*Canadian Studies in Population, Vol. 14 (1), 1987, pp. 47-68*

# AN ANALYSIS OF THE FIRST MARRIAGE PATTERNS OF CANADIAN WOMEN

**Gilles Grenier**
*University of Ottawa, Ottawa, Ontario, Canada*

**David E. Bloom**
*Columbia University, New York, New York, U.S.A.*

**D. Juliet Howland**
*Informetrica Limited, Ottawa, Ontario, Canada*

*Résumé* – Le modèle de mariage de Coale et McNeil est utilisé pour étudier l'évolution et les déterminants de l'âge au premier mariage des Canadiennes à partir de données des recensements de 1971 et 1981. Les résultats indiquent une tendance vers une stabilisation de l'âge moyen au premier mariage et vers une diminution de la proportion de celles qui se marient au cours de leur vie. Cependant, les changements estimés ne sont pas aussi grands que ceux indiqués par les statistiques de l'état civil récentes. Une raison importante de cette différence est que le recensement de 1981 tient compte en partie des mariages de droit commun. Une analyse des déterminants du mariage montre que la langue maternelle française, la naissance au Québec ou dans un pays étranger, la religion catholique, le niveau d'éducation et la résidence dans un milieu urbain ont un effect positif sur l'âge moyen au premier mariage, alors que la naissance au Québec, la religion catholique, le niveau d'éducation et la résidence dans un milieu urbain ont un effet négatif sur la probabilité de se marier.

*Abstract* – The Coale-McNeil marriage model is applied to study the evolution and determinants of female first marriage patterns in Canada with data from the 1971 and 1981 censuses. The results indicate a tendency toward a stabilization of the mean age at first marriage and toward a decline in the proportion ever-marrying for younger cohorts; however, the changes reported are not as large as those shown in recent marriage vital statistics data. A major reason for that difference is that the 1981 census data include some common law marriages. An analysis of the determinants of marriage patterns shows that French mother tongue, birth in Quebec and in foreign countries, Catholic religion, education and urban residence affect positively the mean age at first marriage; while birth in Quebec, Catholic religion, education and urban residence affect negatively the probability of ever-marrying.

*Key Words* – **Age, marriage, determinants, cohorts.**

## *Introduction*

There have been important changes over time in marriage patterns in Canada. From the beginning of the century until the early 1970s, there was a clear trend towards younger and more universal marriage (see, for example, Basavarajappa, 1983; Gee, 1980; Mertens, 1976). During the last decade, however, the situation seems to have reversed dramatically. A recent study by Statistics Canada (1984) indicates that the number of marriages has been dropping by an average of 1,200 per year since 1972. The same study reports that if age-specific first marriage rates were to remain as they were in 1982, only 66 per cent of the female population would ever marry, a low never before matched in Canadian history. As these changes took place, there was also an increase in the number of common law marriages. This recent evolution of marriage patterns raises three interesting questions: Does the recent decline in the number of marriages reflect a delaying of marriages to older ages or an increase in the proportion of the population who will never marry? To what extent can this decline be attributed to the fact that common law marriages are excluded from the calculations? Did marriage behaviour change so much if the latter are considered?

In this paper, we study the evolution of marriage patterns of Canadian women using data from the Public Use Samples of the 1971 and 1981 censuses. We seek *(1)* to identify the existence of trends, across birth cohorts, in the timing and incidence of first marriage (e.g., the mean age at first marriage and the proportion of women who ever marry) and *(2)* to estimate the determinants of age at first marriage and the probability of ever-marrying. Note that the definition of marriage in the 1981 census makes reference to common law marriages, so that the latter are partly accounted for in the patterns that we estimate.

The estimates presented in the paper are derived by fitting the Coale-McNeil marriage model (Coale, 1971; Coale and McNeil, 1972) to data on age at first marriage for individual women in the two Canadian censuses. Because of its parametric nature, the Coale-McNeil model is extremely useful in this application, since many of the cohorts whose first marriage patterns are of interest have yet to complete their prime marriageable years. When fitted to data for such incomplete cohorts, estimates of the model permit projection of the remainder of the cohort's first marriage experience and thereby its mean age at marriage and the proportion ever-marrying. Moreover, a series of recent studies has established that the Coale-McNeil model provides a good fit to first marriage data derived from vital registration statistics and from census and survey data (see, for example, Ewbank, 1974; Rodriguez and Trussell, 1980; Trussell, 1981). In addition, our paper represents the first application of the Coale-McNeil model to Canadian marriage data.

A key feature of our approach is that our model specification relates the parameters of the Coale-McNeil model (i.e., the mean age at first marriage and the proportion of women ever-marrying) to different social and economic variables. This is achieved by utilizing a method developed by Trussell and Bloom (1983) which combines elements of both the Coale-McNeil model and of regression analysis. More specifically, we assume that the Coale-McNeil model describes the underlying pattern of age at first marriage but that its parameters depend on socioeconomic variables in a regression-like manner. In this way, we can research the determinants of the timing and incidence of first marriage in Canada. Finally, we test the predictive power of the Coale-McNeil model by comparing parameter estimates – computed separately and independently – for identical cohorts in the 1971 and 1981 censuses.

The next section of the paper describes the Coale-McNeil model and the estimation method that we are using. The following section describes the data and the variables that are included in the analysis. We then present and analyze several sets of estimates of the model: first, when no explanatory variables are included; second, when the mean age at first marriage depends on explanatory variables; and, third, when the proportion of women ever-marrying depends on explanatory variables.

