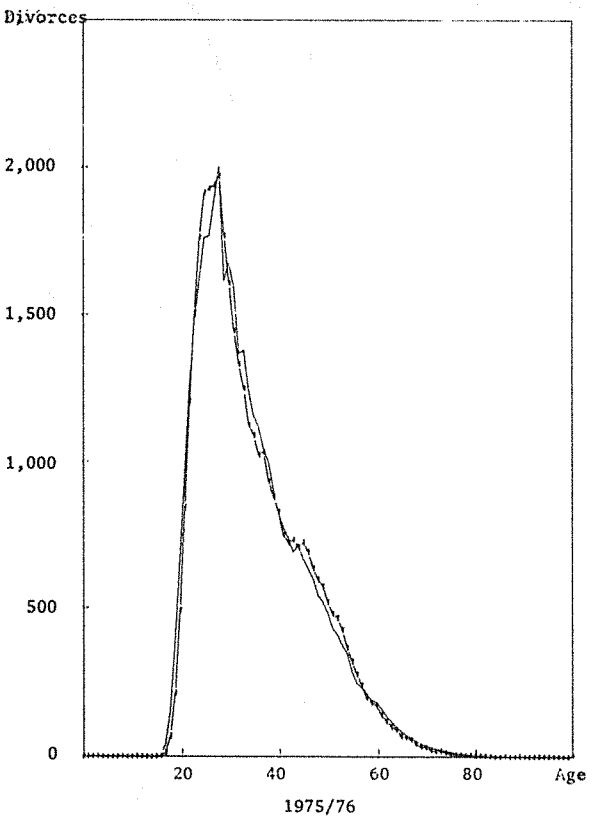


FIGURE 18

TYPICAL AGE DISTRIBUTIONS OF THE NUMBERS OF DIVORCES FOR AUSTRALIAN MALES (++) AND THEIR GAMMA APPROXIMATIONS (—)
1921/22, 1950/51, 1965/66 AND 1975/76

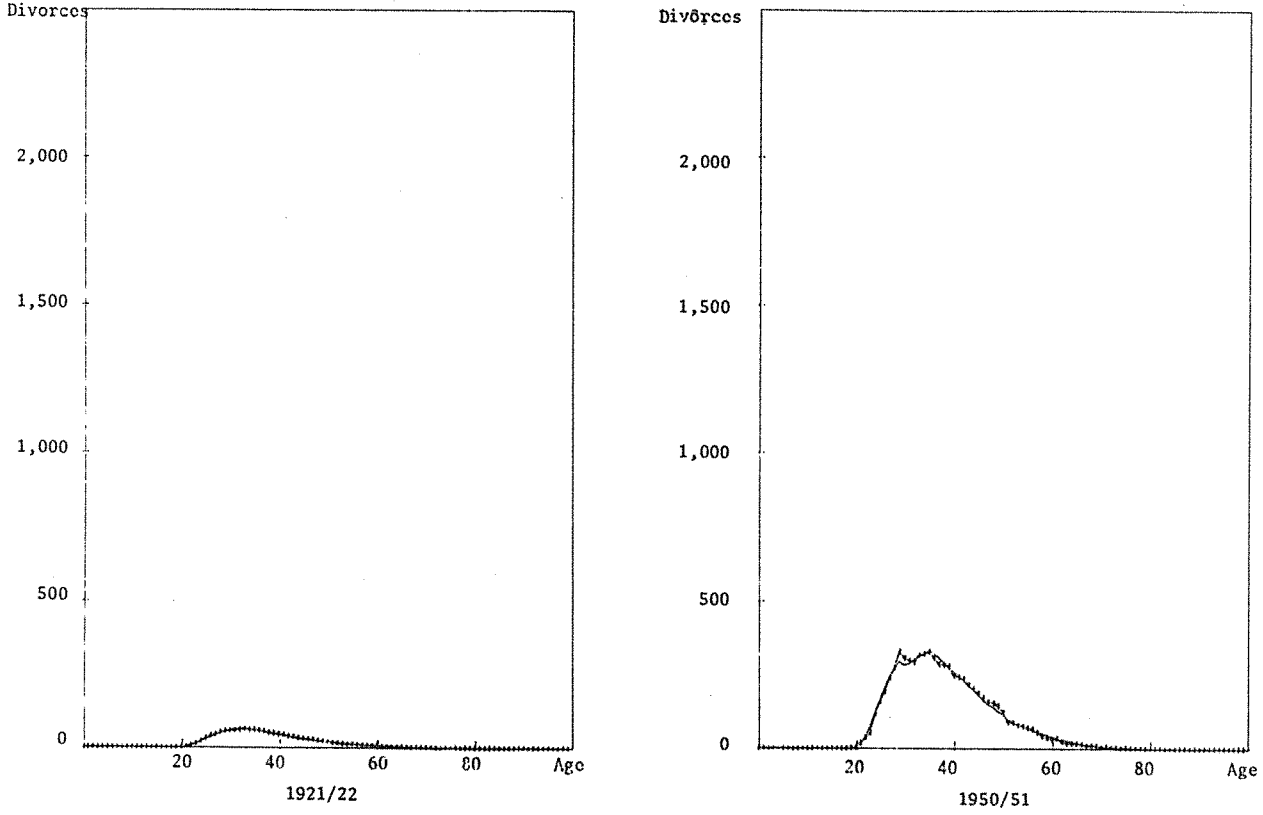
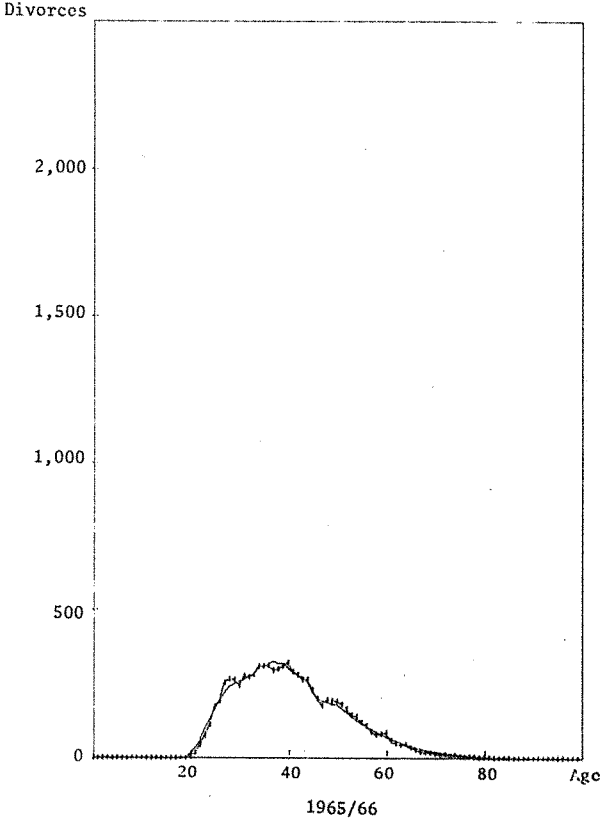


FIGURE 18 *continued*



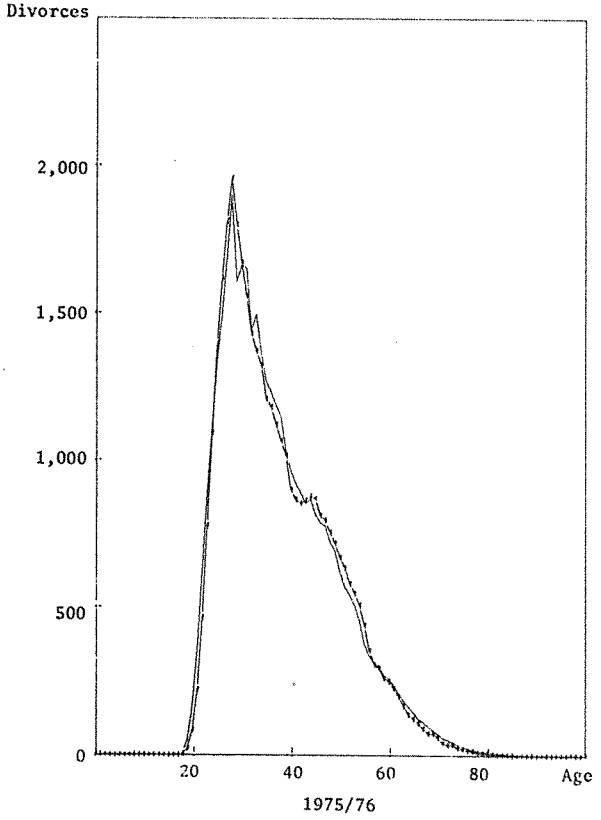


FIGURE 19

MEAN ERROR BETWEEN THE NUMBER OF DIVORCES AND ITS GAMMA APPROXIMATION FOR AUSTRALIAN FEMALES (++) AND MALES (—) 1921/22 TO 1975/76

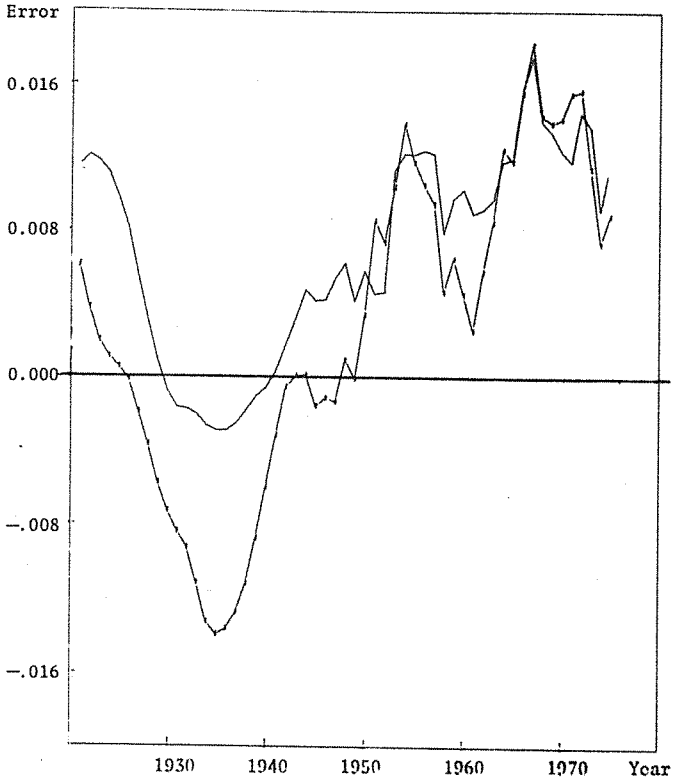
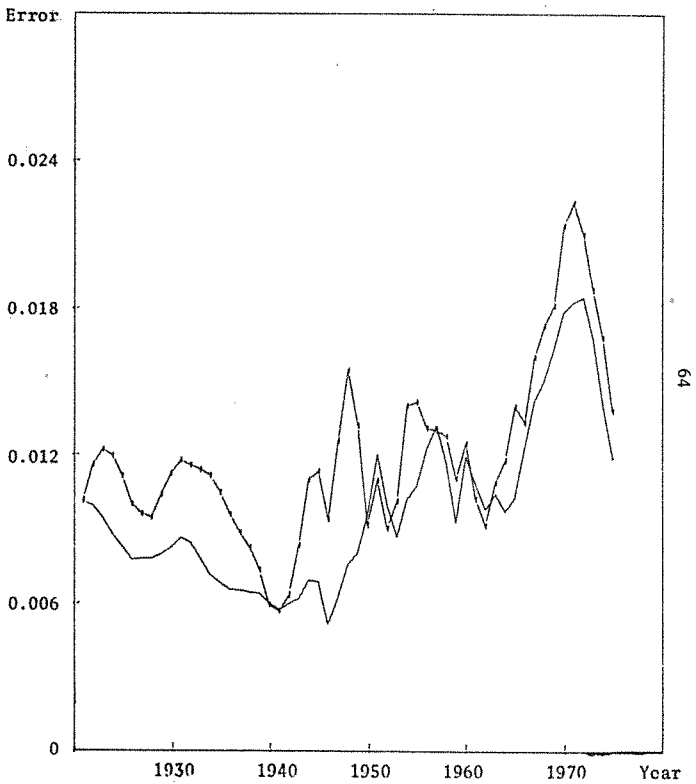


FIGURE 20

ROOT MEAN SQUARED ERROR BETWEEN THE NUMBER OF DIVORCES AND ITS GAMMA APPROXIMATION FOR AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76



is a source of concern. In projection this could imply not only that the number of divorces would be overestimated, but also that the number of remarriages of divorcees would also be overestimated, since the numbers at risk of remarriage would be artificially inflated. Concurrently the numbers at risk of divorce, who are the numbers of married persons, would be decreased by the larger number of divorces and increased by the larger number of remarriages of divorcees. The total net effect is therefore difficult to determine.

The root mean squared error between the number of divorces and the approximation for both females and males is given in Figure 20. This error, which measures the ability of the technique to approximate the number of divorces at a given age, fell from high levels during the 1920's, to about half these levels in the early 1940's before rising again. The error for males was consistently below that for females. From 1950/51 up to the mid-1960's, the root mean squared error fluctuated for both females and males about a level approximately equal to that attained by females in the 1920's. From the mid-1960's to the early 1970's, however, the root mean squared error increased dramatically for males and even more so for females. This occurred at approximately the same time that the mean error was increasing for both females and males, suggesting that the technique was performing poorly in terms of approximating the total number of divorces and the divorces at any given age. Fortunately, however, from the early 1970's, both the mean error and the root mean squared error have been falling for males and females. The root mean squared error appears to be approaching that level about which it fluctuated in the 1950's. Hence, for any particular age, the accuracy of the approximation appears to be improving at the end of the sample period. This is encouraging given the the enormous changes in divorce behaviour at that time.

(e) The parameters of the age distributions

The index of propensity to divorce for females and males is given in Figure 21. The trends exhibited by the propensity closely follow the behaviour of the overall rate of divorce, which is given in Figure 14, and has been analysed earlier. The index for females has been consistently below that for males throughout the period, although both have followed very similar trends. Differences between the two are closely related to the differences between females and males in the age distribution of divorces and of persons at risk of divorce. Throughout the sample period, the propensity has shown a generally increasing trend, with some decline during the Depression and then following World War II and until the late 1950's. The decline at the time of the Depression was to be expected, as the pecuniary costs of divorce (including the capability of either partner to support himself or herself outside of the marriage) would have become more prohibitive. The increased propensity to divorce immediately following World War II was to be expected given wartime dislocation and the breakdown of hastily arranged wartime marriages. This view is supported by the observation that divorce propensity declined soon after and that marriages of short duration were a larger proportion of this post-war increase in divorce propensity.[1] The decline in divorce propensity in the 1950's probably reflects the effects of the "high societal value that was placed on marriage and the family during the 1950's"[2] and of the increased fertility of that period,[3] which could be

1. See Lincoln H. Day, "Divorce in Australia", op. cit., p.59.

2. See Peter F. McDonald, "Marriage and Divorce in Australia", op. cit., p.2

3. Thornton has shown, for the United States, that marital instability is greatest for families with no children or a large number of children and is least for families with between one and four children; see Arland Thornton, "Children and Marital Stability" in Journal of Marriage and the Family, Vol.39, No.3 (August 1977). During the 1950's and 1960's, Australian fertility patterns were such that families increasingly fell into the "stable" category.

expected to increase the pecuniary and non-pecuniary costs associated with divorce. Despite the post-war decline, the propensity to divorce still remained in excess of the levels experienced before the war and, after 1960, it increased almost continually throughout the remainder of the sample period. This occurred during a period of general economic growth when the capacity to afford divorce proceedings and to afford living outside the conventional conjugal arrangements (especially for women) increased substantially. Increased divorce propensity was observed for all ages and all durations of marriage, indicating an enhanced acceptance of divorce throughout the population.[1] To some extent, the Family Law Act merely facilitated a trend of increased propensity to divorce which was already present; some divorces were brought forward and a large number of informal divorces were legalised. As was discussed earlier, future trends in divorce propensity are difficult to determine. Whilst the decreased pecuniary and non-pecuniary costs of divorce under the new laws and the increased economic and social independence of women, would suggest long-term increases in divorce propensity, the effect of the trends relating to marriage should also be considered. If the trends of increasing cohabitation, declining marriage propensity and increased age at marriage were to continue, perhaps only the more stable unions of females and males would culminate in legal marriages, and, consequently, the likelihood of marriage breakdown and divorce would fall.[2] However, marriage, of itself, still appears to be strongly desired and it may be more likely that we will observe an increase in serial marriages, with divorce propensities remaining at a high level.

In Figure 22, the means of the approximated age distributions of divorce rates for females and males are illustrated. Of interest is the

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1. See Peter F. McDonald, "Marriage and Divorce in Australia", op. cit., p.27.

2. This hypothesis is supported by the analysis, using United States data, of Gary R. Lee, "Age at Marriage and Marital Satisfaction : A Multivariate Analysis with Implications for Marital Stability" in Journal of Marriage and the Family (August 1977).

FIGURES 21, 22 AND 23
THE PARAMETERS OF THE APPROXIMATED AGE DISTRIBUTIONS OF AGE SPECIFIC RATES OF DIVORCE FOR AUSTRALIAN FEMALES AND MALES 1921/22 TO 1975/76

FIGURE 21

INDEX OF PROPENSITY TO DIVORCE FOR AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76

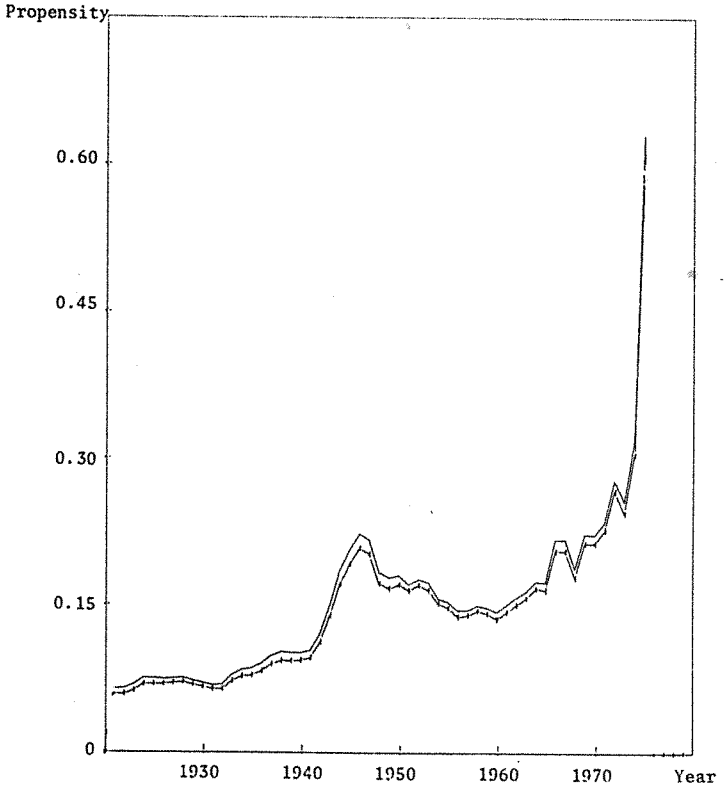


FIGURE 22

MEAN AGE AT DIVORCE FOR AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76

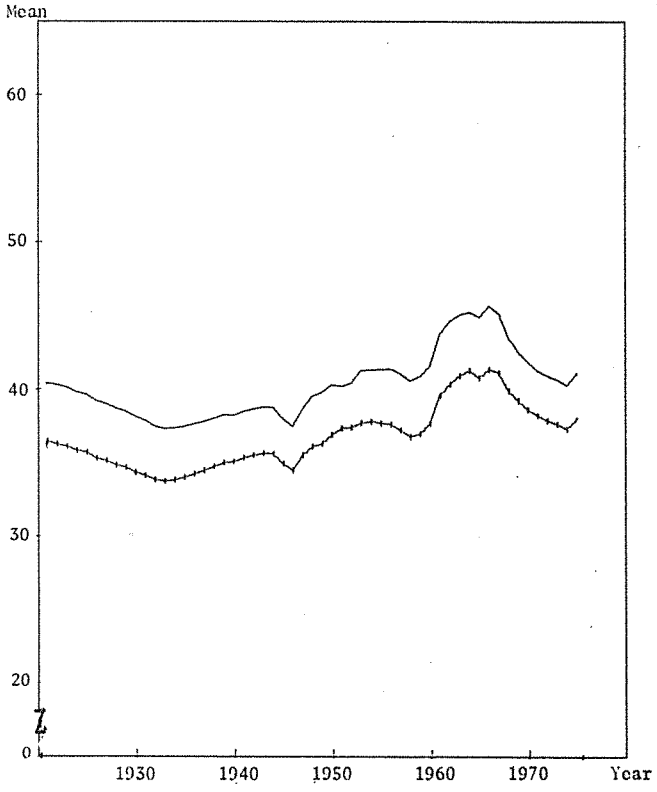
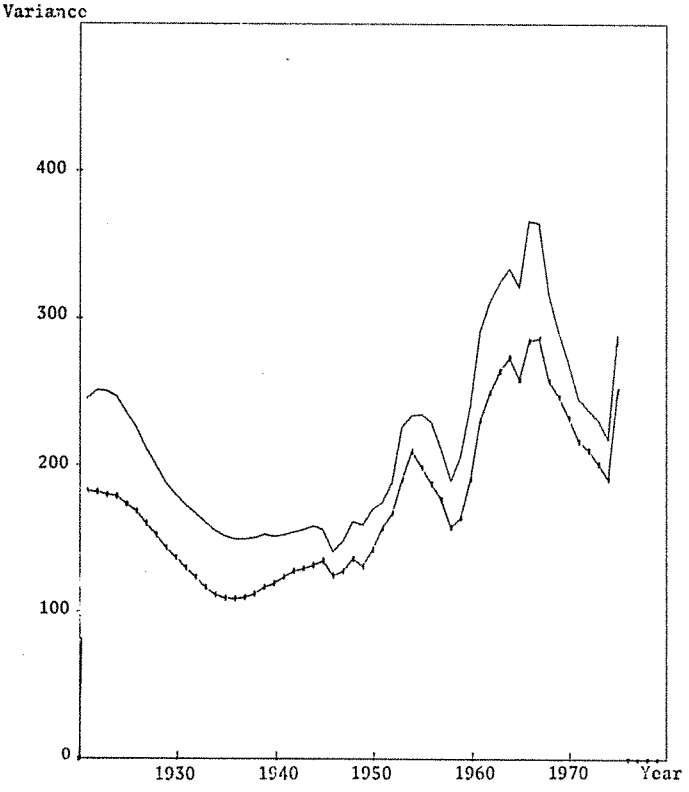


FIGURE 23

VARIANCE OF AGE AT DIVORCE FOR AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76



observation that the mean age for males has been consistently above that for females by approximately four years, except during wartime and in the last few years of the sample period when the differential declined to approximately three years. The timing of these declines has roughly corresponded to periods in which the propensity increased dramatically. This observation could be said to support the widely held notion that couples of wider age difference are more prone to divorce,[1] in that, when divorce increases in popularity, couples with a lower difference in age begin to resort to divorce, thus reducing the difference between the mean age at divorce for females and males. Over the early part of the sample period, the means move very smoothly but this is a direct consequence of the manufacture of divorce data prior to 1950 and may not accurately represent divorce behaviour over that period. Immediately following World War II, when the propensity to divorce rose dramatically, the mean age at divorce fell. This was to be expected given that divorces of young persons were a substantial component of this increased propensity to divorce. The mean age then increased to above its pre-war levels and showed a general trend of increase (with the exception of a slight fall in the late 1950's) until the mid 1960's. Hence, the trend of increase in the propensity to divorce from the late 1950's did not derive at first from a disproportionate increase in the divorces of younger persons, as could have been expected.[2] However, as divorce levels increased after the mid 1960's and as the age at marriage continued to decline, the mean age at divorce could not be sustained at such high levels and began a steady decline for

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1. This proposition has been supported by statistical analysis in Lincoln H. Day, "Divorce in Australia", op. cit., p.63.

2. This was also observed in Lincoln H. Day, "Divorce in Australia - Another Look" in The Australian Quarterly, Vol.48, No.2, June 1976, p.62ff.

the rest of the sample period. Over this period, before the introduction of the Family Law Act, there were substantial increases in divorces for all durations of marriage, and especially for marriages of longer durations. It has been suggested that this resort to divorce for more "respectable" marriages led to a quicker social acceptance of divorce and an acceleration of the introduction of the Family Law Act.[1] Despite these increases in divorce for marriages of longer duration, the mean age at divorce continued to fall, with divorce increasing for younger ages. In the very last year of the sample period, however, the mean age increased for both males and females. This should not be seen as a significant new trend, since the nature of the enormous changes in divorce in this year were related more closely to legislative and procedural changes than to actual changes in divorce behaviour. The Family Law Act provides for substantial reduction in the time taken to gain a divorce and should prompt some decline in the mean age at divorce in the short term. However, in the long term, if age at marriage continues to rise, and if serial marriages become more common, continued reductions in the mean age at divorce seem unlikely.

The variance of the approximations to the age distributions of female and male divorce are given in Figure 23. The variance for males is consistently higher than that for females, but the differential between the two varies throughout the sample period. For both males and females, there was a general decline in the variance until the mid 1930's, after which it increased. This increase in variance continued until the late 1960's, except for a short period of rapid decline in the 1950's. The general increase in variance was to be expected because the increased

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1. Peter F. McDonald, "Marriage and Divorce in Australia", op. cit., p.27.

incidence of divorce was distributed more evenly across the age distribution. However, from the late 1960's, the variance of the age distribution fell along with the decline in the mean age at divorce and the rise in the propensity to divorce. Divorce became increasingly concentrated amongst a smaller, younger group. In the final year of the sample period, the variance increased, but this may (as with the mean age) be only a short term phenomenon. Possible future trends for the variance of age at divorce are debatable. Under the Family Law Act 1975, divorce has become increasingly accessible for couples of all ages, and those with marriages of short duration have been quick to take advantage of this accessibility. Whilst this could imply reductions in the mean age and variance in age at divorce in the future, it must be balanced against the expected trends towards older age at marriage and serial marriage, which would imply increased mean age and variance in age at divorce.

(f) Summary

The ability of the gamma approximation to depict adequately changes in divorce behaviour over the sample period has been well demonstrated. The age distributions of divorce rates are erratic and their shape is difficult to approximate using smooth distributions. As the divorce rate distribution widened over the sample period, the approximation tended to shift divorces for both females and males from the early to mid 20's and overestimated rates at older ages. Whilst this led to consistent overestimation of the total number of divorces in the post-war period, the overestimation never exceeded 1.8% for females or males and the approximation method showed some improvement in its ability to capture divorce rates for individual ages at the end of the sample period. It has been possible to attribute the movements in the propensity to divorce and in the mean age and variance in age at divorce to changes in legislation pertaining to divorce, general economic conditions, dislocation caused by war, the

financial and social independence of women, and increasingly positive social attitudes towards divorce.[1] These variables should therefore be incorporated into the econometric model to be used to explain the movements in these parameters of Australian divorce behaviour.

3.3 Remarriages

(a) Data and the effects of legislative changes

Accurate data on the remarriages of divorced and widowed persons are readily available. Since the remarriage behaviour of divorced and widowed persons are quite different, their remarriages have been approximated separately in this study. Whilst there have been some changes in the legislation pertaining to marriage, as discussed earlier, the subsequent effects have been concentrated in younger marriages, which are less likely to be remarriages of divorced or widowed persons. In the long term, these legislative changes could be expected to affect the number of remarriages and the age distribution of these marriages via the effect on first marriages and subsequent divorce and widowings. It is possible that any legislation which, for example, tends to decrease the age at first marriage will tend to bias the distribution of numbers at risk of divorce and widowing towards the younger ages and subsequently bias the numbers of divorced and widowed persons, who are in turn at risk of remarriage, towards younger ages. Hence, in the long term, decreases in the age at first marriage could lead to decreased age at remarriage. A decrease in the age at first marriage may also imply an increase in the proportions of females or males who finally marry. This would increase the numbers at risk generally and lead to increased numbers of remarriages. The exact nature of these effects is, however, difficult to quantify.

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1. However, one should be wary of overzealous attempts to explain divorce behaviour totally in terms of general economic and social variables; see Elwood Carlson, "Divorce Rate Fluctuation as a Cohort Phenomenon" in Population Studies, Vol.33, No.3 (November 1979), p.524ff.

Of more obvious relevance are changes in the legislation pertaining to divorce, which were discussed earlier. If divorce becomes more accessible, and consequently increasingly common, the stock of divorcees at risk of remarriage and hence the total number of remarriages could be expected to increase (especially if one subscribes to the notion that divorce can be the means of dissolving a marriage in order for the individuals involved to form a more satisfactory union.[1]). However, it is debatable whether, in the long term, increased accessibility of divorce will dramatically increase divorce rates and lead to reduced age at divorce and subsequent increases in the rates of, and reductions in the age at, remarriage for divorcees. These possibilities must be carefully considered when projections are made.

This study requires age specific data on the rates of remarriage of divorced and widowed persons to numbers at risk, which are available for the entire sample period. The data do, however, present some difficulties. The population at risk of remarriage is measured at the beginning of the period and it is possible that remarriages within the period will include some remarriages of people who became at risk during the period. If the age group under consideration involves a small number of people, the number of remarriages within the period of persons of that age may exceed the number of persons of that age who were at risk of remarriage at the commencement of the period. Thus remarriage rates, especially at younger ages, could possibly exceed unity.

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1. The view that increased divorce rates indicate an increased turnover of marriages rather than a rejection of marriage is widely held; for example, see Alisa Burns, op. cit., p.309; Lincoln H. Day, "Divorce in Australia - Another Look", op. cit., p.65; and S. Sarantakos, "Anatomy of Divorce" in Australian Journal of Social Issues, Vol.10, No.3 (1975), p.176.

In the very small groups, this could also be a consequence of the method used to convert data on population stocks and flows from an annual to financial year basis. In fact, in several cases the rates of remarriage of divorced and widowed persons exceeded unity. To avoid difficulties of interpretation, those rates which exceeded unity were constrained to equal unity. As the rates which exceeded unity were at ages where the numbers at risk were small, the effect on the total number of remarriages is very small.[1]

However, for remarriages of divorcees, it was felt that the data problem which allowed rates to exceed unity was less easily solved. It is reasonable to suppose that many people divorce for the express purpose of remarrying, and will remarry as soon as possible after their divorce. Hence, it is likely that a person who was not divorced at the start of the period may divorce and then remarry within the period. Rates of remarriage of divorcees, calculated using an at-risk population of the number of divorcees at the beginning of the period will therefore be artificially high. Under the assumption that divorces are evenly distributed throughout the year, half of those who become divorced during the year are at risk of remarriage during that year. Hence, rates of remarriage of divorcees are calculated using an at-risk population comprising the number of divorcees at the beginning of the period plus one half of the number of divorces during the period. It was hoped that, as well as providing more realistic rates of remarriage for divorcees, this would reduce the possibility of remarriage rates exceeding unity. In those few cases where these rates did exceed unity, they were constrained to equal unity.

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1. Constraining remarriage rates to unity also has little effect on the fitting of the gamma approximation to the age distribution of remarriage rates, since the fitting procedure is devised to give little importance to fitting rates where the numbers at risk are very small.

In the remainder of this section, there follows a discussion of the remarriages of divorced persons followed by a discussion of the remarriages of widowed persons.

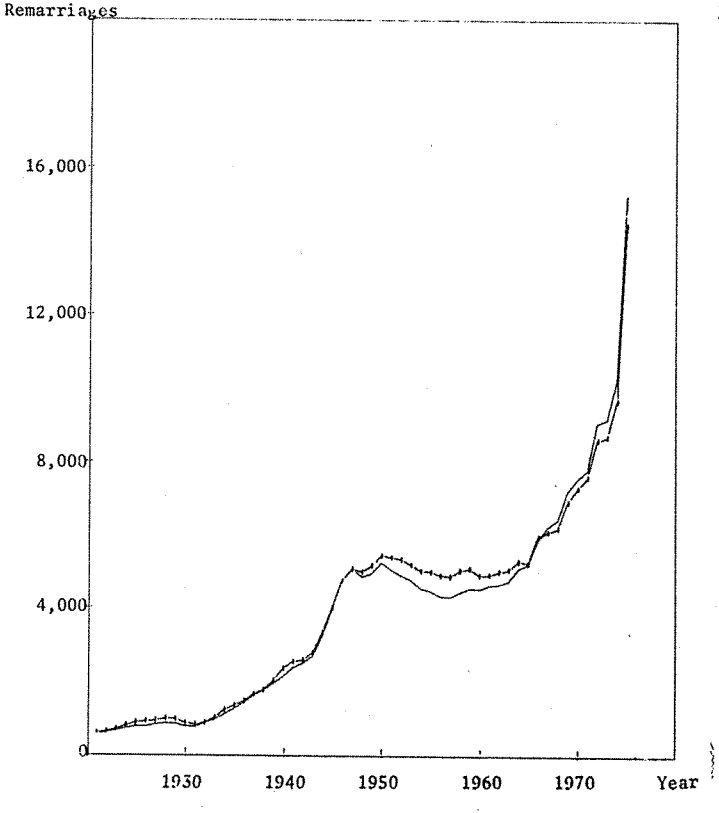
3.3.1 Remarriages of Divorced Persons

(b) General trends

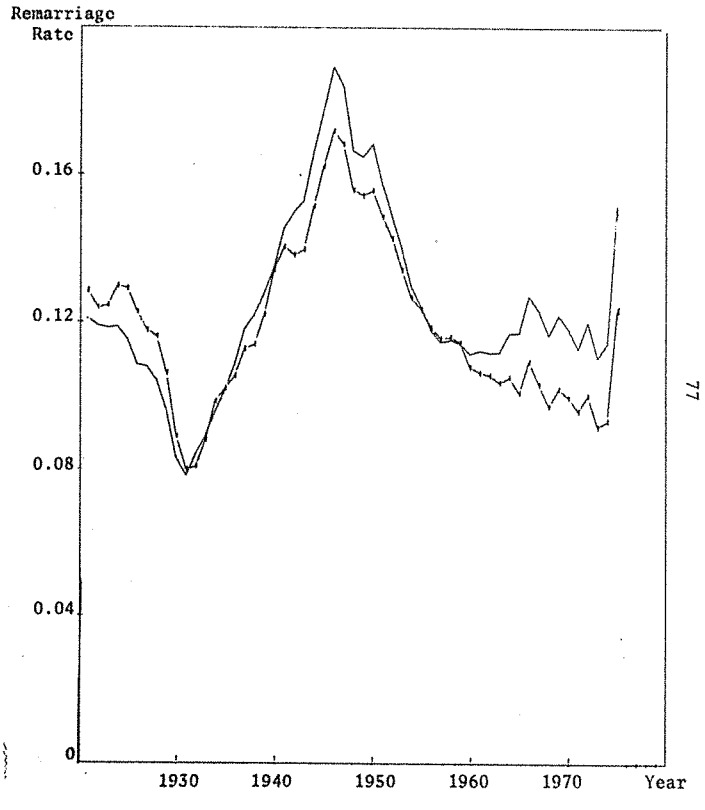
The total number of remarriages of divorced females and males, given in Figure 24, indicates that, whilst substantial changes in remarriage behaviour have occurred, the numbers of remarriages of females and males have been positively correlated, with the numbers of females generally exceeding that for males until the mid 1960's and the reverse occurring thereafter. The differences between female and male behaviour can be related to the imbalance between the sexes in Australia, which was discussed extensively in Section 3.1. In a period of relative surplus of males, the marriage desires of males would be restricted by the limited availability of suitable female partners, and the shortfall would to some extent be made up by divorced females. This hypothesis is borne out by the increased differential between female and male remarriages in the 1950's, when the surplus of unmarried males reached a high level under the influence of heavily male-biased migration. Similarly, since the mid-1960's, the imbalance between unmarried males and females has eased and at the same time the number of remarriages of female divorcees has fallen below that of males.

Over the period 1921/22 to 1975/76, there has been a general trend of increase in the numbers of remarriages of divorced females and males, but for two periods -- the Depression of the 1930's and the more prosperous times of the 1950's. There have also been substantial changes

REMARRIAGES OF DIVORCED AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76



OVERALL REMARRIAGE RATE FOR DIVORCED AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76



in the stock of divorced females and males who are at risk of marriage, which can help to explain the source of variations in remarriage behaviour. The number of remarriages grew slightly from 1921/22 until the Depression; however, the overall rate of remarriage,[1] which controls for changes in the stock at risk of marriage, declined over most of the pre-Depression period, as shown in Figure 25. Hence, the increases in remarriages were probably a direct result of the continually growing population at risk, and reflected a falling, rather than growing, popularity for remarriage amongst divorcees. During the Depression, economic and social circumstances militated against legal changes in marital status and, although there was probably a good deal of family formation and dissolution which occurred outside the sanction of laws pertaining to marriage and divorce, the numbers of remarriages of divorcees, and also the numbers of divorces and of marriages of never married and widowed persons, declined. The reduced incidence of remarriage for divorcees is more clearly shown by the overall rate of remarriage which declined dramatically during the Depression. Following the Depression, the general trend of increased numbers of remarriages continued, with the rate of increase accelerating at the end of World War II as servicemen returned to Australia. At this time there were substantial rises in divorce and subsequent remarriage, reflecting the dissolution of hasty wartime marriages and the formation of more suitable unions. As the rapidly rising overall remarriage rate indicates, these increases in remarriages before and after the war outstripped the increases in the numbers at risk of remarriage. In fact, in 1946/47, 17% of female divorcees and 19% of male divorcees remarried. These levels of remarriage

1. The overall rate of remarriage for divorcees is calculated as the total number of remarriages of divorced persons in a given period divided by the total number of divorced persons aged 15 years and over at the beginning of that period.

have not since been equalled, even after the introduction of the Family Law Act in 1976, when we could have expected there to be substantial rises in remarriages. During the 1950's, the numbers of remarriages declined from their wartime levels. The overall rate of remarriage declined even more sharply due to a continued increase in the population of divorced persons. The 1950's was a time of declining propensity to divorce and rising mean age at divorce. Persons who are older at the time of divorce are much less likely to remarry,[1] so the older age of the population at risk of remarriage led to falls in the numbers of remarriages. From the mid - 1960's, remarriages began a continuous increase which was of dramatic proportions at the end of the period. Initially, this increase was closely related to an increase in the population at risk of remarriage and did not indicate any increase in the popularity of remarriage; in fact, for females the overall rate of remarriage continued to decline under the influence of enhanced economic and social independence of females, whilst for males it stabilized until the last year of the sample period, 1975/76. The increased number of divorces in 1975/76 resulting from the introduction of the Family Law Act led to an enlarged population at risk of remarriage but, at the same time, remarriages of divorcees increased so dramatically that the overall rate of remarriage increased by 32% for females and by 33% for males from the previous year. Since the end of the sample period, the overall rate of remarriage has exhibited a decline for both females and males which suggests that the Family Law Act provided a once-off opportunity for the legalization of marriage breakdowns and an immediate legalization of already existing

1. See Peter F. McDonald, "Changing Patterns of Nuptiality in Australia", op. cit., p.32.

de facto unions. Once this "catch-up" in divorces and remarriages is complete, the overall remarriage rate may return to the trends of the early 1970's, when females in particular were becoming less likely to give up the independence of the divorced state for remarriage.

(c) The age distributions and their approximations

The age distributions of the age specific rates of remarriages of divorcees for females and males do not conform closely to any smooth mathematical distribution. In general the peak of the distribution is ill-defined and rates of remarriage are often erratic, especially at younger ages. The rates of remarriage at younger ages reflect the behaviour of a small number of people and can vary dramatically between ages in a given year and between years for a given age. For females, peak rates occur in the early 20's ages in the pre-war period, and in the late teen ages in the post-war period. After the peak ages, rates fall rapidly, although not smoothly, until they reach negligible levels at older ages. The age distributions for males follow a similar shape, although they peak in the late 20's ages in the pre-war period, and in the mid 20's ages in the post-war period. The male rates are also less likely to be erratic at a given age. Not surprisingly, these age distributions are not very closely approximated by the gamma distribution. As an illustration, Figures 26 and 27 show four typical age distributions of the rates, and the approximations to these rates, of remarriage of divorced females and males respectively. For females, the approximation underestimates the rates at younger ages and smooths through the rates in the 20's age group for most of the pre-war period. However, from the late 1940's, the gamma approximation generally takes its exponential form[1]

1. The gamma distribution becomes exponential in shape when $\alpha \leq 1$ (see page 8, equation (1)). An illustration of the range of shapes which can be taken by the gamma distribution is given in Figure 1 on page 10.

and subsequently overestimates the rates at young ages.[1] This has obvious consequences, which will be discussed later, for the parameters of the approximated distribution. Fortunately, at those ages where the fit appears especially poor, there are a very few remarriages involved so the total effect on the number of remarriages is minimal. The results for males are similar, except that there is some consistent overestimation of rates at older ages.

The results are, however, more encouraging when the numbers, rather than rates, of remarriages of divorcees are considered. As shown in Figure 28 for females and Figure 29 for males, the age distributions of the numbers of remarriages have been closely approximated by the gamma distributions, although they do not capture all of the erratic behaviour between individual ages. The technique is performing well.

(d) The accuracy of the approximations

Analysis of the percentage differences between the historical total number of remarriages of divorcees and its approximation indicates that the approximation has been successful to varying degrees over the sample period. For both females and males, as shown in Figure 30, the mean error fluctuated substantially. Female remarriages have generally been overestimated and this overestimation appears to be increasing at the end of the period. For males, there was a greater tendency for underestimation to occur but, as for females, there was substantial overestimation in the latter part of the sample period.