## *The Model*

Coale (1971) observed that the distribution of age at first marriage in a female cohort follows a similar pattern in different populations. The distribution is smooth, unimodal and skewed to the right. Populations differ from each other, however, in the age at which a significant number of women start to marry, in the rate at which marriages occur after the starting age, and in the proportion of women who will ever marry. This observation led Coale to postulate a three-parameter model of age at first marriage. Let $f(a)$ be the frequency of first marriage at age $a$, i.e. the proportion of a cohort who will marry at exact age $a$, Coale's model can be represented as follows:

$$f(a) = C \cdot \frac{1}{K}\, g_s \left(\frac{a - a_o}{K}\right)$$

where the three parameters of the model are

$C$ = the proportion of the cohort who will ever marry,

$a_o$ = the age at which marriage starts to occur in significant numbers, and

$K$ = a scale parameter which depends on the rate at which marriages occur,

and where $g_s(\cdot)$ is a given standard schedule. To construct the standard schedule, marriage data for Swedish women were used. Coale and McNeil (1972) found that the function $g_s(\cdot)$ can be well approximated by

$$g_s(z) = 0.1946\ Exp\ \{-0.174(z - 6.06) - Exp[-0.2881(z - 6.06)]\}$$

This basic model was successfully used to fit several marriage distributions. Coale and McNeil also proved that the above function can in turn be approximated very closely by a convolution of a normally distributed random variable and three or four exponential delays. This provided an interesting behavioural interpretation of the model: age at entry into the marriage "market" has a normal distribution, but marriage occurs after a few successive exponentially distributed delays, such as those between finding a partner, getting engaged and getting married. Note that this interpretation has points in common with some of the marriage models based on neoclassical economic theory (see, for example, Becker, 1981; Keeley, 1979).

For the purpose of analyzing and comparing distributions of age at first marriage in different populations, it is convenient to reparameterize the Coale-

McNeil model in order to express it in terms of more easily interpretable quantities. The parameters most often used are the mean age at first marriage, the standard deviation of age at first marriage and the proportion who eventually marry. Reparameterization can be done by redefining the standard schedule in such a way that it has a mean of zero and a standard deviation of one (as in the standard normal distribution). By doing this, the model can be rewritten (Rodriguez and Trussell, 1980):

$$f(a) = C \cdot \frac{1}{\sigma} g_o \left(\frac{a - \mu}{\sigma}\right)$$

where $\mu =$ mean age at first marriage of those who marry, and $\sigma =$ standard deviation, and $g_o(z) = 1.2813\ Exp\ \{-1.145(z + 0.805) - Exp[-1.896(z + 0.805)]\}$ is the new standard schedule with a mean of zero and a standard deviation of one. Rodriguez and Trussell (1980) developed a computer program to estimate the parameters of the Coale-McNeil model with survey data using maximum likelihood techniques. One of the key features of the program is that it can estimate the parameters of the model with *censored* data, i.e., with data on young cohorts who had not completed their prime marriageable years at the time of the census or survey. The model can then be used to project the behaviour of these young cohorts.

A useful extension of the model was recently provided by Trussell and Bloom (1983), who developed a technique that combines elements of both the Coale-McNeil model and of regression analysis: they allow the three parameters of the model to depend on explanatory variables as in regression analysis. They assume:

$$\mu_i = X'_i \beta$$

$$\sigma_i = Y'_i \gamma$$

$$C_i = W'_i \alpha$$

where $X_i$, $Y_i$ and $W_i$ are vectors of individual $i$ (defined by a set of dummy variables) and $\beta$, $\gamma$, and $\alpha$ are regression coefficients. This technique is a powerful tool for the analysis of the *determinants* of age patterns at first marriage.[1] A computer program was developed to implement that technique.[2]

*The Data and the Variables Included in the Analysis*

The data for this study come from the public use sample tapes of the 1971 and 1981 Canadian censuses. The sample contains 1 per cent of the population in 1971 and 2 per cent in 1981. Besides the question on marital status, the Canadian census also asks a question on age at first marriage to those who are or have been married. By using the answers to that question, the Coale-McNeil model can be used to analyze the marriage patterns of different cohorts of women. One particular feature of our study is that all the analysis is done on cohorts, as opposed to on cross-sections as done in most previous studies.[3]

Before proceeding further, we should discuss the ways in which common law unions are treated in the two censuses. As is well known, this kind of living arrangement became increasingly popular during the 1970s. In the 1971 census, when these unions were still uncommon, the questions on marital status and on age at first marriage referred only to legal marriages. In the 1981 census, however, the questions on marital status and on age at first marriage referred specifically to the above situation. In particular, the guide to the questionnaire instructed people living in common law unions who had never before been officially married to report the date at which the current union started. As a result of this change in the definition of marriage, some common law unions are included in the 1981 census. However, these unions were not treated the same way as legal marriages, since persons who had previously been in common law unions that had terminated by the time of the census were requested not to report those unions. For this reason, and also for reasons relating to the way imputations were made for nonrespondents (Norland, 1983), comparisons between the 1971 and 1981 censuses require some caution. On the other hand, there are advantages to counting common law unions (even if only partly). For many types of analyses that are related to marriage (e.g., the study of fertility, labour force participation and consumption patterns), it does not matter whether a couple is legally married or not. By not including common law marriages, we would ignore a nontrivial proportion of the population whose behaviour is actually influenced by marriage. Note that the decline in the number of marriages reported earlier in this paper was based on vital statistics data that included only legal marriages. We cannot, therefore, compare those statistics directly to the ones computed in this study which are based on data derived from the 1981 census.

By using data from both the 1971 and 1981 censuses, we can analyze the marriage behaviour of many generations of women. But the major reason for using two censuses is that we can test one of the key features of our estimation technique, i.e., its ability to estimate the parameters of the model with censored data on cohorts that contain women who are not yet married. This test can be done by comparing the results for a given age group in 1971 to those for the age group that is 10 years older by 1981. Although the samples were taken independently in the two censuses, this latter group represents approximately the same population of women as in the previous census. It may be assumed that differences due to mortality and international migration by age at first marriage are very small. By comparing the results for the same cohort in the two censuses, we can see the extent to which the magnitudes of parameter estimates for a cohort with incomplete information in 1971 are similar to those for the same cohort with more complete information 10 years later. For example, we estimate the mean and standard deviation of age at marriage and the proportion ever-marrying for the age group 25-29 in 1971. We then compare these estimates with those computed from more complete (i.e., less censored) data for the age group 35-39 in 1981.