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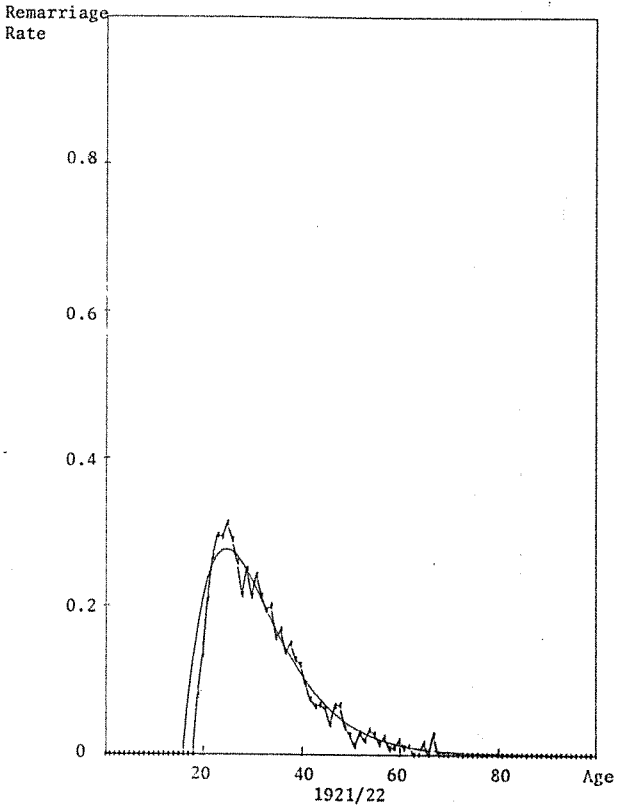
1. In those cases where the gamma approximation was exponential, approximated remarriage rates occasionally exceeded unity at young ages. This is difficult to avoid, so these values were merely constrained to unity.

FIGURE 26

TYPICAL AGE DISTRIBUTIONS OF THE RATES OF REMARRIAGE OF DIVORCED AUSTRALIAN FEMALES (++) AND THEIR GAMMA APPROXIMATIONS (——)
1921/22, 1950/51, 1965/66 AND 1975/76



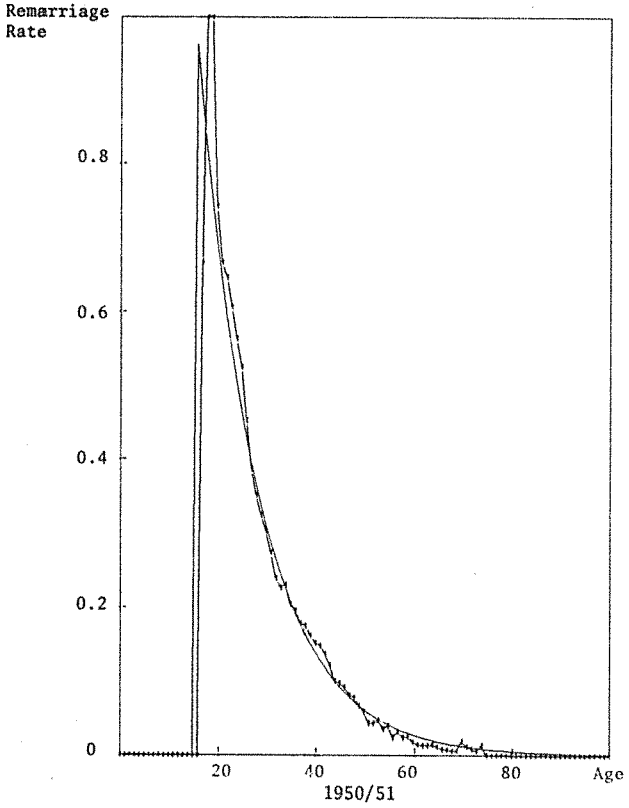
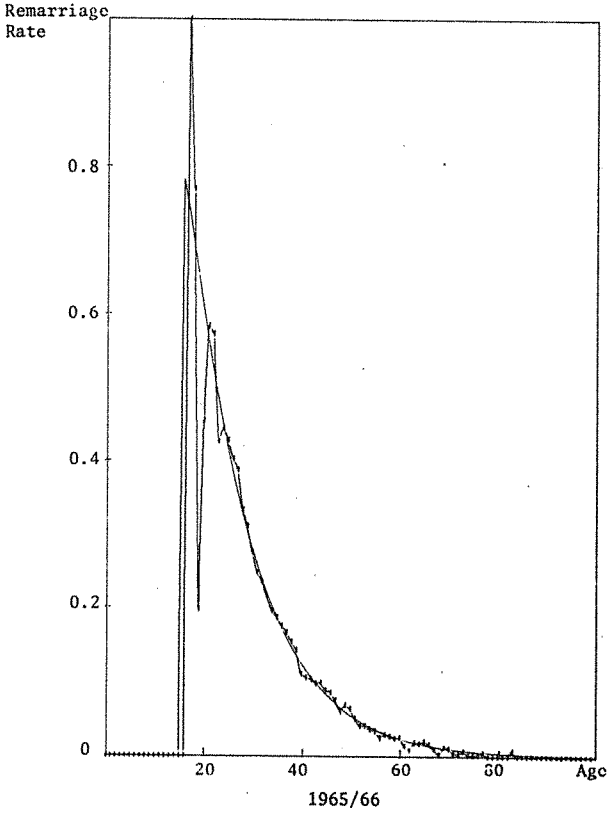


FIGURE 26 *continued*



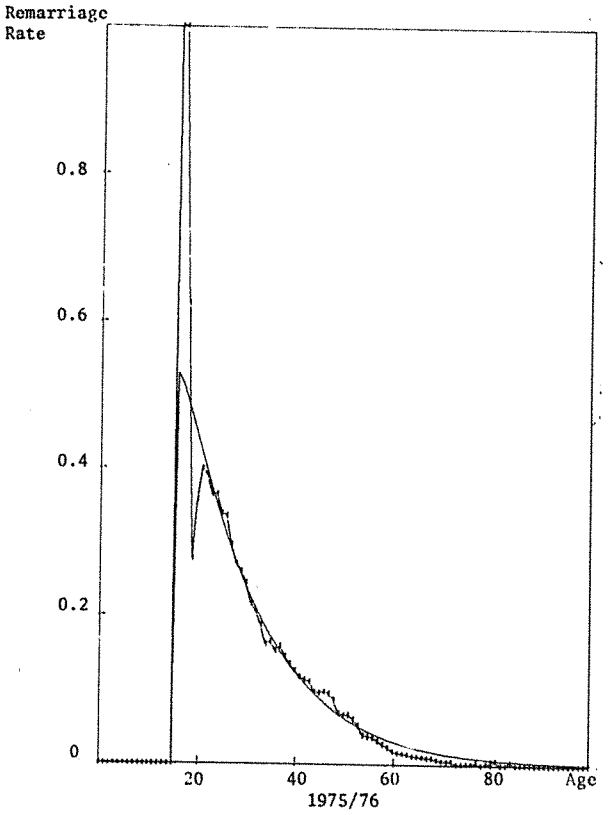
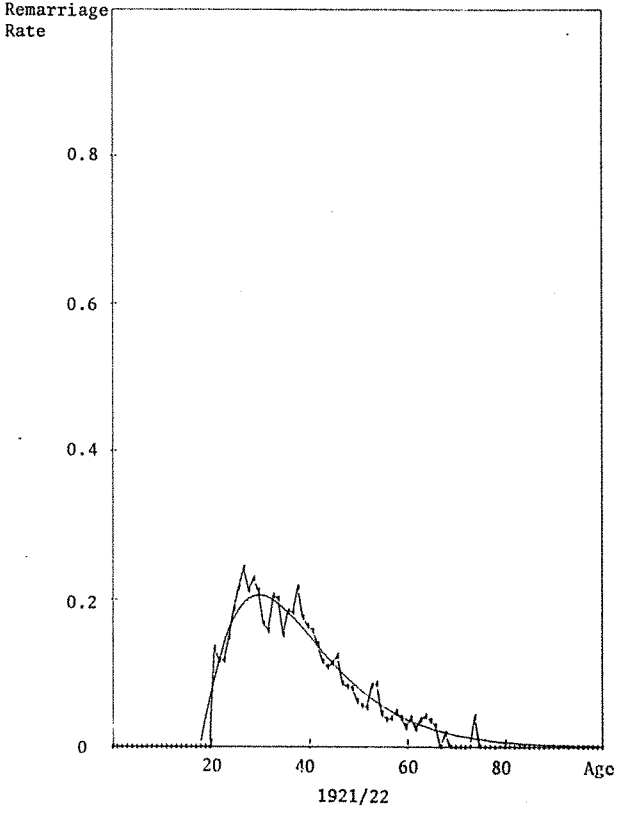


FIGURE 27

TYPICAL AGE DISTRIBUTIONS OF THE RATES OF REMARRIAGE OF DIVORCED AUSTRALIAN MALES (++) AND THEIR GAMMA APPROXIMATIONS (—)
1921/22, 1950/51, 1965/66 AND 1975/76



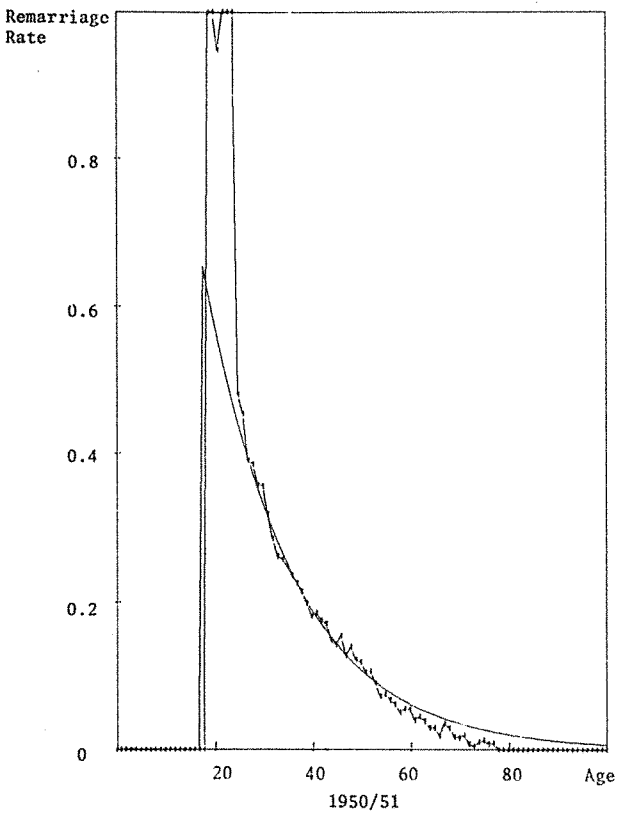
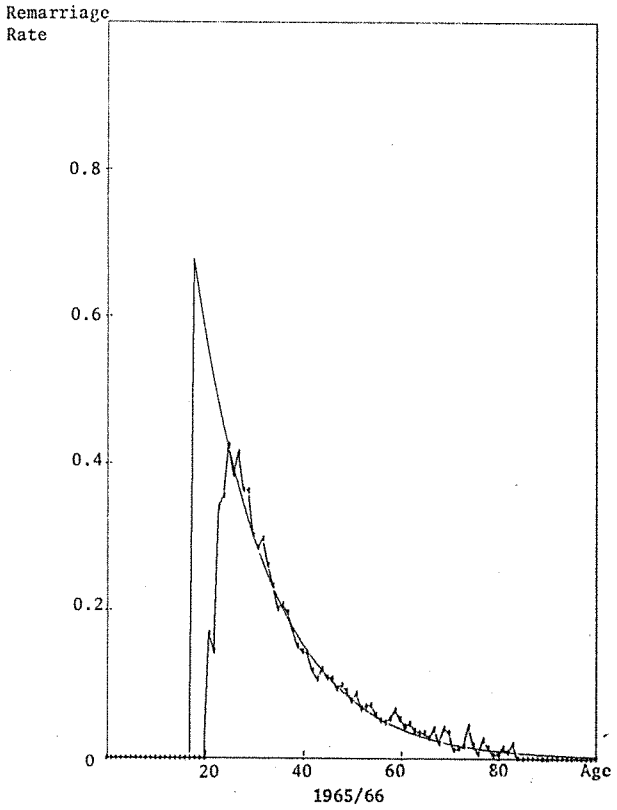


FIGURE 27 *continued*



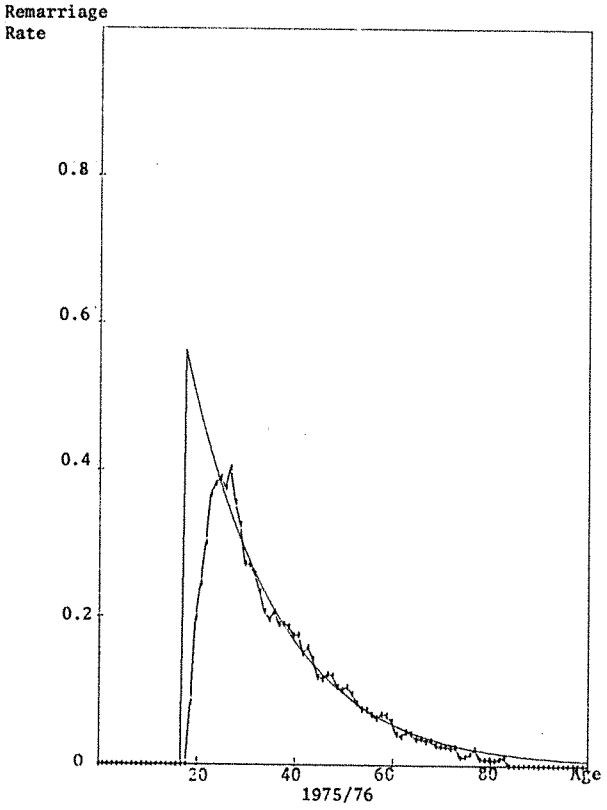


FIGURE 28

TYPICAL AGE DISTRIBUTIONS OF THE NUMBERS OF REMARRIAGES OF DIVORCED AUSTRALIAN FEMALES (+++) AND THEIR GAMMA APPROXIMATIONS (—), 1921/22, 1950/51, 1965/66 AND 1975/76

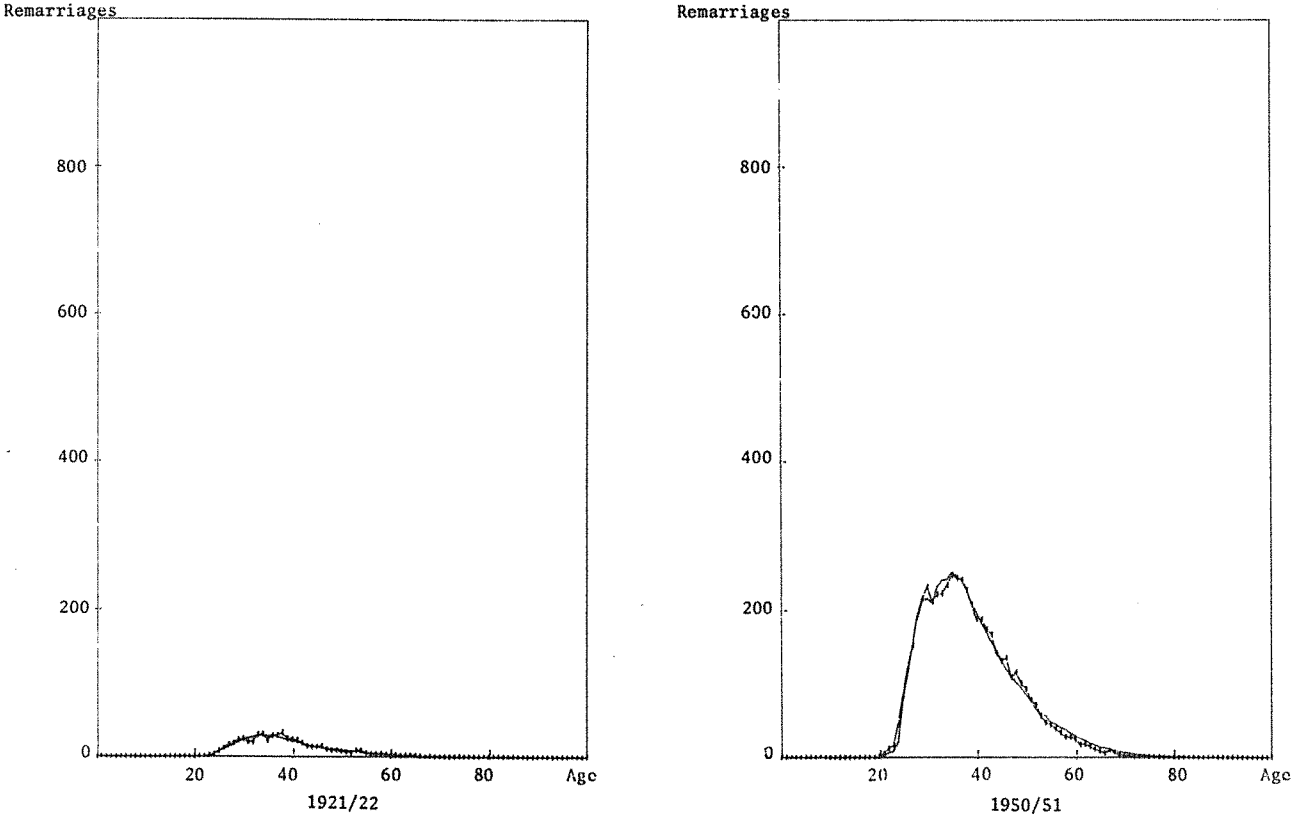
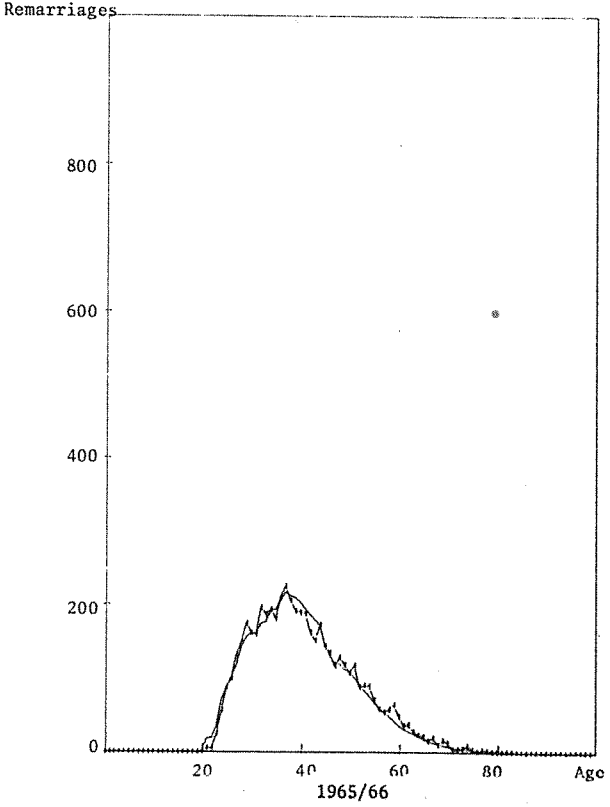


FIGURE 28 *continued*



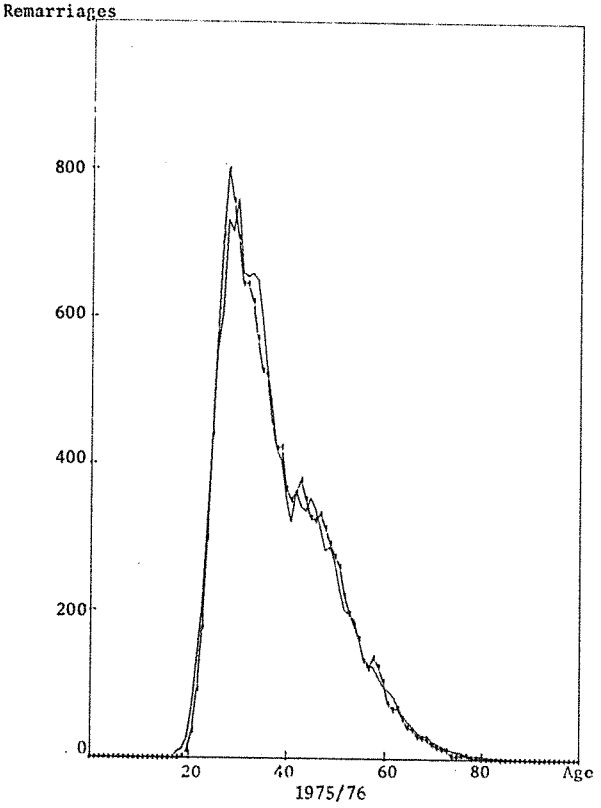


FIGURE 29

TYPICAL AGE DISTRIBUTIONS OF THE NUMBERS OF REMARRIAGES OF DIVORCED AUSTRALIAN MALES (+-+) AND THEIR GAMMA APPROXIMATIONS (—) 1921/22, 1950/51, 1965/66 AND 1975/76

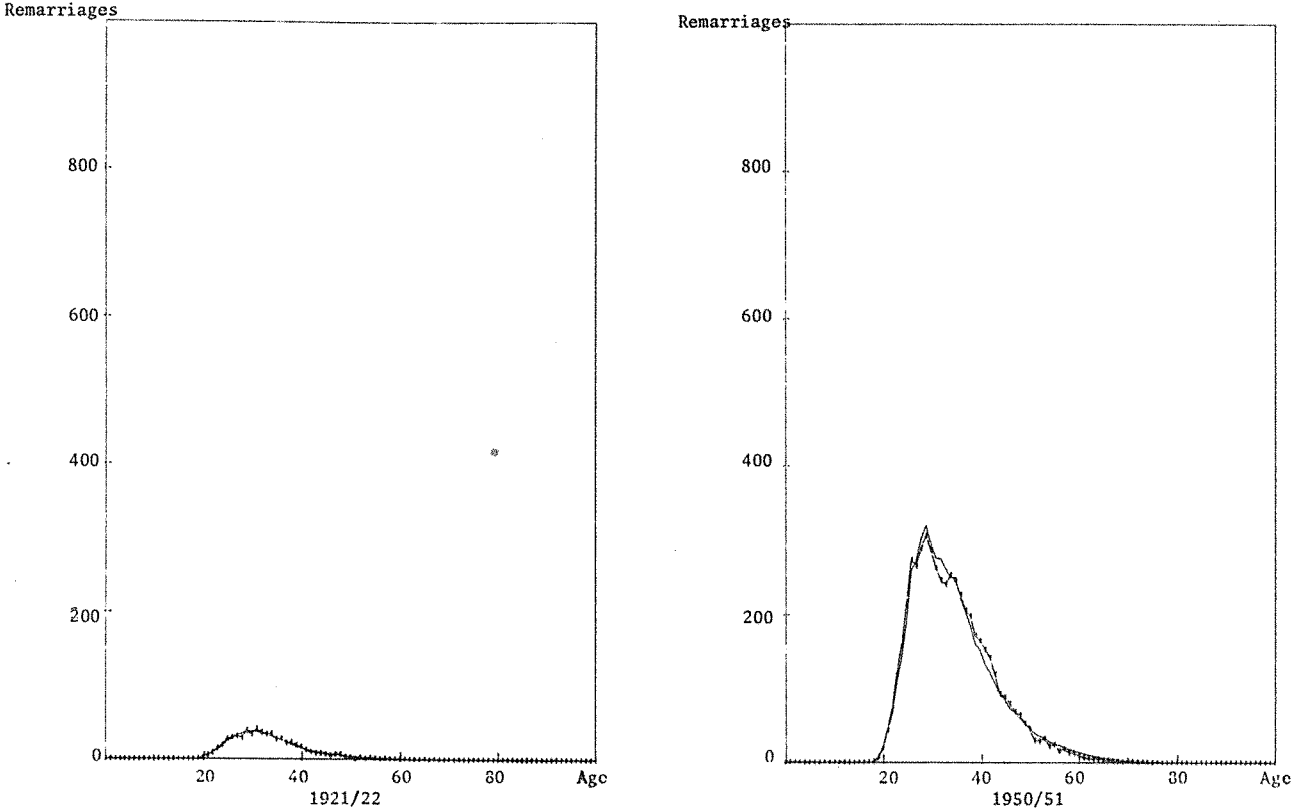
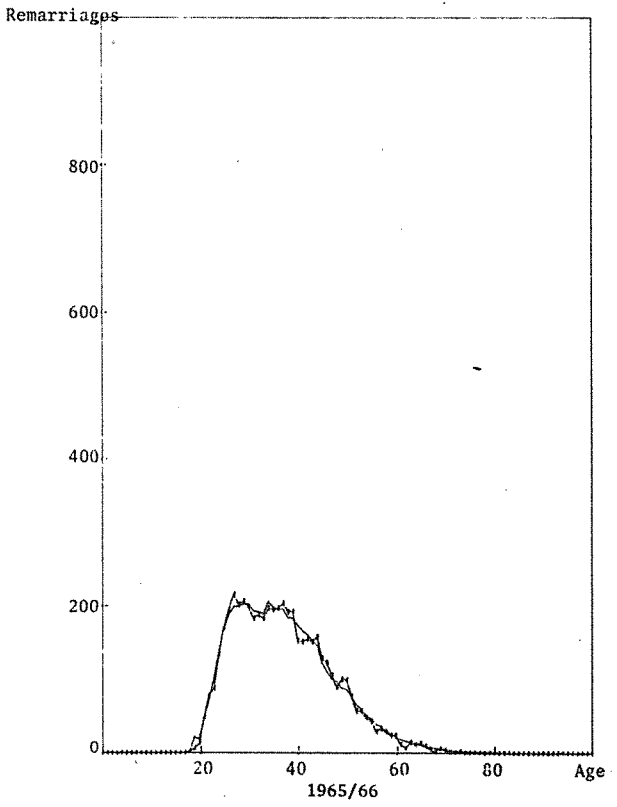


FIGURE 29 *continued*



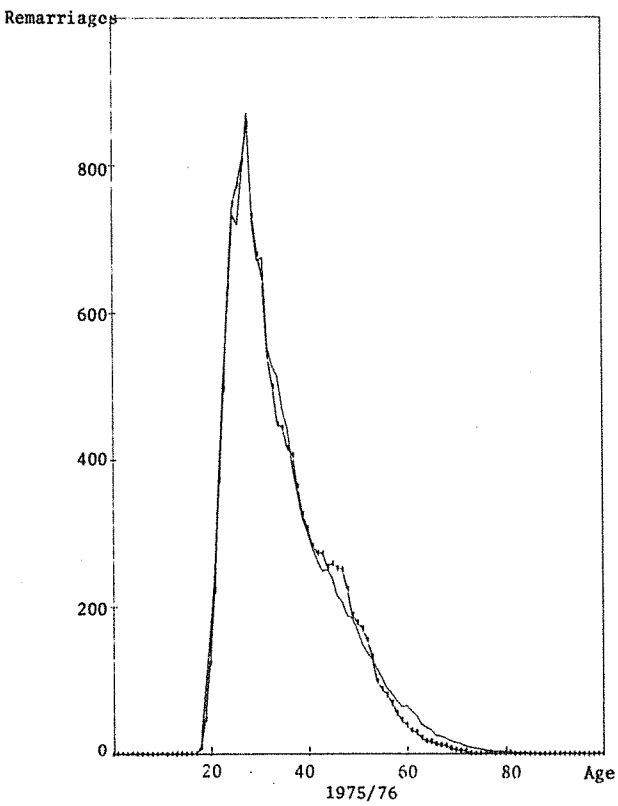


FIGURE 30

MEAN ERROR BETWEEN THE NUMBER OF REMARRIAGES OF DIVORCEES AND ITS GAMMA APPROXIMATION FOR AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76

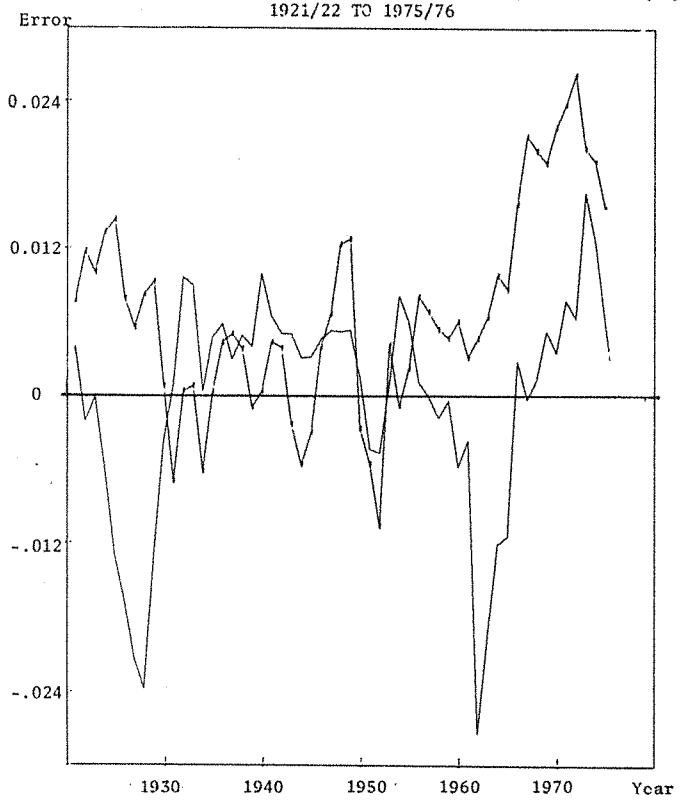
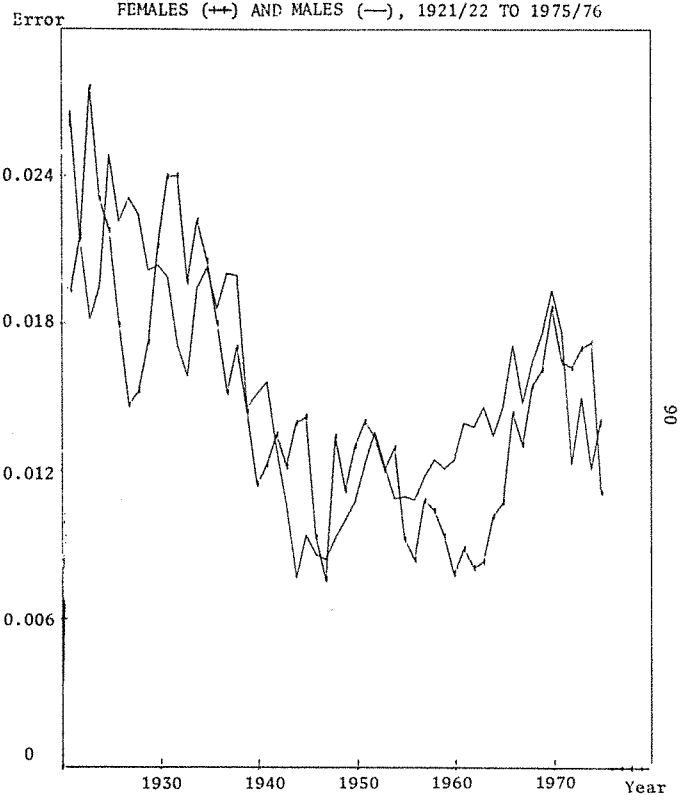


FIGURE 31

ROOT MEAN SQUARED ERROR BETWEEN THE NUMBER OF REMARRIAGES OF DIVORCEES AND ITS GAMMA APPROXIMATION FOR AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76



The root mean squared error between the historical and approximated numbers of remarriages of female and male divorcees, given in Figure 31, indicates substantial variability in the accuracy of the gamma distribution for approximations to the number of remarriages for each individual age. In both cases the root mean squared error showed some decline until the mid to late 1950's and then rose towards the end of the sample period. The adequacy of the approximation technique thus showed some worsening in the latter part of the sample period for both females and males.

Despite the adequate aggregate results for numbers of remarriages, the consistent underestimation of, and the large variability in, rates of remarriage for divorcees (and, as will be shown later, for widowed persons) at younger ages lead to erratic rates of remarriage which can vary dramatically between ages in a given year and between years for a given age. If the remarriage rate data were smoothed over time, it may be possible to avoid statistical perturbations caused by the small numbers involved. Three-year and five-year moving averages were attempted for remarriages of divorcees and of widowed persons and, although variability was reduced to some extent, high values for remarriage rates at young ages continued to be observed. This suggested that perhaps these rates were not merely perturbations; for the small numbers of divorced and widowed persons at risk of remarriage at these young ages, the probability of remarriage may in fact be consistently high. In order to test this hypothesis, the annual remarriage rate distributions were averaged over time to give average remarriage rate distributions. It was found that the average values of remarriage rates of widows and divorcees at young ages were still high and that the average distributions did not closely resemble gamma distributions. A gamma approximation to the average distributions of

remarriage rates for widows and for divorcees continued to substantially underestimate the remarriage rates at younger ages. Despite the underestimation of remarriages of divorced and widowed persons at young ages, it was decided to persist with a gamma approximation. The numbers at risk at young ages are so few that even substantial underestimation of the age specific rates only marginally affects the estimate of the total number of remarriages of divorced and widowed persons. Consequently, the approximations will not closely approximate the number of remarriages of divorced or widowed persons at very young ages.

In this study, the age distributions of age specific rates of marriages and divorces are parameterized by their mean, variance and index of propensity, which are calculated without weighting the rates according to their relative inportance in terms of numbers at risk. The numbers of persons involved in remarriages at young ages are very small, and their rates of remarriage are erratic. Hence, these erratic rates of remarriage at younger ages may be a source of spurious variability in the values of the propensity, mean and variance which bears little relationship to underlying changes in remarriage behaviour. In order to control for this unwanted variability, the historical rates at younger ages (up to 21 years) were replaced by their long term averages and gamma distributions were then fitted to the revised data. It was expected that the propensity, mean and variance derived would be more accurate indicators of the remarriage behaviour of divorced and widowed persons. However, as the propensity, mean and variance so calculated were not substantially different, this more complicated procedure was eventually discarded.

(e) The parameters of the age distributions

The parameters of the age distributions of age specific rates of remarriage for divorced females and males, which are given in Figures 32, 33 and 34, are highly variable over the period, although they have followed similar trends, with a few exceptions. In the 1920's, the propensity declined for males but increased for females, such that female remarriage propensities substantially exceeded those for males. At this time, the propensity for females to first marry also exceeded that for males, indicating that the number and age structure of females at risk was such that balance in the marriage market required them to marry in greater proportions than males. The economic hardships of the Depression forced people to resort to non-legal formation and dissolution of marriages, so the remarriage propensities of males and females fell substantially during the Depression. From the end of the Depression to the peak in remarriage, just after World War II, remarriage propensities rose by an average of 6½% per year for both males and females. It was during this period that first marriage rates also increased dramatically, indicating a shift towards more universal marriage within the population. After the post-war peak, remarriages declined for both males and females, although less dramatically for the latter. This difference may have been due to the substantial oversupply of males which forced a relatively stronger demand for female brides, regardless of their previous marital status. Since persons who are newly divorced tend to exhibit greater rates of remarriage[1], it could be expected that the propensity to remarry may change in line with, though as a lagged response to, changes in propensity to divorce. This

1. See Peter F. McDonald, "Marriage and Divorce in Australia", op. cit., p.31.

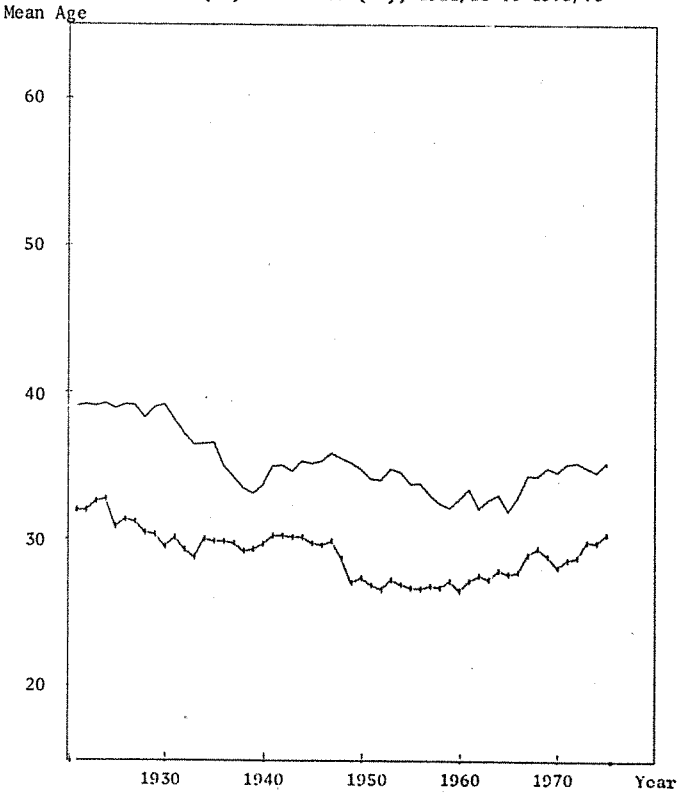
FIGURES 32, 33 AND 34

THE PARAMETERS OF THE APPROXIMATED AGE DISTRIBUTIONS OF AGE SPECIFIC RATES OF REMARRIAGE FOR DIVORCED AUSTRALIAN FEMALES AND MALES, 1921/22 TO 1975/76

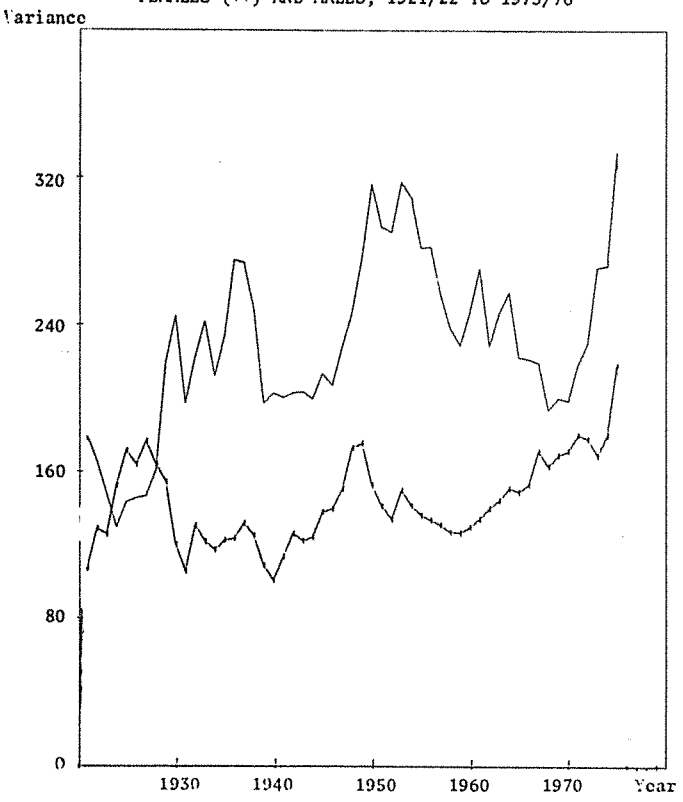
FIGURE 32

INDEX OF PROPENSITY TO REMARRY FOR DIVORCED AUSTRALIAN FEMALES (+++) AND MALES (——), 1921/22 TO 1975/76

MEAN AGE AT REMARRIAGE FOR DIVORCED AUSTRALIAN FEMALES (+++) AND MALES (—), 1921/22 TO 1975/76



VARIANCE OF AGE AT REMARRIAGE FOR DIVORCED AUSTRALIAN FEMALES (+++) AND MALES, 1921/22 TO 1975/76



could be partly the explanation for the declines in propensity to remarry from the post-war peak to the early 1960's. From the 1960's, however, divorce propensity rose for both males and females, whilst propensity to remarry continued to fall at an increasing rate. This was so until the end of the sample period when the effects of the Family Law Act dominated divorce and remarriage behaviour. The increasingly declining propensity for remarriage by divorcees over the 1960's and early 1970's appears to have derived from a decline in the popularity of remarriage amongst younger divorcees. It is possible that the improved economic circumstances, expecially for non-dependent women,[1] the increased availability and efficiency of contraception (which allowed greater female independence), the increased social acceptance of cohabitation, and the greater emphasis on individuality for both females and males led to a decline in the popularity of remarriage amongst divorcees, expecially for younger divorcees. In comparison with trends elsewhere,[2] these falls in propensity of Australian divorcees to remarry appear to have occurred in advance of other countries, such as the United States and Sweden, whose social trends Australia has usually followed after some lag. In those countries, a period of increased divorce propensities and increased remarriages, indicating the popularity of serial marriages, has more recently been followed by a period of continued increases in divorce and

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1. A study of remarriage in the United States provides statistical support for the notion that the propensity of females to remarry will decline as welfare payments to non-dependent women are increased; see Robert M. Hutchens, "Welfare, Remarriage and Marital Search" in American Economic Review, Vol.69, No.3 (June 1979). In Australia over the 1960's and 1970's, welfare payments to separated and divorced women, especially with dependent children, increased substantially. This may have lead to some reluctance on the part of these women to become legally remarried; no doubt many of them were de facto married.

2. See Charles F. Westoff, "Some Speculations on the Future of Marriage and Fertility", op. cit., p.80.

declining remarriages and first marriages, indicating the popularity of cohabitation. It is unlikely that the declining Australian remarriage propensity from the end of World War II to the early 1970's derived mainly from the latter cause, since marriage in general remained a desirable goal in Australia over this period. The study of remarriages has received scant attention in Australia; such a deficiency is lamentable.