The Canadian census is a good source of data for studying marriage patterns because it contains information on a large number of individual characteristics. By using the technique described earlier, we can estimate the effects of several variables related to the timing and incidence of first marriage.

Using the information contained in the census, we chose a number of variables that may have an impact on marriage behaviour. For the purpose of the analysis, it is convenient to divide these variables into two categories. The first category includes variables that reflect mainly cultural or ethnic differences which may affect preferences of a particular society concerning marriage. Variables in the second category may be seen as affecting the opportunity cost of marriage. Among the former, we included mother tongue (i.e., English, French and other) and religion (i.e., Catholic and non-Catholic). An important variable that may be related to the opportunity cost of marriage is education. Three education groups were defined: less than high school, which includes persons with grade 11 or less; high school, which includes persons with grade 12 or 13; and more than high school, which includes persons having reached more than grade 13. Given that marriage for women may involve forgoing work opportunities, we expect more educated women to have a smaller probability of marriage or to marry later. Of course, the causality could also go in the other direction – women who marry at a young age are less likely to pursue their education. However, given the broad educational categories that we have defined, we do not believe that this potential source of simultaneity bias is a significant problem in this study.

Place of residence, whether rural or urban, can also be seen to some extent as reflecting the opportunity cost of marriage. Women living in urban areas have more attractive work opportunities than women in rural areas, and may decide to marry later or not to marry at all. In that case, a sample selection process may also be operating – women who are more work oriented decide to live in urban areas. We introduced this variable in the analysis with the 1971 census; it was not available in the 1981 census.

Finally, we included in our analysis a variable for region of birth (Atlantic provinces, Quebec, Ontario, West, and Foreign country). This variable may reflect different values and preferences associated with different regions. It may also capture the opportunity cost of marriage, such as different work opportunities for women in each region or different marriage markets in each region.

## *The Results*

### Estimation of the model without explanatory variables

Table 1 presents estimates of the three basic parameters of the model: the mean, the standard deviation and the proportion ever-marrying for female cohorts ranging from age 25 to age 49 in 1971 and 1981. From the results, we can follow the evolution of the marriage experience of generations of women born over a period of 35 years (1921 to 1956). The marriage patterns of some of these women are estimated twice, at the two ends of a 10 year interval. When two estimates are produced for the same cohort, those from the 1981 census are preferable because they draw on the greater degree of information available for that cohort.

If we look at the mean age at first marriage, we observe a long-run decline over the period. This decline has been documented in previous studies (Basavarajappa, 1983; Gee, 1980; Mertens, 1976). The decline stops with the cohort aged 30-34 in 1971 and 40-44 in 1981, which married the youngest at about 22.2 years. For younger cohorts, there is a slight increase of about 0.1 years. However, we note that the mean age is about the same for all the cohorts between ages 25 and 39 in 1981. What is remarkable in this result is that there is no upward trend in the mean age at first marriage contrary to what vital statistics data show. This finding is due to the fact that the 1981 census data include common law marriages (or at least some of them). One interesting aspect of these results is that, if we account for common law marriages, the marriage patterns did not change as much as they appear to have based solely on legal marriage data.

TABLE 1. MAXIMUM LIKELIHOOD PARAMETER ESTIMATES OF THE COALE-McNEIL MODEL FOR AGE AT FIRST MARRIAGE, FEMALE POPULATION, CANADA, 1971 AND 1981
(STANDARD ERRORS IN PARENTHESES)

| | 1971 | | | | |
|---|---|---|---|---|---|
| | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 |
| MEAN AGE | 22.686<br>(0.074) | 22.242<br>(0.058) | 22.676<br>(0.058) | 23.157<br>(0.060) | 23.694<br>(0.063) |
| STANDARD DEVIATION | 4.310<br>(0.062) | 4.141<br>(0.050) | 4.236<br>(0.049) | 4.566<br>(0.052) | 4.901<br>(0.054) |
| PROPORTION EVER MARRYING | 0.974<br>(0.0064) | 0.939<br>(0.0038) | 0.944<br>(0.0032) | 0.933<br>(0.0032) | 0.930<br>(0.0033) |
| - log L | 18,924 | 17,498 | 16,888 | 17,525 | 17,569 |
| Sample size | 7,750 | 6,611 | 6,164 | 6,190 | 6,059 |
| Proportion married | 0.852 | 0.911 | 0.936 | 0.926 | 0.928 |
| | 1981 | | | | |
| | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 |
| MEAN AGE | 22.317<br>(0.043) | 22.358<br>(0.032) | 22.319<br>(0.036) | 22.213<br>(0.038) | 22.570<br>(0.040) |
| STANDARD DEVIATION | 3.892<br>(0.039) | 3.938<br>(0.028) | 4.074<br>(0.030) | 4.086<br>(0.032) | 4.260<br>(0.034) |
| PROPORTION EVER MARRYING | 0.879<br>(0.0040) | 0.915<br>(0.0024) | 0.932<br>(0.0022) | 0.941<br>(0.0021) | 0.942<br>(0.0022) |
| - log L | 47,305 | 50,727 | 42,049 | 34,780 | 33,320 |
| Sample size | 20,187 | 19,486 | 15,522 | 12,643 | 11,914 |
| Proportion married | 0.785 | 0.891 | 0.926 | 0.940 | 0.941 |

With regard to the estimates of the standard deviation, we note a tendency to decrease over time, from 4.9 years for the oldest cohorts to 3.9 years for the youngest considered. This is interesting and perhaps contrary to expectations. While the changes in women's opportunities over time have tended to increase the diversity in life styles and behaviour (for example, fertility), the diversity in age at first marriage has tended to decrease. This is perhaps because marriage is less closely related to fertility than it used o be. In the past, fertility was largely controlled by age at marriage. Now that marriage is much less related to fertility, partly because of the increased use of contraception, people are less constrained with respect to age at marriage.