The mean age at remarriage for males has exceeded that for females throughout the sample period, as shown in Figure 33. This is to be expected given the older age of males at first marriage and at divorce.[1] The difference between the two has, however, varied from around 7 years in the pre-war period, to 4 years just prior to World War II, to 6 years in the 1950's to around 5 years at the end of the sample period. The mean age declined almost continually until the early 1960's, with some arresting of that decline in the 1940's. From the early 1960's to the end of the sample period, the mean age at remarriage has increased. It could be suggested that, since those who are recently divorced are most likely to remarry, it could be expected that the mean age at remarriage would follow, with a lag, changes in the age at divorce. However, the mean age at divorce is calculated as the sum of the age-weighted age specific rates of remarriage and, therefore, already takes into account changes in the age distribution of divorcees at risk of remarriage. Only if the new divorcees had different rates of remarriage when compared to other divorcees of the same age would we expect the mean age at remarriage to be affected by an

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1. It is interesting to note that the mean of the age distribution of age specific rates of remarriage for divorcees is consistently and substantially lower than the mean age at divorce. The apparent anomoly is due to the use of age specific rates when calculating the means. The remarriage rates at younger ages are very high, reflecting the fact that if one is young and becomes a divorcee at risk of remarriage, then one is likely to remarry very quickly.

influx of young (or, for that matter, old) divorcees. In fact, since the 1950's, the mean age at remarriage for divorcees has tended to fall (rise) at times when the mean age at divorce has risen (fallen). The rising mean age at remarriage in the 1960's and 1970's could be said to derive from the differential effects upon younger females and males of improved economic conditions (especially for females, who experienced improved career opportunities, higher relative wage rates and became increasingly able to rely on welfare support) and social attitudes (especially towards contraception and cohabitation), which increased their time of search for an eligible mate and reduced the necessity for young divorcees in particular to join marital unions. The continuation of this trend towards increased age at remarriage for divorced persons will be dependent upon future long term trends in economic conditions and social attitudes and the extent to which they differentially discourage younger divorcees from remarrying.

The variance in age at remarriage for male and female divorcees, given in Figure 34, is very erratic over the sample period. Except for a few years in the 1920's, the variance for males has exceeded that for females, although to varying degrees. For both females and males, the variance has increased over the period. This reflects the widening of the age distribution of remarriage rates; rates at younger ages have fallen and rates at older ages have remained comparatively unchanged. Fluctuations in the variance are, however, difficult to explain in terms of the economic and social changes over the period, so future trends are difficult to anticipate.

(f) Summary

The performance of the approximations to the age distributions of remarriage rates for divorcees is encouraging. The historical age distributions are very difficult to characterize in terms of a smooth mathematical distribution, because of their erratic behaviour between ages and between years, especially for younger divorcees. In terms of aggregate numbers of remarriages, the approximation has performed satisfactorily, although there is some overestimation for males and females at the end of the sample period. In terms of the performance at individual ages, the approximation has improved over the sample period, except for a short time during the late 1950's and 1960's. The under- or overestimation of rates of remarriage at young ages is of minimal importance as the numbers involved are very small. However, if the age at divorce, and hence remarriage, were to fall the remarriage rates for divorcees at young ages would become increasingly important. This difficulty is, in part, likely to solve itself, as the increased numbers at risk of remarriage will tend to reduce the likelihood of statistical perturbations in the data. The propensity to remarry and the mean age, and variance in age, at remarriage for divorced females and males have been highly variable over the sample period, and changes in their levels over time are difficult to explain fully. Changes in divorce legislation, imbalance of males and females at risk of marriage, general economic conditions, the dislocation caused by war, the economic and social independence of women, the use of contraception and the social attitudes towards cohabitation have all been mentioned as determinants of variations in the parameters of remarriage behaviour for divorced Australians. However, lack of research regarding remarriage behaviour has severely limited analysis. In attempting to explain the erratic movements in the parameters of remarriage behaviour for divorced persons, the econometric model faces a difficult task.

3.3.2 Remarriages of Widowed Persons

(b) General trends

The total number of remarriages and the overall rate of remarriage[1] for widowed females and males, given in Figures 35 and 36, indicate the effect of demographic, economic and social conditions on remarriage behaviour. In the 1920's, remarriages declined from their post-World War I high to a low level in the Depression. Again it is possible to observe the disruptive influence of adverse economic conditions upon the family formation behaviour of Australians. The overall rate of remarriage, by controlling for the number of persons at risk of remarriage, indicates even more graphically the declining popularity of remarriage for widowed persons from the mid-1920's to the Depression. Following the Depression, the number of widows and widowers remarrying and their overall rate of remarriage increased to a wartime high; the overall rate of remarriage was, however, substantially below that achieved at the beginning of the period and that observed for divorced persons. From that time, the number of remarriages of widowed persons declined until the mid 1960's and then increased until the end of the sample period. During these years, the widowed population at risk of remarriage increased, so the overall rate of remarriage declined almost continually, with some recovery for males near the end of the sample period. The post-war decline in remarriage rates was greatest for widowers as a result of the relative surplus of males over females which made widowers relatively less attractive partners when compared with the oversupply of never married males. The general decline in the

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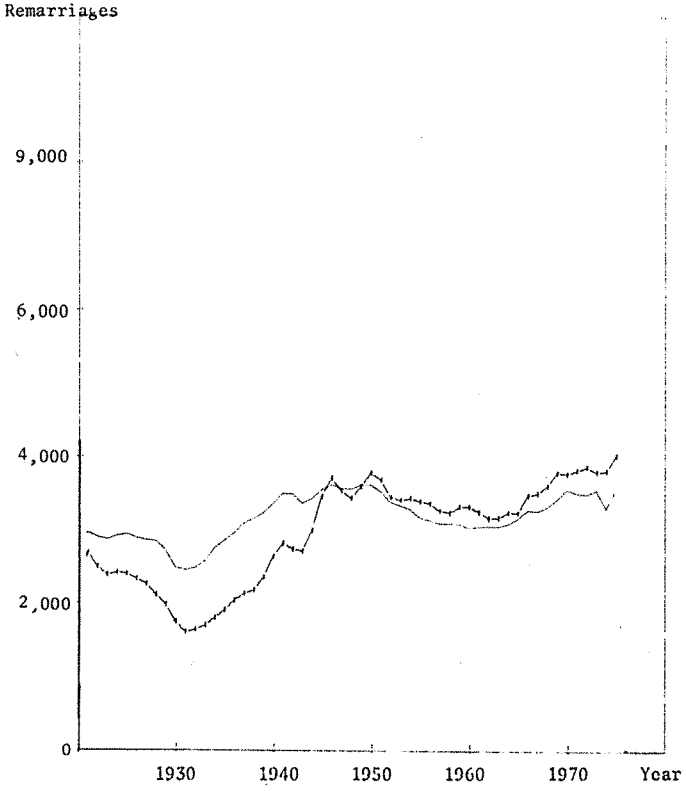
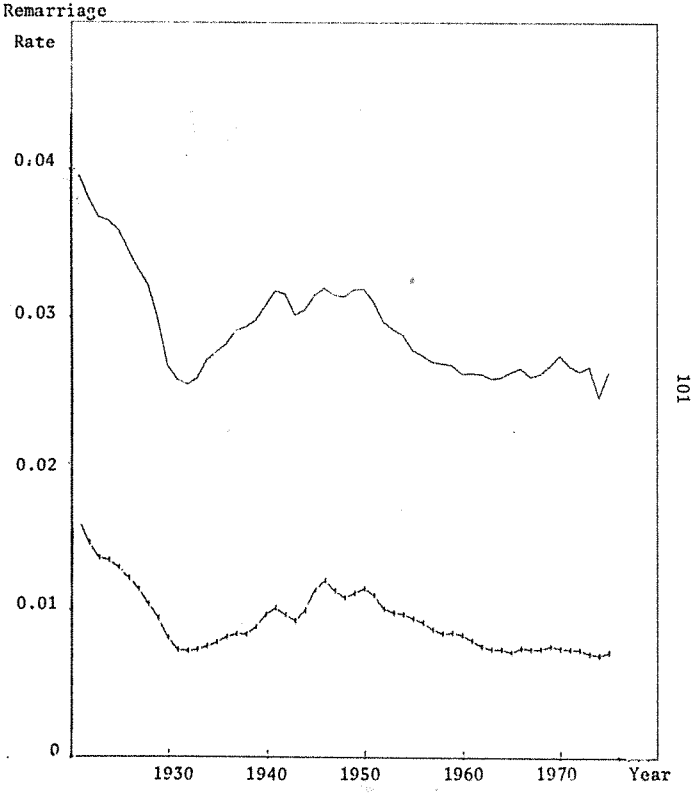
1. The overall rate of remarriage for widowed persons is calculated as the total number of remarriages of widowed persons in a given period divided by the total number of widowed persons aged 15 years and over at the beginning of the period.

REMARRIAGES OF WIDOWED AUSTRALIAN FEMALES (++) AND MALES (—) 1921/22 TO 1975/76



OVERALL REMARRIAGE RATE FOR WIDOWED AUSTRALIAN FEMALES (++) AND MALES (—) 1921/22 TO 1975/76



popularity of remarriage for widows and widowers is partly related to the increases in life expectancy over this period; persons who are widowed at a later age are less likely to remarry. Over this period there were also substantial improvements in social security for aged persons and increased participation in superannuation schemes. Enhanced economic security may well discourage widowed persons from formally remarrying. These explanations for declining remarriage of divorcees would suggest a future continuation of that trend. The remarriage rate for widowers has historically been about three times that for widows and there is no indication that this will change in the future, especially given the expected improvements in female independence and career opportunities. It is interesting to note that the overall remarriage rates for widowed persons are substantially below those for divorcees -- for females, about one-tenth of the divorcee remarriage rate and, for males, about one-quarter of the divorcee remarriage rate. There has been a general decline in the popularity of remarriages for both divorced and widowed persons in the post-war period, which has persisted throughout the substantial economic and social changes of that period.

(c) The age distributions and their approximations

The age distributions of the age specific rates of remarriage for widows and widowers, given in Figures 37 and 38, are similar to those for remarriage of divorcees; they do not closely resemble any smooth mathematical distribution, the peak of the distributions is not well-defined and rates can vary dramatically from age to age and from year to year. The erratic behaviour of these distributions is partly due to the small populations at risk of remarriage, particularly at the younger ages. For females peak rates occur in the early 20's ages in the pre-war period and a little later near the end of the sample period. High rates are generally

present at the younger ages followed by a rapid decline in rates of remarriage until ages above 70 years, when rates are negligible. The age distributions for males follow a similar pattern, but they are less erratic at younger ages, they peak later, in the mid to late 20's ages, and decline much less sharply, especially at the older ages where the rates of remarriage for males are substantially higher than those for females. Given the erratic nature of these age distributions, the approximations have captured the age distributions for remarriage rates well. Whilst the peak age rates are generally underestimated, the rates at older ages are adequately captured. The adequacy of the approximation can be observed in Figures 39 and 40 where four typical age distributions of the numbers of remarriages for widows and widowers are presented. The age distributions of the numbers are highly erratic, especially at the peak ages (around 40 for females and 50 for males in the pre-war period and around 50 for females and 60 for males in the post-war period). The approximation has captured the numbers of remarriages at each age remarkably well, despite the dramatic changes in shape that these age distributions have undergone over the sample period. As with the remarriage of divorcees, the poor fit of the approximation at younger ages is of little consequence when the numbers, rather than the rates, of remarriage are considered. There is, however, some tendency for the approximation to consistently overestimate the number of widows and widowers remarrying at older ages, especially in the post-war period. Given the expected future trends regarding increased life expectancy and ageing of the population, the overestimation of rates at older ages could be a source of some concern.

FIGURE 37

TYPICAL AGE DISTRIBUTIONS OF THE RATES OF REMARRIAGE OF WIDOWED AUSTRALIAN FEMALES (++) AND THEIR GAMMA APPROXIMATIONS (—), 1921/22, 1950/51, 1965/66 AND 1975/76

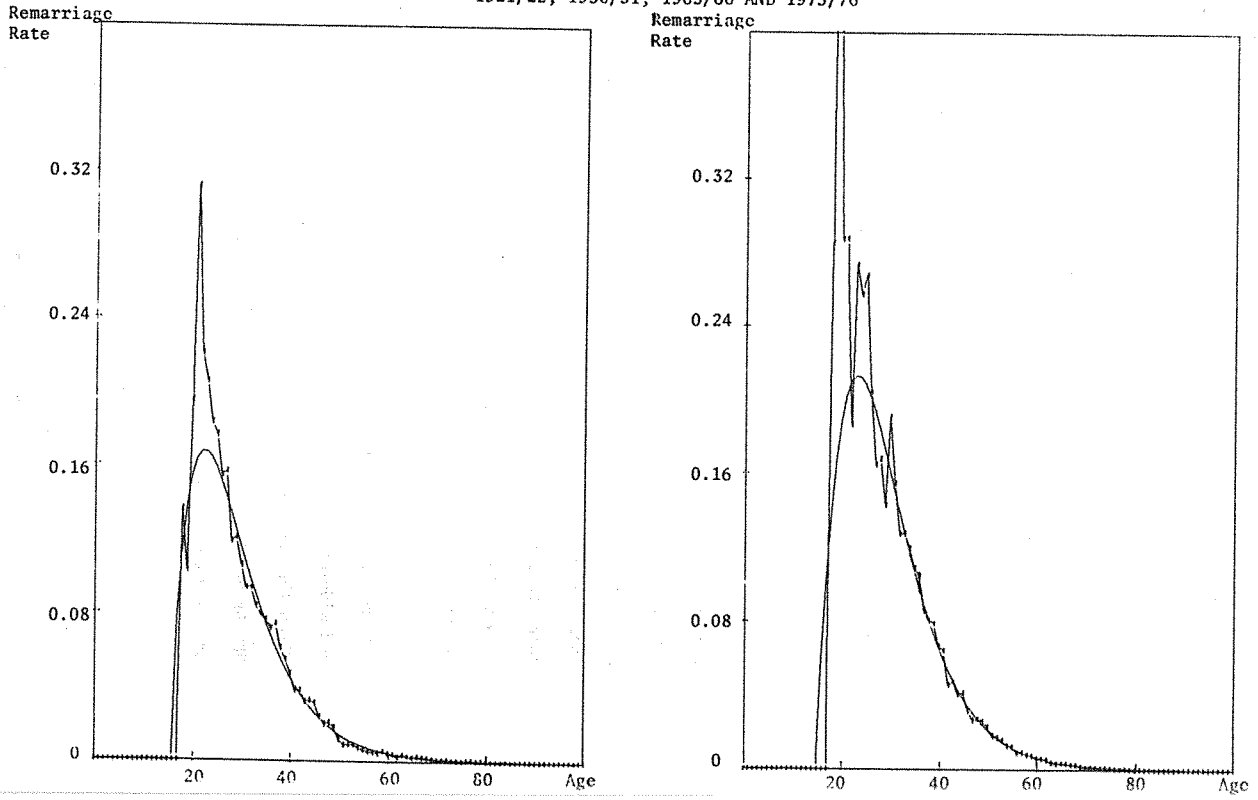
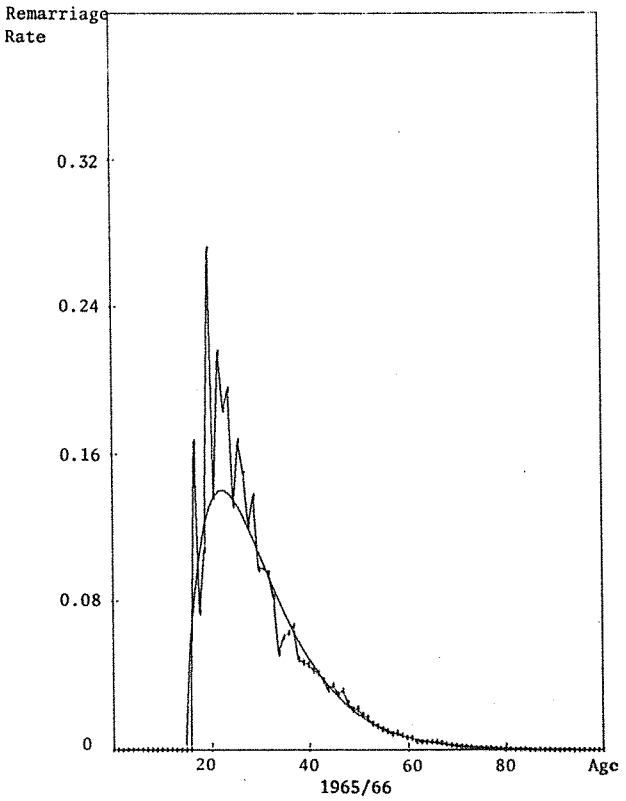


FIGURE 37 *continued*



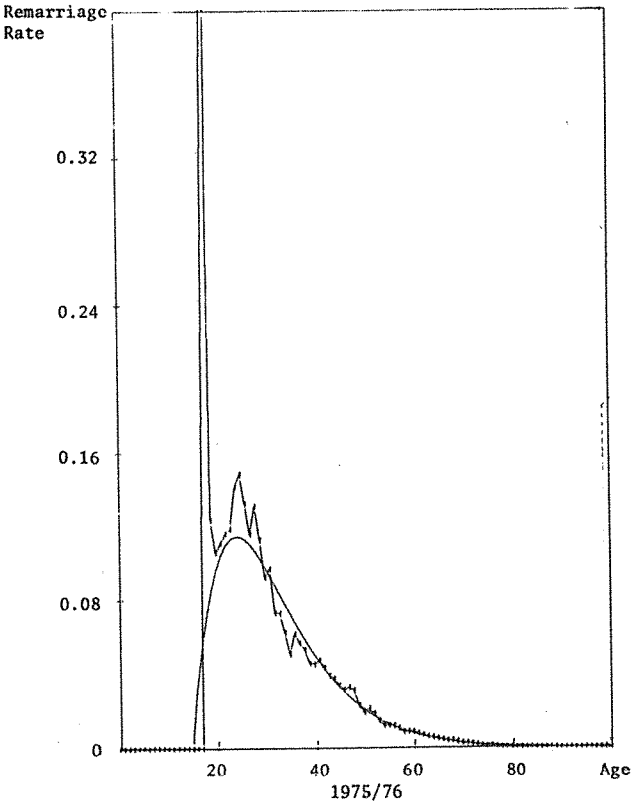
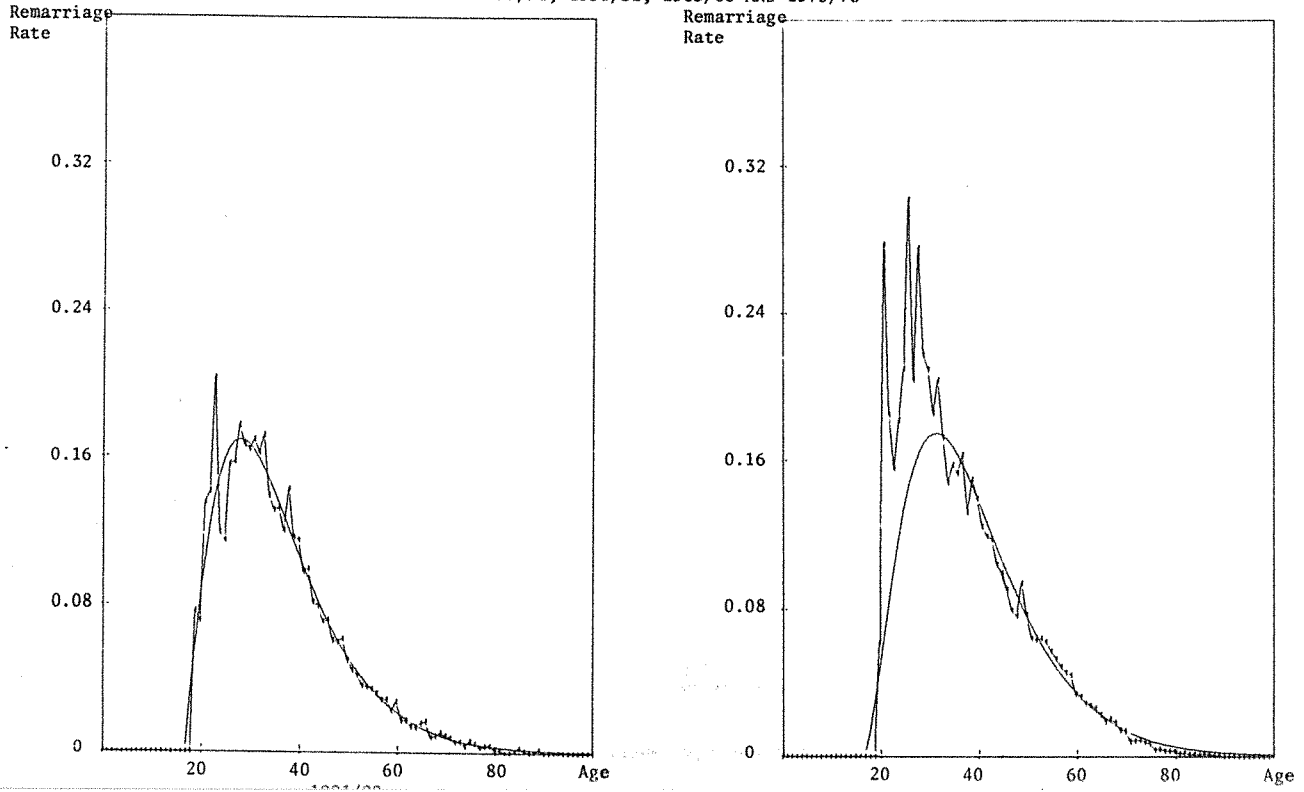
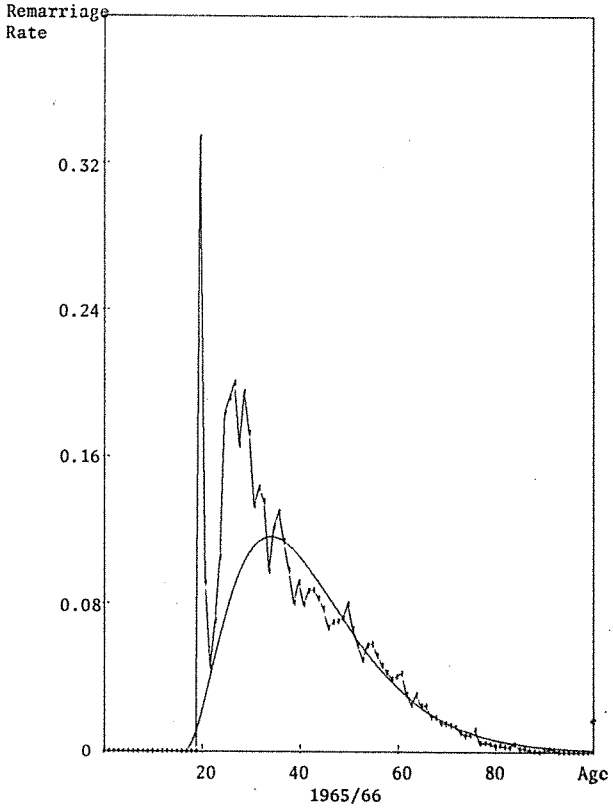