The proportion ever-marrying has been increasing slightly in the past for older cohorts to about 94 per cent in the cohorts of women aged between 40 and 49 in 1981.[4] For younger cohorts, we note a clear trend downward, to 93.2 per cent in the cohort aged 35-39 in 1981, 91.5 per cent for those aged 30-34 and 87.9 per cent for those aged 25-29. However, this last figure should be interpreted with some caution, given the incompleteness of the data on that cohort. But these results, combined with earlier observations, seem to indicate that the major change in marriage patterns is that fewer people eventually marry, not that the mean age at first marriage is increasing. This decline in the proportion ever-marrying, however, is much smaller than the one projected using vital statistics data (see Statistics Canada, 1984). Of course, this important discrepancy is related to the way in which common law marriages are treated in each source of data. Another explanation of the discrepancy is that, if there is a trend towards postponing age at legal marriage, a temporary downward bias will occur in estimating the proportion ever-marrying from cross-section data, given that fewer first marriages are observed among older cohorts because they married earlier, and among younger cohorts because they are postponing marriage.

Also deserving of comment is the close compatibility between parameter estimates coming from the same cohorts in the two censuses (cohorts aged 25-29, 30-34 and 35-39 in 1971, and aged 35-39, 40-44 and 45-49 in 1981). The model tends to overestimate slightly the mean age at marriage in 1971, but the difference is very small given that the estimates come from two independent samples and that the definition of marriage changed between the two censuses. The estimates for the standard deviation and proportion ever-marrying are also very close, with the exception of the proportion ever-marrying in the cohort aged 25-29 in 1971, which is much too high in light of the 1981 census information. But this is due to the difficulty of estimating the model accurately for a cohort when the information is very incomplete (i.e., highly censored).

It should be stressed that the consistency of the estimates computed for the same cohorts in the two censuses is evidence of the robustness of our analytical technique. In other words, the fact that two different data sets, obtained at different points in time, yielded similar results contributes to our confidence in the estimates. However, this pattern of results does not rule out the possibility that the model fits the data poorly but in roughly the same way across censuses. To examine this possibility, we have calculated observed and fitted marriage rates by age for the two oldest cohorts in 1971 and 1981 and have plotted these in Figures 1 to 4. Although the models tend to underpredict the proportion of marriage occuring at the modal age at marriage, and to overpredict slightly the proportion occurring at the mean age at marriage, they do replicate the data quite closely, and especially in the tails of the distribution. Thus, it appears that the Coale-McNeil model does indeed provide a satisfactory fit to the data.

## Estimation of the Model with the Mean Age at First Marriage a Function of Explanatory Variables

In order to take a closer look at the determinants of the mean age at first marriage, we present in Table 2 the results for a specification of the model in which the mean age at first marriage is allowed to depend on explanatory variables; but the standard deviation and the proportion ever-marrying are constant. It can be shown that the inclusion of these variables contributes significantly to the explanatory power of the model.[5] In this case also, we can compare the estimates of the two censuses for the same cohorts of women. We see that the model predicts well with incomplete information. Most of the coefficients referring to the same cohorts have the same sign in both censuses and are often very close to each other. Out of 27 possible comparisons (3 cohorts and 9 parameters), there are only five cases where the signs are different. In all of these instances, one or both coefficients are not statistically different from zero.[6]

Looking now at the effects of particular variables, we note that French mother tongue affects positively the mean age at first marriage in seven of the ten regressions shown,[7] and that estimates of this parameter are significantly different from zero in four of those cases. It is interesting to note a reversal of the situation for younger cohorts in 1981; in particular, for the 25-29 year-old cohort, French mother tongue has a significant negative coefficient. On the other hand, we note that the coefficients of the variable "other mother tongue" are not significantly different from zero except in two cases. Thus, the marriage timing behaviour of women of other mother tongues does

FIGURE 1. AGE GROUP (40-44) 1971

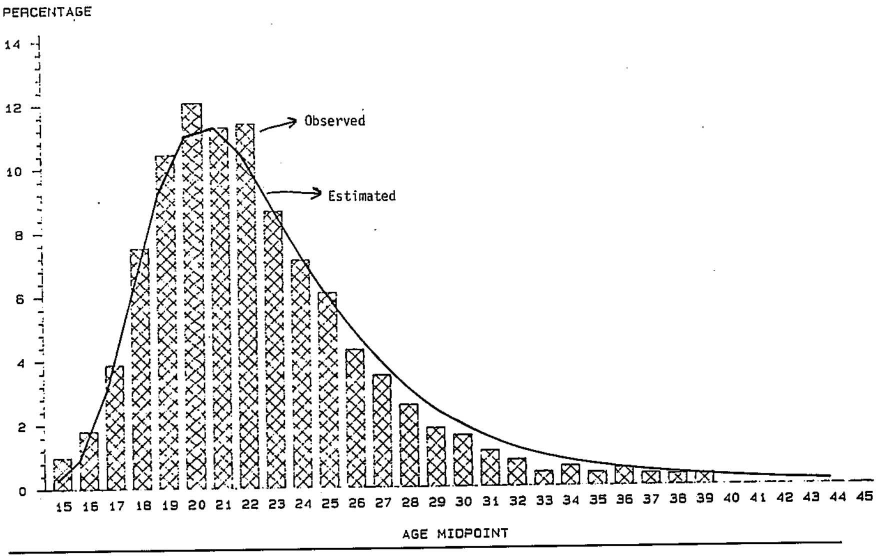


FIGURE 2. AGE GROUP (45-49) 1971

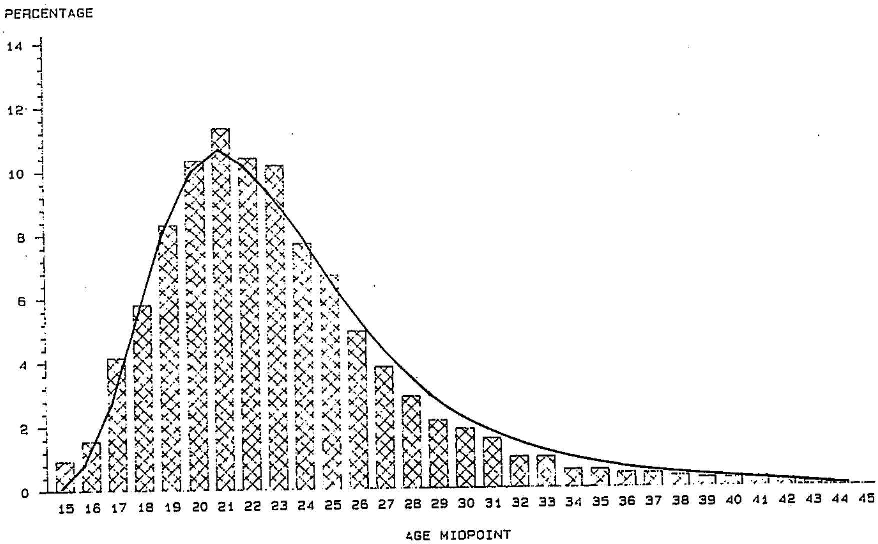

FIGURE 3. AGE GROUP (40-44) 1981

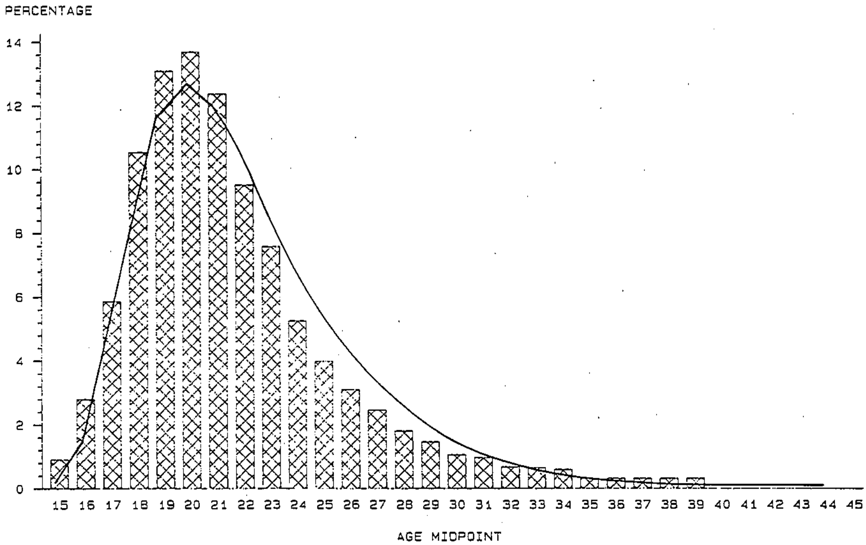


FIGURE 4. AGE GROUP (45-49) 1981

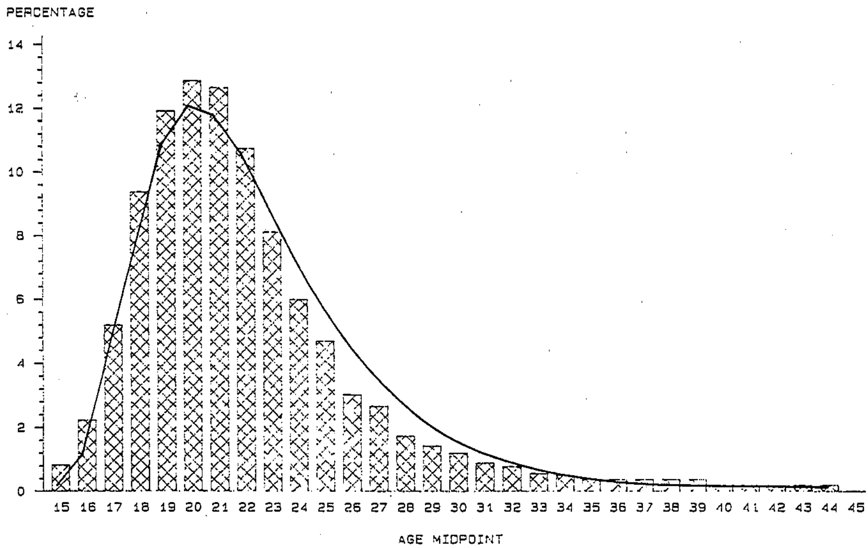

TABLE 2. MAXIMUM LIKELIHOOD PARAMETER ESTIMATES OF THE COALE-MCNEIL MODEL FOR AGE AT FIRST MARRIAGE, WITH MEAN AGE FUNCTION OF EXPLANATORY VARIABLES, FEMALE POPULATION, CANADA, 1971 AND 1981 (STANDARD ERRORS IN PARENTHESES)