FIGURE 38

TYPICAL AGE DISTRIBUTIONS OF THE RATES OF REMARRIAGE OF WIDOWED AUSTRALIAN MALES (↔) AND THEIR GAMMA APPROXIMATIONS (—), 1921/22, 1950/51, 1965/66 AND 1975/76




Remarriage
Rate
0.32
0.24
0.16
0.08
0
20
40
60
80
Age
1965/66

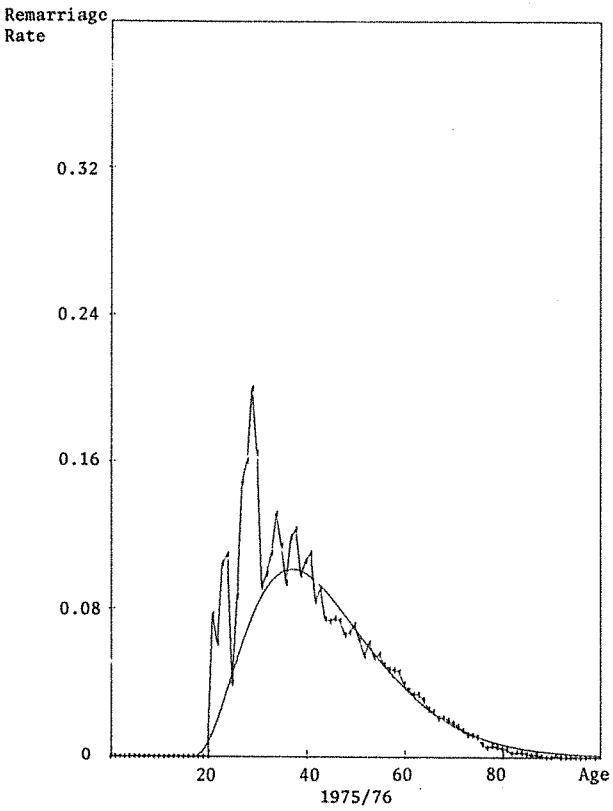
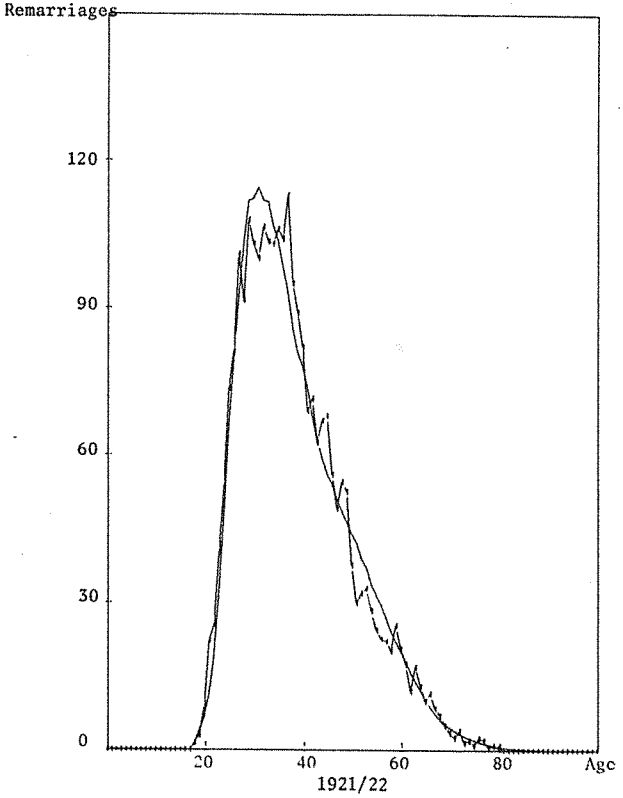

Remarriage
Rate
0.32
0.24
0.16
0.08
0
20
40
60
80
Age
1975/76

FIGURE 39

TYPICAL AGE DISTRIBUTIONS OF THE NUMBERS OF REMARRIAGES OF WIDOWED AUSTRALIAN FEMALES(++) AND THEIR GAMMA APPROXIMATIONS (—), 1921/22, 1950/51, 1965/66 AND 1975/76



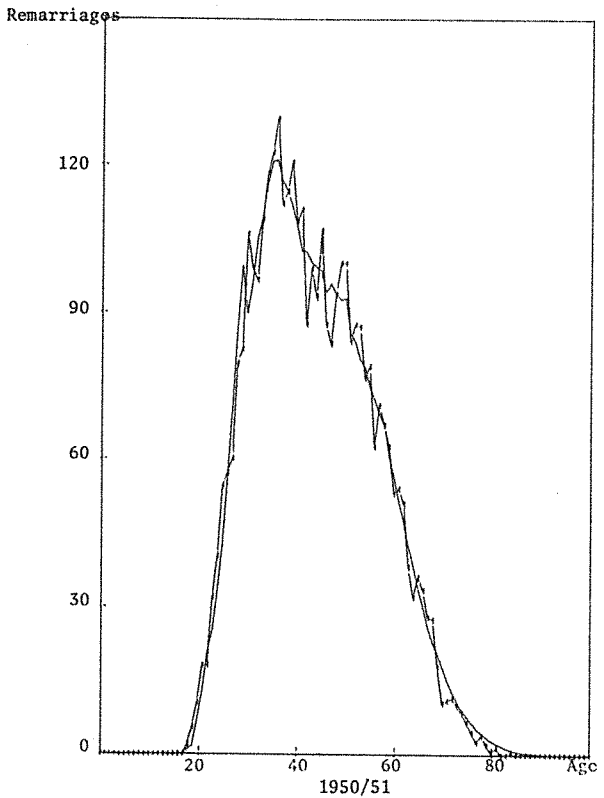
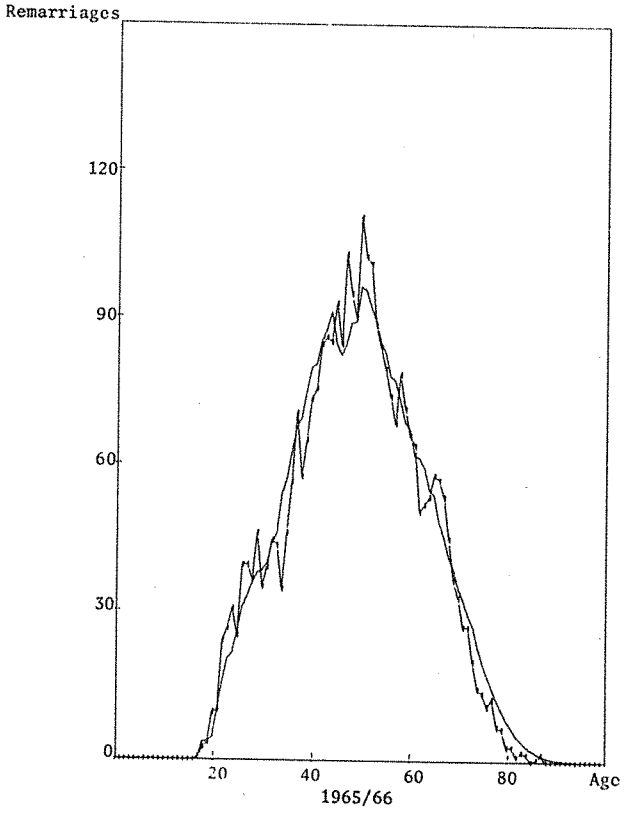


FIGURE 39 *continued*



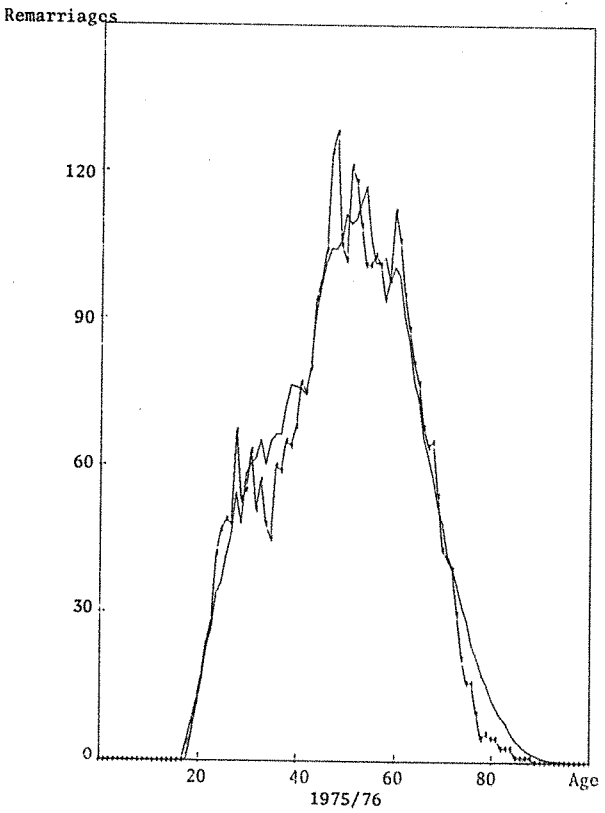
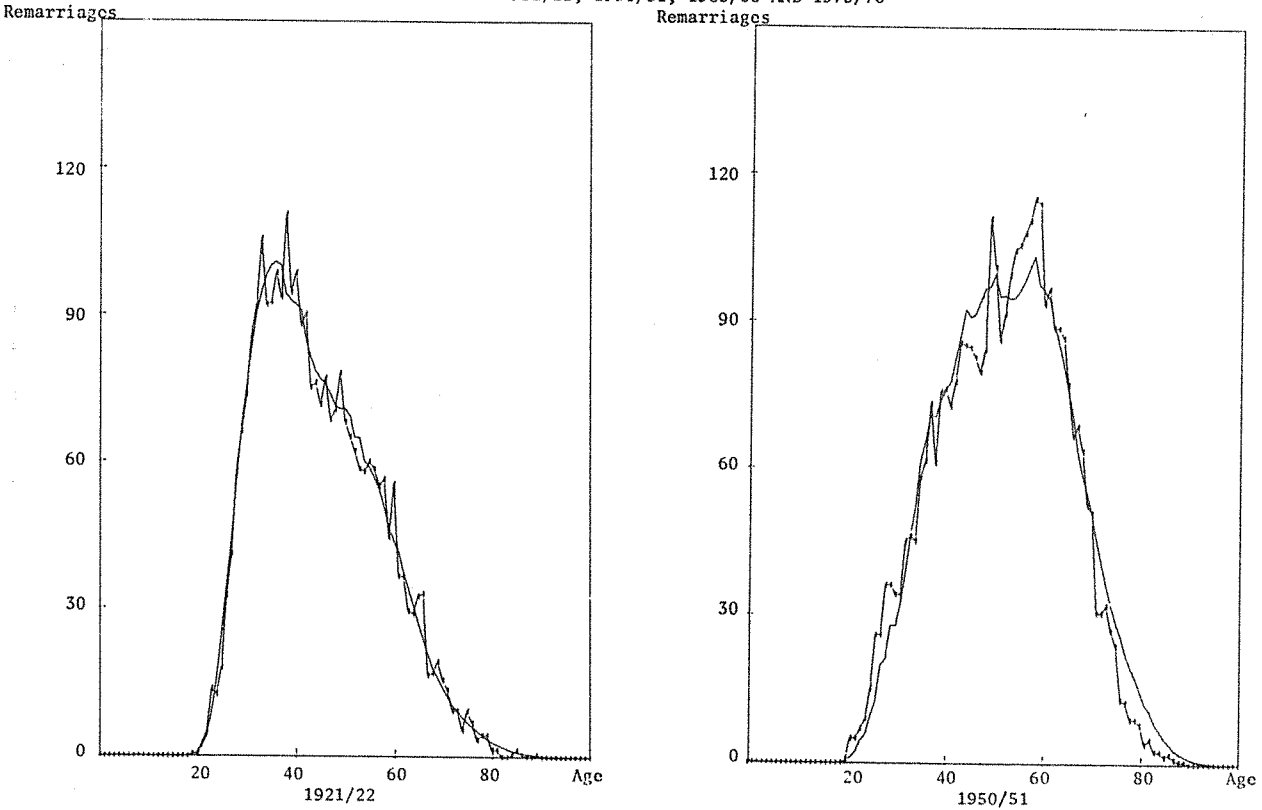
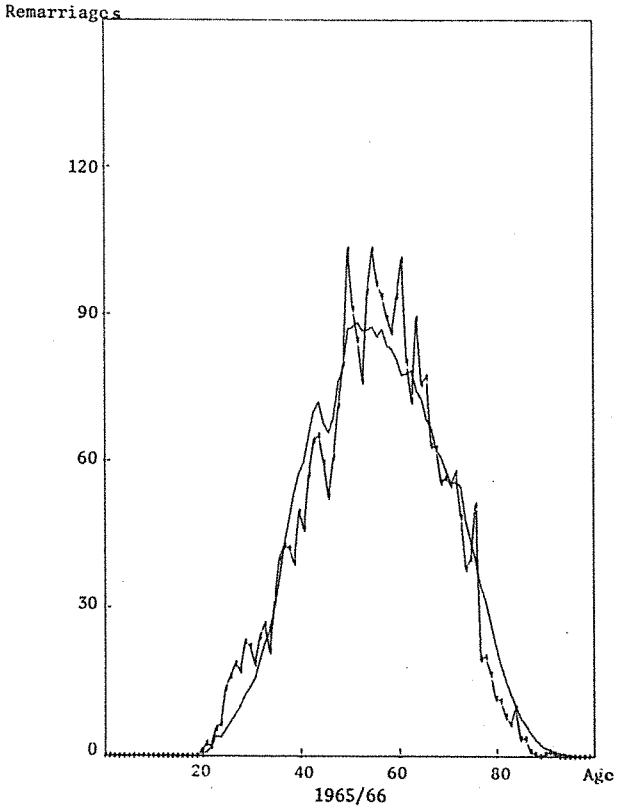
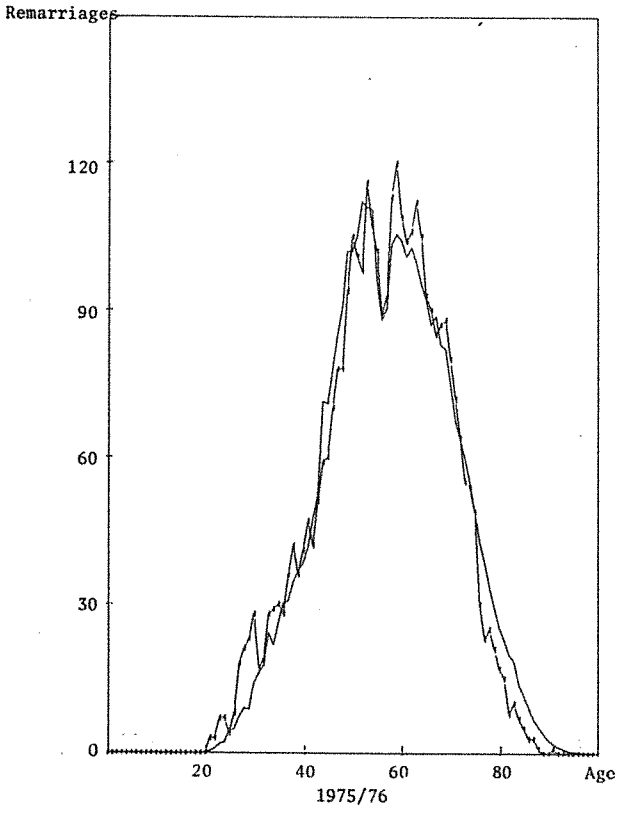


FIGURE 40

TYPICAL AGE DISTRIBUTIONS OF THE NUMBERS OF REMARRIAGES OF WIDOWED AUSTRALIAN MALES (++) AND THEIR GAMMA APPROXIMATIONS (—), 1921/22, 1950/51, 1965/66 AND 1975/76




Remarriages
120
90
60
30
0
20
40
60
80
Age
1965/66


Remarriages
120
90
60
30
0
20
40
60
80
Age
1975/76

(d) The accuracy of the approximations

The accuracy of the approximations to the remarriages of widows and widowers can be measured by the mean error between the number of remarriages and its approximation, given in Figure 41, and by the root mean squared error, given in Figure 42. Both these measures, for females and males, are extremely erratic over the sample period, indicating the varying ability of the approximation to characterize adequately remarriage behaviour in total and for individual ages in each year of the sample period. The mean error for remarriage of widows is small and fluctuates about zero, except in the last few years of the sample period when the approximation overestimates remarriage of widows by around two per cent in several years. For widowers, however, the approximation overestimated remarriages for most of the sample period, except in the last few years. From year to year the extent of over- or underestimation has varied enormously for both sexes, such that in some years remarriages of widowers were overestimated by up to 1% and remarriages of widows were underestimated by up to 1%. In projection, such imbalances between males and females would require correction by the two-sex marriage and divorce model. Despite this pessimistic outlook, the extent of under- or over-estimation was within 1% in forty-two of the fifty-five years of the sample period for females and in forty of the fifty-five years for males. Also, at no stage did the under- or overestimation exceed 2.8% for females and 1.8% for males.

For widows and widowers, the root mean squared error varies substantially over the sample period. For widows, the root mean squared error is stable in the pre-war period and then falls dramatically during World War II.