| | | 1971 | | | | | 1981 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 25–29 | 30–34 | 35–39 | 40–44 | 45–49 | 25–29 | 30–34 | 35–39 | 40–44 | 45–49 |
| MEAN AGE | Constant | 21.781* (0.107) | 21.537* (0.104) | 22.049* (0.126) | 22.646* (0.102) | 23.188* (0.218) | 20.962* (0.080) | 21.014* (0.058) | 21.330* (0.068) | 21.300* (0.078) | 21.829* (0.089) |
| Mother tongue | English (reference) | | | | | | | | | | |
| | French | 0.380* (0.120) | 0.334* (0.122) | 0.106 (0.147) | 0.269 (0.151) | 0.127 (0.418) | −0.143* (0.065) | −0.114 (0.079) | 0.284* (0.092) | 0.310* (0.112) | −0.0120 (0.113) |
| | Other | −0.00264 (0.115) | −0.0606 (0.103) | 0.146 (0.121) | 0.105 (0.133) | 0.256 (0.205) | 0.245* (0.080) | −0.0409 (0.074) | 0.0771 (0.075) | 0.284* (0.084) | 0.0606 (0.086) |
| Region of birth | Ontario (reference) | | | | | | | | | | |
| | Atlantic | 0.224 (0.116) | 0.313* (0.116) | 0.0149 (0.155) | 0.0778 (0.152) | 0.232 (0.395) | 0.0446 (0.070) | 0.273* (0.069) | 0.133 (0.787) | −0.0791 (0.099) | 0.180 (0.100) |
| | Quebec | 0.677* (0.126) | 0.736* (0.095) | 0.740* (0.145) | 0.335* (0.151) | 0.349 (0.632) | 0.973* (0.077) | 1.103* (0.079) | 0.705* (0.093) | 0.668* (0.106) | 0.912* (0.107) |
| | West | 0.00277 (0.097) | 0.0296 (0.104) | 0.191 (0.122) | 0.373* (0.121) | 0.280 (0.316) | −0.295* (0.057) | −0.222* (0.056) | −0.110 (0.067) | −0.0390 (0.075) | 0.159 (0.084) |
| | Foreign | 0.326* (0.114) | 0.848* (0.134) | 0.618* (0.137) | 0.527* (0.128) | 0.354 (0.363) | 0.0528 (0.101) | 0.550* (0.073) | 0.511* (0.072) | 0.633* (0.086) | 0.833* (0.095) |
| Religion | Catholic (reference) | | | | | | | | | | |
| | Non-Catholic | −0.192* (0.080) | −0.124 (0.084) | −0.180 (0.095) | −0.127 (0.101) | −0.0776 (0.124) | −0.114* (0.049) | −0.149* (0.047) | −0.148* (0.055) | −0.131* (0.048) | −0.325* (0.071) |
| Education | < High-school (reference) | | | | | | | | | | |
| | High-school | 1.542* (0.074) | 1.250* (0.080) | 1.284* (0.061) | 1.089* (0.131) | 1.203* (0.123) | 1.317* (0.042) | 1.419* (0.042) | 1.153* (0.048) | 1.106* (0.058) | 1.075* (0.064) |
| | > High-school | 2.338* (0.098) | 2.034* (0.117) | 1.805* (0.185) | 2.089* (0.138) | 2.227* (0.255) | 2.954* (0.063) | 2.875* (0.054) | 2.519* (0.070) | 2.472* (0.087) | 2.235* (0.106) |
| Place of residence | Urban (reference) | | | | | | | | | | |
| | Rural | −0.606* (0.079) | −0.410* (0.088) | −0.542* (0.093) | −0.656* (0.103) | −0.583* (0.111) | – | – | – | – | – |
| STANDARD DEVIATION | | 4.060* (0.053) | 3.993* (0.046) | 4.082* (0.059) | 4.444* (0.050) | 4.801* (0.052) | 3.475* (0.031) | 3.551* (0.023) | 3.863* (0.028) | 3.894* (0.032) | 4.102* (0.032) |
| PROPORTION EVER MARRYING | | 0.975* (0.0058) | 0.940* (0.0038) | 0.944* (0.0032) | 0.933* (0.0032) | 0.929* (0.0035) | 0.870* (0.0037) | 0.911* (0.0023) | 0.932* (0.0021) | 0.941* (0.0022) | 0.942* (0.0021) |
| − log L | | 18,480 | 17,220 | 16,677 | 17,357 | 17,446 | 45,964 | 49,331 | 41,310 | 34,223 | 32,912 |

*Significantly different from zero at the 95% level.

not seem to be different from the behaviour of women of English mother tongue (the reference category).

Looking at the parameters referring to the different regions of birth, we note that most of them are positive, which indicates that the region of reference, Ontario, has a lower mean age at first marriage than all other regions. In particular, birth in the Atlantic provinces has a positive effect in all but one case, but the parameters are not significantly different from zero, except in two regressions. The effect of Quebec birth the other hand is quite clear – the coefficients of that variable are significantly greater than zero in all regressions except one. Furthermore, the estimated parameters are quite large, indicating that birth in Quebec is related to a greater mean age at first marriage of the order of more than six-tenths of a year in eight of the ten regressions. Birth in Western Canada seems to be associated with a lower mean age at first marriage for younger cohorts in 1981, while for older cohorts the coefficient is positive, although not significantly different from zero, except in one regression. Foreign birth is clearly associated with a later age at first marriage, the coefficient being positive in all cases and significantly different from zero in all cases except one. The magnitude is also quite large, of the order of about half a year or so, just a little bit under that observed for Quebec.

The effect of religion is also quite clear: all the regressions indicate that non-Catholics have a lower mean age at first marriage than Catholics and the coefficients is significantly different from zeror in six of the ten regressions. However, the magnitude is relatively small, between one-and two-tenths of a year.

By looking at the three previous factors (mother tongue, region of birth and religion), we can analyze the behaviour of the French Canadian population with regard to mean age at first marriage. We see that the following three factors contribute to a greater age at first marriage for that population: French mother tongue by itself, birth in Quebec and Catholic religion. The factor with the highest magnitude is birth in Quebec.

As expected, there is a strong relationship between education and age at first marriage. We note that all the parameters related to the education factor are positive, which indicates that women with a high school education or more marry at an older age than women with less than high school education. In all the cases, the coefficients are significantly different from zero and are quite large in absolute value. High school education increases the mean age at first marriage by more than one year, and having more than a high school education increases it by approximately another year. It is also interesting to note that the effect of education seems to increase over time; in particular, young cohorts in 1981 with more than high school education marry at a relatively older age than earlier cohorts with the same education.

Finally, the last factor considered in Table 2, place of residence, also presents the expected pattern for the five regressions relating to the year 1971, which are the only ones in which it was included. In all the regressions rural residence (as opposed to urban) is associated with a lower mean age at first marriage, and the parameter is significantly different from zero in all cases. The effect is relatively large, rural residence decreasing the mean age at first marriage by about half a year.

### Estimation of the Model with the Proportion Ever-marrying a Function of Explanatory Variables

We now analyze the factors that determine the proportion of women who eventually marry. Table 3 presents the parameter estimates for another specification of the model, where the mean age at first marriage and the standard deviation are constant but the proportion ever-marrying is allowed to depend on explanatory variables.[8] Again, it can be shown that the introduction of covariates adds significantly to the explanatory power of the model. However, the increase in explanatory power is not as large as it was in the previous case.[9] Note also that the model for the age group 25-29 is not estimated in Table 3. As noted earlier, it is difficult to estimate accurately the proportion ever-marrying for this group because the information is too incomplete. This was the case when the proportion ever-marrying was assumed constant, and it is even more of a problem when the proportion ever-marrying is modelled as a function of explanatory variables.

Comparing the parameter estimates in the two censuses corresponding to the same cohorts (cohorts aged 30-34 and 35-39 in 1971, corresponding to cohorts aged 40-44 and 45-49 in 1981), we see again that the consistency is quite high. The coefficients are of the same sign and of similar magnitude almost everywhere. There is a sign reversal in only three cases our of 18 possible comparisons, and in none of them are the coefficients significantly different from zero in both years.

We consider now the effects of the particular explanatory variables on the proportion ever-marrying. Mother tongue does not seem to have a well-determined impact on the proportion ever-marrying. For French women, the coefficient is negative in four cases and positive in the other four. For women of other mother tongue, the coefficient is positive in all cases except one but significantly different from zero in only two regressions.

TABLE 3. MAXIMUM LIKELIHOOD PARAMETER ESTIMATES OF THE COALE-McNEIL MODEL FOR AGE AT FIRST MARRIAGE, WITH PROPORTION EVER-MARRYING FUNCTION OF EXPLANATORY VARIABLES, FEMALE POPULATION, CANADA, 1971 AND 1981 (STANDARD ERRORS IN PARENTHESES)

| | | 1971 | | | | 1981 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30–34 | 35–39 | 40–44 | 45–49 | 30–34 | 35–39 | 40–44 | 45–49 |
| MEAN AGE | | 22.337* | 22.677* | 23.156* | 23.694* | 22.356* | 22.319* | 22.213* | 22.570* |
| | | (0.059) | (0.058) | (0.061) | (0.065) | (0.030) | (0.036) | (0.038) | (0.040) |
| STANDARD DEVIATION | | 4.136* | 4.237* | 4.566* | 4.902* | 3.936* | 4.074* | 4.086* | 4.260* |
| | | (0.051) | (0.049) | (0.052) | (0.055) | (0.025) | (0.030) | (0.032) | (0.034) |
| PROPORTION EVER MARRYING | | | | | | | | | |
| | Constant | 0.946* | 0.953* | 0.949* | 0.925* | 0.941* | 0.958* | 0.957* | 0.956* |
| | | (0.011) | (0.0087) | (0.0085) | (0.010) | (0.0064) | (0.0055) | (0.0061) | (0.0057) |
| Mother tongue | English (reference) | | | | | | | | |
| | French | -0.00165 | -0.0179 | -0.0165 | 0.0110 | 0.00496 | 0.00111 | 0.00227 | -0.0216* |
| | | (0.015) | (0.014) | (0.013) | (0.015) | (0.00841) | (0.0082) | (0.0094) | (0.0090) |
| | Other | 0.0146* | 0.00686 | 0.00384 | -0.00258 | 0.00807 | 0.0102 | 0.0106* | 0.00585 |
| | | (0.0096) | (0.0070) | (0.0065) | (0.0086) | (0.0071) | (0.0059) | (0.0053) | (0.0046) |
| Region of birth | Ontario (reference) | | | | | | | | |
| | Atlantic | -0.00868 | -0.00597 | -0.0268* | -0.0238 | -0.00784 | -0.0147* | -0.00530 | -0.00841 |
| | | (0.012) | (0.012) | (0.011) | (0.0126) | (0.0081) | (0.0071) | (0.0078) | (0.0070) |
| | Quebec | -0.0233 | -0.0141 | -0.0291* | -0.0340* | -0.0416 | -0.0518* | -0.0516* | -0.0265* |
| | | (0.015) | (0.014) | (0.013) | (0.0141) | (0.0090) | (0.0083) | (0.010) | (0.0089) |
| | West | 0.00612 | 0.00841 | -0.0104* | -0.00994 | 0.00661 | -0.00480 | -0.00234 | -0.0112* |
| | | (0.0097) | (0.0082) | (0.0069) | (0.0093) | (0.0064) | (0.0058) | (0.0064) | (0.0053) |
| | Foreign | -0.0120 | 0.0189* | – | 0.0156 | -0.00421 | -0.0137* | -0.00226 | 0.00114 |
| | | (0.011) | (0.0079) | | (0.0086) | (0.0071) | (0.0061) | (0.0064) | (0.0051) |
| Religion | Catholic (reference) | | | | | | | | |
| | Non-Catholic | 0.0205* | 0.0101 | 0.0129* | 0.0236* | 0.00675 | 0.00461 | 0.00588 | 0.0141* |
| | | (0.0085) | (0.0070) | (0.0077) | (0.0091) | (0.0054) | (0.0048) | (0.00509) | (0.0047) |
| Education | < High-school (reference) | | | | | | | | |
| | High-school | -0.0204* | -0.0146* | -0.0189* | -0.00543 | -0.0156* | -0.00381 | -0.00282 | -0.00791 |
| | | (0.0086) | (0.0071) | (0.0080) | (0.0082) | (0.0048) | (0.0044) | (0.0049) | (0.0042) |
| | > High-school | -0.117* | -0.100* | -0.116* | -0.0919* | -0.0905* | -0.0721* | -0.0616* | -0.0749* |
| | | (0.016) | (0.016) | (0.017) | (0.018) | (0.0075) | (0.0077) | (0.0096) | (0.011) |
| Place of residence | Urban (reference) | | | | | | | | |
| | Rural | 0.0241* | 0.00363 | 0.0291* | 0.0219* | – | – | – | – |
| | | (0.0078) | (0.0068) | (0.0056) | (0.0068) | | | | |
| – log L | | 17,436 | 16,827 | 17,447 | 17,521 | 50,619 | 41,952 | 34,694 | 33,224 |