FIGURE 41

MEAN ERROR BETWEEN THE NUMBER OF REMARRIAGES OF WIDOWS AND ITS GAMMA APPROXIMATION FOR AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76

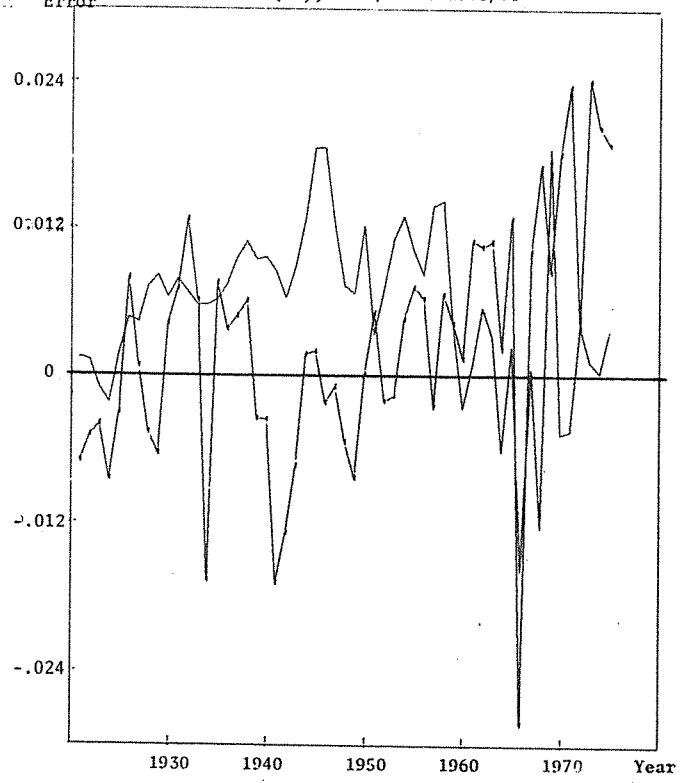
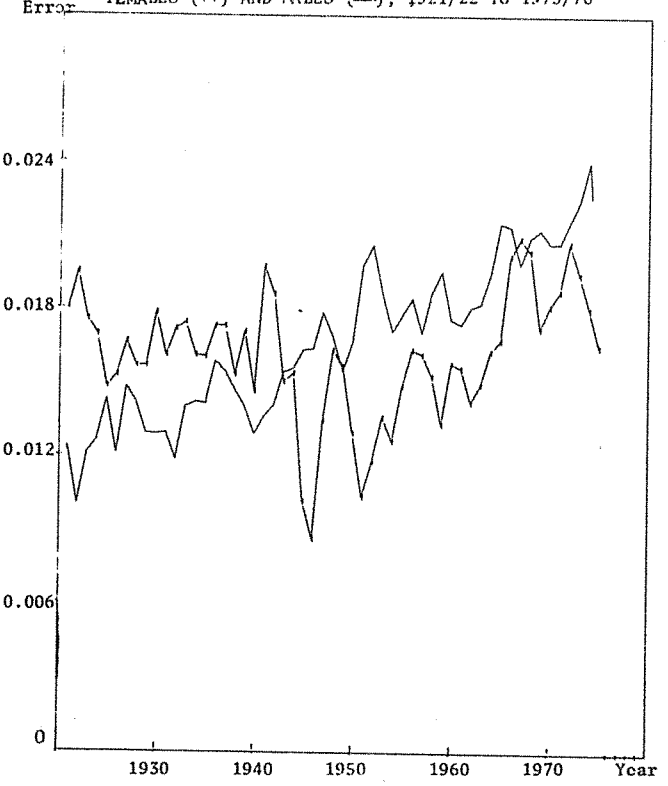


FIGURE 42

ROOT MEAN SQUARED ERROR BETWEEN THE NUMBER OF REMARRIAGES OF WIDOWS AND ITS GAMMA APPROXIMATION FOR AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76



Following World War II, the error generally rises until, by the end of the sample period, it tends to fluctuate about a level similar to that experienced in the pre-war period. For widowers, the root mean squared error has tended to rise throughout the sample period, such that the error for males was below that for females in the pre-war period and above it in the post-war period. Thus the adequacy of the approximation declined at the end of the sample period -- a source of some concern.

(e) The parameters of the age distributions

The parameters of the approximated age distributions of age specific rates of remarriage for widowed females and males are given in Figures 41, 42 and 43. The propensity to remarry has been highly variable over the period. In the 1920's, the propensity fell from its high post-World War I levels for both females and males. At this time, up until the end of World War II, the propensity for males substantially exceeded that for females; widowed males were generally more likely to remarry than their female counterparts. It is interesting to note that the difference between the overall rates of remarriage for widowed females and males is much greater than that for their respective propensities. Thus, when the age distribution of widowed persons at risk of remarriage is taken into account, widowed men do not exhibit a substantially greater tendency to remarry when compared to their female counterparts. At the time of the Depression, the influence of adverse economic conditions led to a continued decline in propensity to remarry. Following the Depression, remarriage propensities recovered and then increased substantially in the immediate post-war period, probably as a response to the return of Australian servicemen from overseas. Propensities fluctuated markedly during World War II, especially for females, but this was predominantly

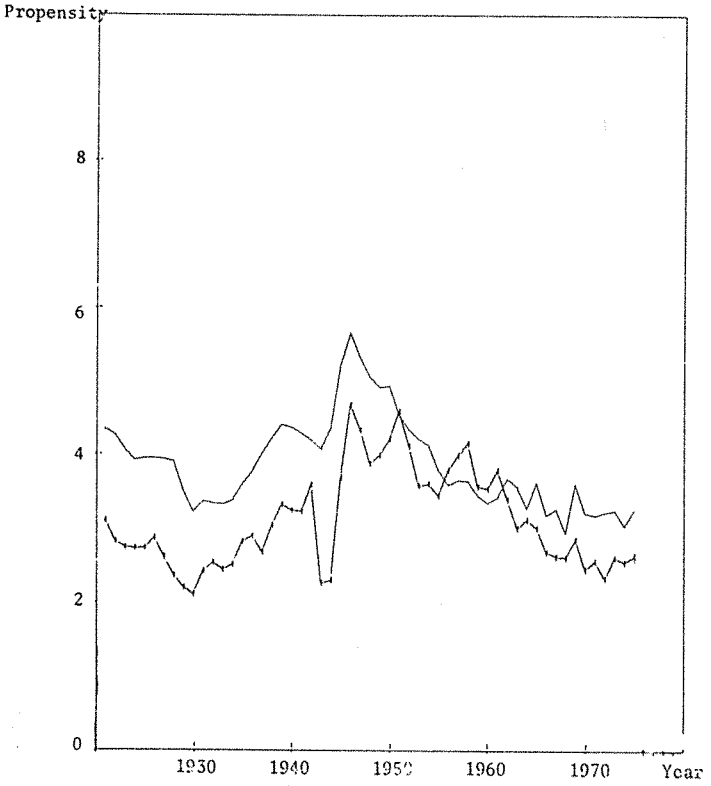
caused by the procedure adopted by the builders of the Databank, who recorded all service deaths as having occurred in 1943. The high propensities of the immediate post-war period were not to be repeated for, from this time, the propensity for widowed females and males to remarry began a decline which appears only to have been arrested in the early 1970's when remarriage propensities stabilized for females and males. This decline was less severe in the 1950's and early 1960's for females, as the relative oversupply of males led to substantial demand for females of all marital states. Consequently, female propensity to remarry actually exceeded that of males for a few years in the late 1950's and early 1960's. By the 1970's, however, male propensity to remarry exceeded that for females, although to a much smaller extent than it had in the pre-war period. As has been discussed for the remarriages of divorcees, the declining propensity for widowed persons to remarry is difficult to explain in terms of general economic or demographic trends. Persons who are older at the time of widowing are less likely to remarry, so the declining popularity of remarriage could be thought to be related to increasing life expectancy. However, as discussed for remarriages of divorcees, the propensity makes allowance for changes in the age distribution of widowed persons at risk of remarriage, such that increasing life expectancy or older age at widowing, per se, will not lead to declining propensity to remarry. Improved social security and superannuation, declining social resistance to de facto marriages and the like may have reduced the necessity to remarry. In fact, given the tendency for welfare benefits to be lower for married couples than for two single people, improvements in welfare benefits may act as a disincentive for widowed persons to remarry, at least formally. There are two opposing forces (for both remarriages of widowed and divorced persons); on the one hand social obstacles to remarriage are weakening but, on the other hand, the economic necessity to remarry is becoming less crucial. The net outcome

FIGURES 43, 44 AND 45

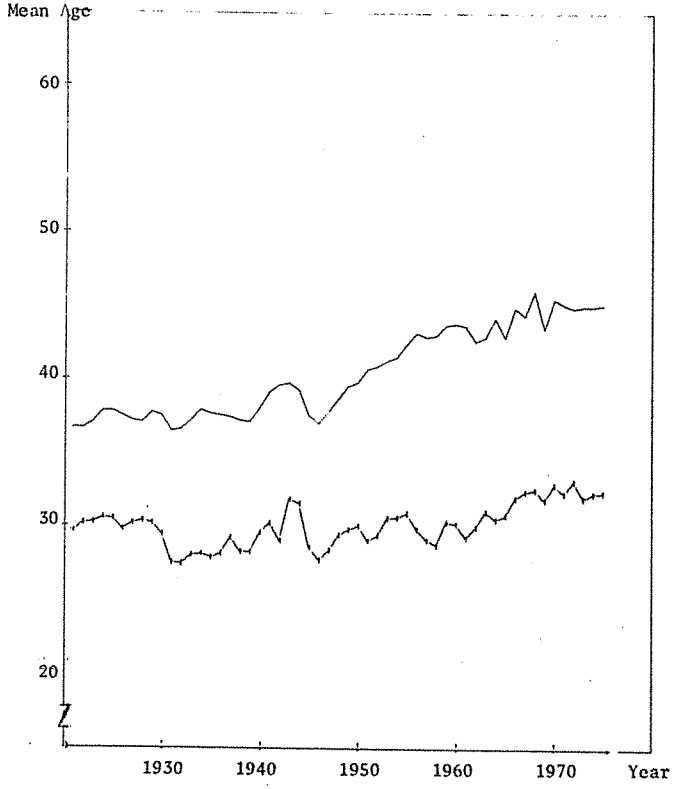
THE PARAMETERS OF THE APPROXIMATED AGE DISTRIBUTIONS OF AGE SPECIFIC RATES OF REMARRIAGE FOR WIDOWED AUSTRALIAN FEMALES AND MALES, 1921/22 TO 1975/76

FIGURE 43

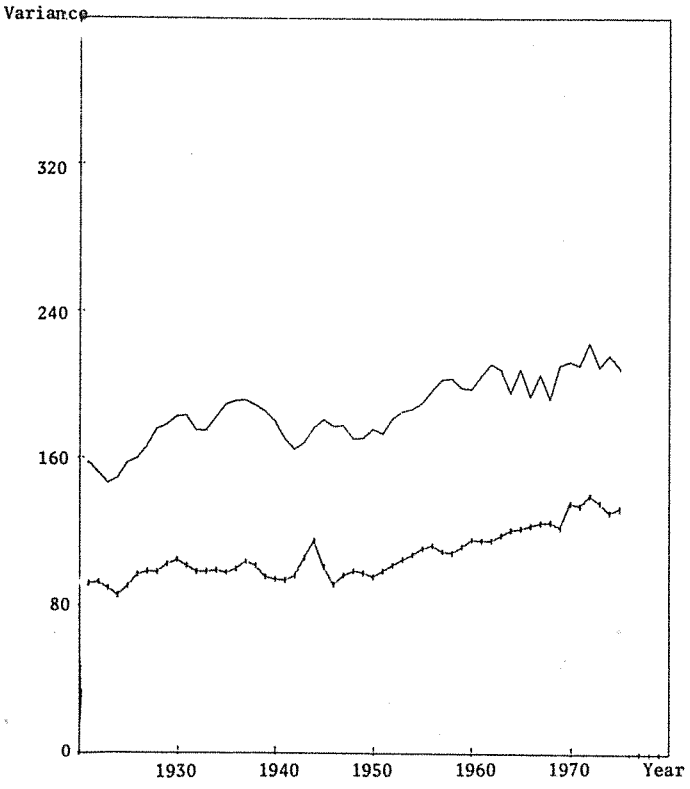
INDEX OF PROPENSITY TO REMARRY FOR WIDOWED AUSTRALIAN FEMALES (++) AND MALES (——), 1921/22 TO 1975/76



MEAN AGE AT REMARRIAGE FOR WIDOWED AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76



VARIANCE OF AGE AT REMARRIAGE FOR WIDOWED AUSTRALIAN FEMALES (++) AND MALES (—), 1921/22 TO 1975/76



of these forces is not clear. To date they have prompted declines in propensity to remarry, but in the future the net result may be different.

The mean age at remarriage for widowed females and males is given in Figure 44 and exhibits a generally increasing trend over the sample period. In the pre-war period, the mean age at remarriage for males was quite stable, whilst that for females declined more substantially during the Depression and then recovered in the years following the Depression. In World War II, the age at remarriage rose for both males and females but soon returned to pre-war levels. From the end of World War II until the end of the 1960's, the mean age increased for both males and females, with the increase for males being much faster than that for females. This increased the difference between male and female ages at remarriage to about 12 years, compared to only 7 or 8 years in the pre-war period. In the 1970's, the mean age appears to have stabilized. The generally increasing mean age at remarriage for widowed persons may have derived from similar sources to those used to explain the generally increasing mean age at remarriage for divorced persons. Rates of remarriage for young widowed persons have declined relative to those of older widowed persons, as the young have responded more positively to the disincentives to remarriage provided by improved economic conditions, increased acceptance of cohabitation and contraception, increased welfare payments and the like. Consequently, the mean age at remarriage for widowed persons has risen and, given the continuation of these economic and social trends, the mean age will probably continue to rise.

The variance of age at remarriage for widowed females and males is given in Figure 45. As with the mean age, the variance in age has tended to increase over the sample period, with the male variance substantially exceeding that for females and the difference between the two

increasing slightly over the sample period. The increasing variance can be seen as the result of the increasing breadth of the remarriage rate distribution; rates at older ages have continued to increase whilst rates at younger ages have fallen. It appears that, as with the mean age, the variance in age will stabilize or continue to increase if the economic and social trends of the 1970's continue.

(f) Summary

The approximations to the age distributions of age specific remarriage rates for widowed persons are adequate. As with the age distributions of remarriage rates for divorced persons, the historical age distributions for widowed persons are erratic and difficult to characterize in terms of a smooth mathematical distribution. In terms of aggregate numbers of remarriages of widows and widowers, the approximation has performed satisfactorily, although there has been consistent over-estimation for males throughout the sample period and some overestimation for females at the end of the period. In terms of the performance at individual ages, the approximation has worsened slightly over the period. At the end of the sample period, the remarriages of widows and widowers are probably the least adequately approximated of all the marital status changes reported in this paper. They are, however, the least important (in terms of numbers) of all these marital flows. The propensity to remarry and the mean age, and variance in age, at remarriage for widowed females and males have changed in response to the imbalance in the numbers of marriageable males and females, general economic conditions, improvements in superannuation coverage and old age and widows' pensions, and changing attitudes towards cohabitation. These variables represent some of the major determinants of the remarriage behaviour of Australian widows and widowers and should be included in the econometric model which seeks to explain the propensity to remarry and the mean, and variance in, age at remarriage.

4. CONCLUSION

One of the aims of the BACHUROO module is to project population by age, sex and marital status. Hence, age specific marital status changes for females and males must be modelled and projected. In this paper the procedure for modelling the age specific rates of first marriage, divorce and remarriage in relation to numbers at risk is detailed. It was expected that econometric techniques could play a useful role in the modelling of marriage and divorce, but the amount of information to be modelled was such that a technique was necessary to condense the data for each marital status flow to a few time dependent parameters. The parameterization involved constructing a time series of gamma (or modified gamma) approximations to the age distributions of the age specific rates of first marriage, of divorce and of remarriage. The parameters of these approximations -- the propensity, mean and variance -- characterize the entire age distribution of age specific rates. It is the time series of these parameters, rather than of the individual rates, which (using procedures not discussed in this paper[1]) are econometrically modelled and can be projected into the future. Projections of these parameters can then be used to calculate projections of rates of first marriage, of divorce and of remarriage for each individual age.

The use of gamma (and modified gamma) distributions to summarize the salient features of female and male marriage and divorce has, in general, been successful over the sample period, 1921/22 to 1975/76. In that period there have been substantial changes in the age distributions of the age specific rates of first marriage, divorce and remarriage, and the

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1. See Clive Brooks, Dennis Sams and Lynne Williams, op. cit..

technique has been able to capture the general pattern of these changes. However, there are some consistent weaknesses with the technique. In most of the distributions studied, rates rose sharply for young ages and, after a peak, fell less sharply for the older ages. The smooth approximation used tended to overestimate the rates at young ages because it rose too sharply, to underestimate the peak of the distribution and then to overestimate the rates for ages just above the peak years. Thus, the approximated technique is spreading the first marriages, divorces or remarriages across ages; they are being moved from the peak ages to younger or older ages. However, if the technique is able adequately to approximate the total marital status flow, the inaccurate spreading of a small part of the flow across ages should not substantially distort the population projections. The first marriage rate distribution presented some difficulties in the latter part of the sample period due to the institutionally determined constraint at age 21. The major effect of this was for the approximation to shift some first marriages to older ages. Since this institutional constraint was changed in 1973, the population projections are not expected to suffer substantially. The addition of a time-invariant constant distribution to the approximated distributions for first marriage has been successful over the sample period as a technique for capturing first marriage rates at older ages; however, the constant distribution implies a lower limit to first marriage rates at older ages that may be excessively high in projection. Experimentation with alternative smooth approximations for first marriage rates may be the only solution. Over time, the divorce rate distribution widened at its peak and the approximation tended to underestimate peak rates, such that divorces were moved from the early and late 20's ages to the 40's to 60's ages. However, it appears that, under the influence of the Family Law Act, the distribution will, at least for the immediate future, be much narrower and easier to

approximate. The remarriage rate distributions were the most difficult to approximate. Because of the very small numbers at risk of remarriage at younger ages, remarriage rates can vary erratically from age to age and from year to year. The approximations do, however, capture remarriage rates at older ages, where the numbers involved are far more substantial.

Errors in the approximations to the age distributions are of particular interest. In a model disaggregated by single year of age, errors in projections of events can occur if the events are not distributed accurately across ages, even if the total number of events is correct, and these errors will accumulate over time, leading to distortions in the age/marital status distribution of the population. A succinct measure of the accuracy of the approximation for each individual age is that the root mean squared error, which measures the size of the fluctuations of the historical data about the smooth approximation. Whilst some fluctuation about the smooth curve is expected, the root mean squared error should be low enough to be attributed to sampling variation and should show no increasing trend, and this would indicate decreasing accuracy. The root mean squared error for first marriages of females and males has, at least, in the later part of the sample period, shown no increasing trend. Unfortunately, for both females and males the errors for divorces, remarriages of divorcees and of widowed persons have increased over most of the later part of the sample period, with some decline being shown in the last few years. For all marital flows, however, the root mean squared error has been highly variable throughout the sample period, indicating inconsistent accuracy in the ability of the approximation to capture the rates at individual ages.

The accuracy of the approach can also be measured by comparing the historical and approximated total numbers of events. Ideally, the total number of first marriages, divorces and remarriages should be closely approximated in each year, with no consistent over- or under-estimation, as this could lead to accumulated errors. Unfortunately divorces and first marriages for females and males are almost consistently overestimated and underestimated respectively. However, both were still closely approximated, first marriages usually being within 1.0% for females and within 1.5% for males and divorces being within 1.5% for females and males of the historical figure. Consistent over- and/or underestimation can lead to distortions in the marital status structure of projected populations. In the situation where divorces are overestimated and first marriages are underestimated, a model would project too few never marrieds to become married and these depleted numbers of marrieds would be divorced at a high rate. So, the model would project too many never married persons and too many divorced persons at the expense of married persons. The total number of remarriages of divorced persons, whilst not being consistently over- or underestimated, varied between overestimation by 2.5% and underestimation by 1.0% for females and by 2.0% and 2.5% respectively for males. There was also consistent over-estimation of remarriages of female and male divorcees near the end of the sample period. In projection, this would in part reduce the distortions in the marital status composition of the population caused by the over-estimation of divorce. For remarriages of widowed females, a similar pattern existed, with the total number of remarriages being overestimated by up to 2.5% and underestimated by up to 2.8% and overestimation being more common at the end of the sample period. Total remarriages of widowed males, however, were almost continually overestimated by up to 1.8%. The erratic performance of the remarriages approximations could be of some

concern in projection. Despite these pessimistic observations, for the 55 years of the sample period, the approximations were within ± 1.5% of the total marital flow in all years for female first marriages, 52 years for male first marriages, 54 years for female divorces, 53 years for male divorces, 45 years for remarriages of female divorcees, 49 years for remarriages of male divorcees, 46 years for remarriages of widows, and 51 years for remarriages of widowers. In terms of total marital flows, the approximations have performed satisfactorily.

The approximation technique discussed in this paper enables the enormous amount of information on marriage and divorce of females and males to be condensed into a few time-dependent descriptive parameters. These descriptive parameters are readily interpretable and can be modelled econometrically. Projections of these marriage and divorce parameters can then be used, along with projections of the population at risk of marriage and divorce, to derive projections of first marriages, divorces, remarriages of divorced persons and remarriages of widowed persons for Australian females and males of each single year of age.

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APPENDIX 1

THE APPROXIMATING TECHNIQUE FOR FIRST MARRIAGES

It was not possible to capture the age distribution of the age specific rates of first marriages with a simple gamma distribution. A gamma distribution which adequately approximates the rise in first marriage rates for young ages and the peak marriage rates for young to mid 20 year old females and mid to late 20 year old males diminishes too rapidly at the older ages to represent accurately the first marriage rates of 30 to 50 year old females and males. Alternatively, a gamma distribution which adequately captures the rates for older ages severely underestimates the peak rates of first marriage.

In order to model the rates for both young and older persons, the smooth approximation adopted is the sum of two distributions; one to approximate the young and peak age rates and another to approximate the difference between the rates at older ages and those given by the peak rate approximation. In practice, the second distribution is fixed to minimize the number of time dependent parameters necessary to specify the total distribution.

The age distribution for first marriage rates, $p(x)$, can therefore be written as

$$p(x) = f(x) + g(x), \tag{A1}$$

where $p(x)$ is the fitted approximation to the historical distribution of the age specific rates of first marriage,

$f(x)$ is the distribution which approximates the peak rates of first marriage, and

$g(x)$ is the distribution of the differences between rates at older ages and those given by the peak rate approximation (or, simply, the distribution of adjustment factors).

Now we define $f(x)$ and $g(x)$ to be gamma distributions

(A2) $$f(x) = A_f\, x^{\alpha-1}\, e^{-x/\beta} \quad , \qquad x > 0 \quad ,$$

where A_f , α and β are parameters to be determined for the distribution in each year, and

(A3) $$g(x) = A_g (x-x_1)^{\alpha_g-1}\, e^{-(x-x_1)/\beta_g} \quad , \quad \text{if } x > x_1 \quad ,$$

$$= 0 \quad , \quad \text{if } x \leq x_1 \quad ,$$

where A_g , α_g and β_g are fixed parameters and this gamma distribution begins at age x_1 .

To determine the fixed parameters of the distribution of age specific adjustment factors, $g(x)$, the gamma distribution given in equation (A3) was fitted to the historical age specific rates of first marriage in each year by minimizing the sum of squares of the difference between the actual number of marriages and that given by the approximation and the known number of persons at risk, except that the contribution to this sum for older ages was ignored. Thus, this distribution attempts to fit to the historical first marriage rates for young and peak age persons, but diverges from the historical rates for older persons. The discrepancy between this distribution and the historical rates at older ages is small for ages below 30, rises to a peak in the late 30's or early 40's ages and then diminishes with increasing age. The age distribution of this discrepancy suggested the use of a gamma distribution for $g(x)$, as defined in equation (A3).

The parameters of $g(x)$, the distribution of age specific adjustment factors, for each year were determined by fitting the gamma distribution in (A3) to the age distribution of the discrepancy at older ages, by again minimizing the sum of squares of the difference between the historical discrepancy and that given by the approximation. The rounded simple averages over time of these fitted parameters for females and males were adopted as the fixed values for the parameters of $g(x)$. However, it was necessary to use two sets of estimates for these fixed parameters; one set for the pre-war period (1921/22 to 1939/40) and the other for the wartime and post-war period (1940/41 to 1975/76) as follows:

	A_g	α_g	β_g	x_1
Females				
Pre-war	.0035	2.2	6.8	33.0
Wartime and post-war	.017	2.0	6.6	27.0
Males				
Pre-war	.008	1.7	8.0	35.0
Wartime and post-war	.0155	1.9	7.7	29.0

With the constant level of adjustment, $g(x)$, determined for each period, the distribution, $p(x)$, as defined in equation (A1), was fitted to the historical rates using the least squares fitting procedure discussed in Section 2.

The propensity of $p(x)$ is given by

$$X_p = \int_0^\infty p(x)\, d(x) \quad ,$$

therefore

(A4) $$X_p = X_f + X_g \quad ,$$

where X_f and X_g are the propensities of the least squares fitted gamma approximation to the peak rates of first marriage and the distribution of adjustment factors. The mean of $p(x)$ is

$$\bar{x}_p = \int_0^\infty x\, p(x)\, dx / X_p \quad ,$$

therefore

$$\bar{x}_p = \frac{X_f \bar{x}_f + X_g \bar{x}_g}{X_f + X_g} \quad . \tag{AS}$$

The variance of $p(x)$ is given by

$$\sigma_p^2 = \overline{x_p^2} - (\bar{x}_p)^2 \quad ,$$

where

$$\overline{x_p^2} = \int_0^\infty x^2\, p(x^2)\, dx / X_p \quad ,$$

and hence

$$\overline{x^2}_p = \frac{X_f \overline{x_f^2} + X_g \overline{x_g^2}}{X_f + X_g} \quad .$$

Therefore,

$$\sigma_p^2 = \frac{X_f(\sigma_f^2 + \bar{x}_f^2) + X_g(\sigma_g^2 + \bar{x}_g^2)}{X_f + X_g} - (\bar{x}_p)^2 \quad . \tag{A6}$$

Projection of first marriage rates requires the projection of the index of propensity to first marry, X_p, the mean of the age distribution of first marriage rates, $\bar{x}_p$, and the variance of the age distribution of first marriage rates, σ_p^2. These projections are for the final approxi-

mation to the first marriage rate distributions, $p(x)$, but the final approximation is the sum of two distributions, $g(x)$, which is constant over time and whose values are known, and $f(x)$, which is the gamma approximation to the peak rates of first marriage and whose values can be calculated from the propensity, mean and variance of $f(x)$. Hence the projected propensity, mean and variance, X_p, $\bar{x}_p$ and σ_p^2, and the parameters of the constant distribution, X_g, $\bar{x}_g$ and σ_g^2, must be used to calculate the parameters of $f(x)$, X_f, $\bar{x}_f$ and σ_f^2. Since $f(x)$ is a gamma distribution, its propensity, mean and variance are sufficient to calculate its values. The projected first marriage rates are then given by equation (A1).

The projected propensity, mean and variance of $f(x)$ can be calculated from the projected propensity, mean and variance of $p(x)$ and the known values of $g(x)$ by re-arranging equations (A4), (A5) and (A6). Re-arranging (A4),

$$X_f = X_p - X_g \quad . \tag{A7}$$

Re-arranging (A5),

$$\bar{x}_g = \frac{X_p \bar{x}_p - X_g \bar{x}_g}{X_p - X_g} \quad . \tag{A8}$$

Re-arranging (A6),

$$\sigma_f^2 = \frac{X_p(\sigma_p^2 + \bar{x}_p^2) - X_g(\sigma_g^2 + \bar{x}_g^2)}{X_p - X_g} - (\bar{x}_f)^2 \quad . \tag{A9}$$

Thus, from projections of the index of propensity to first marry, X_p, the mean of the age distribution of first marriage rates, $\bar{x}_p$, and the variance of the age distribution of first marriage rates, σ_p^2, and the known distribution $g(x)$, the propensity, mean and variance of $f(x)$ can be calculated using equations (A7), (A8) and (A9). The projection of the first marriage rate, $p(x)$, is then the sum of $g(x)$ and the projection of $f(x)$.

APPENDIX 2

TABLE 1 : PARAMETERS OF THE AGE DISTRIBUTIONS OF AGE SPECIFIC RATES OF MARITAL STATUS CHANGE FOR FEMALES: 1921/22 TO 1975/76

Year	First Marriage			Divorce			Remarriage for Divorcees			Remarriage of Widows		
	Propensity	Mean	Variance	Propensity	Mean	Variance	Propensity	Mean	Variance	Propensity	Mean	Variance
1921/22	2.20	29.6	88.6	.058	36.5	182.0	5.81	32.0	107.2	3.11	29.6	91.7
1922/23	2.16	29.6	89.9	.058	36.3	181.5	5.98	32.0	128.8	2.82	30.2	92.4
1923/24	2.20	29.7	90.6	.063	36.1	179.5	5.78	32.6	125.5	2.73	30.3	89.1
1924/25	2.21	29.7	90.6	.069	35.8	178.5	6.41	32.7	152.5	2.72	30.6	85.1
1925/26	2.23	29.7	90.6	.070	35.7	173.5	7.61	30.8	171.2	2.73	30.5	90.2
1926/27	2.24	29.6	90.6	.069	35.3	168.5	6.91	31.3	163.7	2.86	29.8	96.4
1927/28	2.22	29.7	91.4	.071	35.1	160.0	6.95	31.2	176.4	2.60	30.2	98.1
1928/29	2.15	29.7	93.4	.072	34.8	152.2	7.15	30.4	163.7	2.37	30.4	97.8
1929/30	1.98	29.8	97.6	.069	34.7	143.3	6.56	30.3	154.0	2.21	30.2	102.1
1930/31	1.74	30.0	105.3	.066	34.3	136.6	5.48	29.5	119.9	2.11	29.4	104.5
1931/32	1.70	30.1	106.5	.064	34.1	129.6	4.51	30.1	105.4	2.43	27.5	101.4
1932/33	1.84	30.0	101.1	.064	33.8	123.2	5.39	29.3	130.5	2.53	27.4	98.1
1933/34	1.95	29.9	96.6	.073	33.7	116.5	6.11	28.7	121.7	2.45	28.0	98.0
1934/35	2.11	29.7	91.6	.078	33.8	111.5	6.01	30.0	117.0	2.51	28.1	98.9
1935/36	2.26	29.7	88.5	.079	34.0	109.0	6.50	29.8	122.3	2.82	27.9	97.5
1936/37	2.31	29.6	87.5	.083	34.2	108.6	6.82	29.8	123.6	2.90	28.1	99.8
1937/38	2.38	29.6	86.4	.090	34.5	109.7	7.59	29.7	131.6	2.67	29.2	103.7
1938/39	2.47	29.4	84.2	.094	34.7	112.1	7.93	29.2	124.9	3.04	28.3	101.7
1939/40	2.71	29.0	79.2	.094	35.0	116.6	8.02	29.3	108.5	3.33	28.2	95.4
1940/41	3.07	29.3	77.8	.094	35.1	119.3	8.37	29.7	100.6	3.25	29.6	94.2
1941/42	3.17	28.8	77.2	.097	35.3	123.7	8.87	30.2	113.4	3.24	30.2	93.6
1942/43	3.11	28.8	77.8	.113	35.5	127.7	9.10	30.2	126.2	3.60	29.0	96.0
1943/44	2.81	29.0	83.8	.139	35.6	129.3	8.93	30.1	122.1	2.27	31.9	105.3
1944/45	2.70	29.1	85.6	.171	35.6	131.6	9.27	30.1	124.2	2.31	31.6	115.9
1945/46	2.85	28.9	83.9	.191	34.9	134.8	10.20	29.7	138.0	3.69	28.6	100.7
1946/47	3.08	28.5	80.1	.208	34.5	124.8	10.61	29.6	139.6	4.68	27.7	91.3

continued ..

TABLE 1 : Continued

Year	First Marriage			Divorce			Remarriage for Divorcees			Remarriage of Widows		
	Propensity	Mean	Variance	Propensity	Mean	Variance	Propensity	Mean	Variance	Propensity	Mean	Variance
1947/48	3.05	28.4	80.7	.202	35.5	127.7	10.37	29.9	150.3	4.34	28.4	96.1
1948/49	3.08	28.4	80.3	.171	36.1	135.9	11.56	28.7	172.7	3.88	29.4	98.5
1949/50	3.14	28.3	79.8	.166	36.3	131.2	14.22	27.0	175.1	4.00	29.8	97.5
1950/51	3.29	28.2	78.2	.170	36.9	142.5	13.44	27.4	152.5	4.22	30.1	95.6
1951/52	3.34	28.1	78.0	.164	37.3	157.4	13.61	26.9	141.0	4.60	29.0	98.8
1952/53	3.28	28.0	78.8	.170	37.4	167.4	13.67	26.6	134.0	4.12	29.4	101.8
1953/54	3.29	27.9	78.8	.165	37.7	190.2	12.75	27.2	150.0	3.58	30.6	105.1
1954/55	3.37	27.8	77.5	.152	37.8	209.6	12.43	26.9	141.3	3.61	30.6	107.4
1955/56	3.47	27.7	75.9	.146	37.7	198.4	12.66	26.7	136.4	3.46	30.9	111.0
1956/57	3.56	27.8	74.7	.138	37.6	187.3	12.62	26.6	133.7	3.80	29.8	112.8
1957/58	3.62	27.8	73.9	.139	37.2	176.8	12.36	26.8	130.8	4.00	29.1	109.3
1958/59	3.59	27.8	74.3	.144	36.8	157.5	12.70	26.7	127.0	4.17	28.7	108.5
1959/60	3.53	27.8	75.1	.140	37.0	164.5	12.01	27.2	126.6	3.58	30.3	112.0
1960/61	3.50	27.9	75.4	.135	37.7	190.8	12.56	26.5	130.0	3.55	30.2	115.8
1961/62	3.53	28.0	74.9	.142	39.6	230.5	11.76	27.2	134.3	3.80	29.3	115.5
1962/63	3.54	28.1	74.8	.150	40.4	249.5	11.63	27.5	139.9	3.41	30.0	115.5
1963/64	3.55	28.2	75.1	.156	40.9	264.1	12.08	27.3	144.5	3.01	31.1	118.3
1964/65	3.57	28.1	75.0	.166	41.3	273.5	11.83	27.9	150.9	3.12	30.5	121.2
1965/66	3.57	27.7	73.8	.165	40.8	258.3	11.71	27.6	149.0	3.01	30.8	122.1
1966/67	3.53	28.0	75.1	.204	41.4	284.8	12.51	27.8	153.0	2.69	32.0	123.6
1967/68	3.49	27.9	75.6	.205	41.1	286.5	10.59	29.0	171.2	2.63	32.4	125.3
1968/69	3.48	27.6	76.2	.178	39.9	257.2	9.24	29.4	162.8	2.61	32.6	125.6
1969/70	3.43	27.5	77.4	.212	39.2	246.4	10.11	28.9	169.1	2.86	31.9	122.8
1970/71	3.37	27.4	78.8	.213	38.6	232.5	10.31	28.1	171.3	2.46	32.9	136.0
1971/72	3.32	27.5	79.9	.226	38.2	216.3	9.50	28.6	180.1	2.57	32.3	134.7
1972/73	3.18	27.7	82.0	.266	37.9	210.3	9.34	28.8	177.8	2.34	33.2	140.4
1973/74	2.97	27.6	86.8	.244	37.6	201.1	7.40	29.8	168.7	2.61	32.0	136.2
1974/75	2.67	27.9	93.2	.304	37.3	190.6	7.53	29.8	180.1	2.55	32.3	130.9
1975/76	2.50	28.5	95.6	.599	38.0	250.8	9.70	30.4	218.1	2.64	32.4	133.4

TABLE 2 : PARAMETERS OF THE AGE DISTRIBUTIONS OF AGE SPECIFIC RATES OF MARITAL STATUS CHANGE FOR MALES : 1921/22 TO 1975/76

Year	First Marriage			Divorce			Remarriage of Divorcees			Remarriage of Widowers		
	Propensity	Mean	Variance	Propensity	Mean	Variance	Propensity	Mean	Variance	Propensity	Mean	Variance
1921/22	2.15	32.2	82.8	.064	40.4	245.2	5.65	39.1	179.3	4.36	36.7	158.1
1922/23	2.10	32.3	84.7	.065	40.3	251.1	5.33	39.2	165.6	4.27	36.7	152.2
1923/24	2.08	32.3	85.5	.070	40.1	250.3	5.11	39.1	147.7	4.07	37.1	146.4
1924/25	2.08	32.3	86.1	.077	39.8	246.3	4.86	39.2	129.5	3.92	37.8	149.1
1925/26	2.07	32.3	86.9	.076	39.6	235.6	4.84	38.9	143.6	3.95	37.8	157.5
1926/27	2.05	32.2	87.1	.075	39.2	225.7	4.52	39.2	145.7	3.95	37.5	159.9
1927/28	2.00	32.2	88.2	.076	39.0	211.5	4.51	39.1	146.7	3.94	37.2	166.4
1928/29	1.92	32.3	90.1	.076	38.7	199.5	4.65	38.3	160.8	3.90	37.1	175.9
1929/30	1.79	32.5	93.2	.073	38.5	187.5	4.78	39.0	219.6	3.51	37.7	178.3
1930/31	1.61	32.8	100.0	.071	38.1	179.7	4.38	39.2	244.7	3.22	37.5	182.6
1931/32	1.56	32.7	101.1	.069	37.9	172.8	4.03	38.1	196.8	3.37	36.5	183.3
1932/33	1.69	32.6	95.6	.069	37.5	167.1	4.84	37.2	222.1	3.34	36.6	175.3
1933/34	1.81	32.5	91.3	.079	37.3	160.7	5.56	36.4	241.8	3.32	37.2	174.9
1934/35	1.96	32.3	86.7	.085	37.4	155.1	5.63	36.5	211.7	3.39	37.9	182.2
1935/36	2.05	32.1	83.5	.087	37.5	151.4	6.24	36.6	233.3	3.60	37.6	189.3
1936/37	2.09	32.1	82.6	.091	37.6	149.4	8.00	35.0	274.9	3.77	37.5	191.5
1937/38	2.15	32.1	81.8	.099	37.8	149.3	9.21	34.2	273.4	4.02	37.4	191.6
1938/39	2.22	32.0	80.3	.103	38.0	150.3	9.74	33.5	248.0	4.22	37.2	189.1
1939/40	2.45	31.6	76.9	.102	38.3	152.5	9.55	33.1	196.9	4.41	37.1	185.6
1940/41	2.76	32.3	94.9	.102	38.2	151.3	9.72	33.7	202.4	4.37	38.0	180.2
1941/42	2.84	31.9	95.7	.105	38.5	152.4	9.57	35.0	200.1	4.29	39.1	170.6
1942/43	2.73	31.9	98.2	.121	38.7	154.3	9.87	35.0	202.6	4.20	39.6	164.8
1943/44	2.48	32.0	104.7	.149	38.8	155.9	10.17	34.6	203.1	4.08	39.7	168.5
1944/45	2.48	32.1	104.0	.185	38.8	158.6	10.10	35.3	199.1	4.37	39.2	176.7
1945/46	2.65	31.9	100.9	.206	38.0	155.9	10.73	35.2	213.1	5.23	37.5	181.0
1946/47	2.85	31.5	96.5	.222	37.5	140.9	10.87	35.3	206.6	5.66	37.0	177.3
1947/48	2.74	31.5	99.0	.216	38.7	147.9	10.56	35.9	227.8	5.32	37.8	177.8
1948/49	2.71	31.5	99.5	.183	39.5	161.5	10.23	35.5	246.7	5.06	38.7	170.7
1949/50	2.68	31.6	100.5	.177	39.8	159.5	11.12	35.2	276.1	4.92	39.5	170.9

continued ...

TABLE 2 : Continued

Year	First Marriage			Divorce			Remarriage of Divorcees			Remarriage of Widowers		
	Propensity	Mean	Variance	Propensity	Mean	Variance	Propensity	Mean	Variance	Propensity	Mean	Variance
1950/51	2.63	31.6	102.6	.180	40.3	170.2	12.63	34.8	316.0	4.94	39.8	175.9
1951/52	2.54	31.5	105.9	.170	40.2	174.8	12.12	34.1	292.7	4.55	40.7	173.4
1952/53	2.38	31.6	111.0	.176	40.4	188.8	11.61	34.0	290.1	4.35	40.9	181.6
1953/54	2.32	31.6	113.8	.172	41.3	226.3	10.89	34.8	317.1	4.22	41.3	185.6
1954/55	2.37	31.4	112.9	.156	41.3	234.5	10.23	34.6	308.8	4.13	41.5	187.0
1955/56	2.40	31.3	111.8	.153	41.4	235.0	10.06	33.8	281.5	3.80	42.4	190.5
1956/57	2.44	31.3	110.6	.144	41.4	228.9	9.67	33.8	281.8	3.59	43.2	197.1
1957/58	2.50	31.2	108.5	.144	41.0	210.6	9.73	33.0	256.5	3.66	42.9	203.3
1958/59	2.54	31.2	107.4	.149	40.6	189.4	10.07	32.4	237.8	3.64	43.0	203.7
1959/60	2.56	31.1	107.2	.146	40.9	206.6	10.21	32.1	228.5	3.45	43.7	198.3
1960/61	2.54	31.1	107.9	.142	41.6	240.7	9.79	32.7	247.0	3.36	43.8	198.0
1961/62	2.56	31.1	106.9	.149	43.8	291.3	9.80	33.4	270.5	3.43	43.6	205.2
1962/63	2.62	31.1	105.3	.157	44.7	311.4	10.11	32.1	228.3	3.69	42.6	211.8
1963/64	2.70	30.9	103.3	.163	45.1	324.2	10.17	32.7	246.7	3.58	42.9	208.5
1964/65	2.84	30.8	100.0	.174	45.3	333.8	10.69	33.1	257.6	3.28	44.2	195.6
1965/66	2.98	30.6	96.4	.172	44.9	320.9	11.17	31.9	222.1	3.63	42.9	209.2
1966/67	2.85	30.7	100.3	.216	45.7	365.9	11.14	32.9	221.1	3.19	44.9	193.8
1967/68	2.80	30.5	102.0	.216	45.1	364.4	9.43	34.4	219.2	3.27	44.4	206.1
1968/69	2.82	30.4	102.6	.187	43.5	315.8	8.43	34.3	193.6	2.94	46.0	192.4
1969/70	2.77	30.3	104.7	.222	42.5	290.3	8.53	34.9	200.0	3.61	43.5	211.1
1970/71	2.71	30.2	107.0	.221	41.9	269.4	8.16	34.6	198.3	3.21	45.5	213.2
1971/72	2.61	30.3	110.4	.235	41.3	244.9	7.69	35.2	218.2	3.18	45.1	211.0
1972/73	2.52	30.5	112.3	.277	40.9	237.6	8.09	35.3	230.1	3.22	44.9	223.4
1973/74	2.51	30.5	113.2	.255	40.7	230.5	7.91	34.9	271.1	3.25	45.0	210.2
1974/75	2.38	31.0	116.5	.318	40.3	217.6	8.29	34.6	272.2	3.04	45.0	216.6
1975/76	2.24	31.5	119.1	.631	41.1	288.9	11.16	35.3	333.9	3.26	45.1	210.2