*Significantly different from zero at the 95% level.

Most of the coefficients corresponding to the regions of birth are negative, indicating that the region of reference, Ontario, has a higher proportion of women ever-marrying than the other regions. However, most of these coefficients are not significantly different from zero. Only Quebec birth seems to have an important impact, the coefficient being significantly different from zero in five of the eight regressions. Note also that, contrary to what was observed in the case of the mean age at first marriage, foreign birth does not seem to have a clear influence on the proportion of women ever-marrying.[10]

Religion has a clear effect, non-Catholics having a larger proportion of women marrying than Catholics. Furthermore, the coefficient is significantly different from zero in four of the eight regressions. It is also interesting to note that the effect of religion seems to have been decreasing over time, since the coefficient of that variable is very small for the younger cohorts in the 1981 census.

As before, the impact of education is in the expected direction and also very important. In all the cases, the coefficient is negative, indicating that more educated women marry less frequently than less educated women. In particular, we note the very large impact for women who have more than a high school education. The coefficients indicate that the probability of ever-marrying for those women is lower by about 10 percentage points.

Finally, we note that the effect of the place of residence is also well determined. Rural residence affects positively the proportion ever-marrying and the coefficient is significantly different from zero in three out of the four regressions.

## *Conclusion*

The purpose of this paper was to research the first marriage patterns of Canadian women using the Coale-McNeil marriage model. The usefulness of that model in the context of this study stems from its ability to estimate the entire distribution of age at first marriage with incomplete data on cohorts whose members are still subject to becoming married. With the help of that model, we were able to analyze the trends and determinants of the mean age at first marriage and of the proportion of women ever-marrying using data from the 1971 and 1981 censuses.

Our results indicate that there have been some changes across cohorts in marriage patterns. For the older cohorts that we considered, we observed, as previous studies also did, that the mean age at first marriage decreased and that the proportion ever-marrying increased slightly over time. These trends did not continue for younger cohorts. Our results indicate a tendency towards a stabilization of the mean age at first marriage and a decrease in the proportion ever-marrying. However, the changes that we reported do not show such a drastic decline in the marriage institution as some other recent data have shown. One main reason for that difference is that our data include some common law unions, while most other statistics on marriage include only legal marriages. Another main reason is that analysis is based on cohorts rather than cross-sections. Surely, one remarkable finding of our analysis is that marriage patterns did not change as much as they appear to have, given that common law unions are counted among marriages.

In our analysis of the determinants of marriage patterns, we found that women of French mother tongue, those who were born in Quebec and in foreign countries, Catholics, those living in urban areas, and those who are relatively well educated tend to marry at older ages. Furthermore, women who were born in Quebec, who are Catholic, who live in urban areas and who are more educated tend to have a lower incidence of first marriage. It is also interesting to note that for most of these factors the effects on marriage patterns were reasonably stable across cohorts, although the mean values of some factors may have changed in the intercensal period. For example, the average education levels of women have increased over time.

Finally, the comparisons across the two censuses indicate that the ability of the model to estimate marriage patterns with incomplete data is very good. This makes the model a useful tool for predicting marriage patterns of younger cohorts.

Before concluding this paper, a few words should be said about how common law unions should be treated. As mentioned, the fact that our results indicate much less change than other studies is due partly to the inclusion of common law unions. However, it has to be admitted that the relative inconsistency of the census questions on that subject, in particular, the different treatments of past and current common law unions, create some noise in the data. Without further study, it is difficult to estimate the effects of that inconsistency on our results. Perhaps a better way to ask the question on age at first marriage in the census would be to report the age at onset of the first union, legal or not, which lasted more than a specified length of time (e.g., one year). This would greatly facilitate the analysis of marriage patterns in the next census.

*Acknowledgments*

The authors wish to thank Clint Cummins and Richard Henry for their research assistance and the Faculty of Social Sciences of the University of Ottawa for financial assistance.

## *Notes*

1 Trussell and Bloom (1983) also considered the use of the proportional hazards model for estimating the determinants of age at first marriage. However, the proportional hazards model is not used in this study since (*1*) Trussell and Bloom found no evidence that it fits marriage data better than the Coale-McNeil model, and (2) the proportional hazards model cannot be used to project the marriage experience of young cohorts, which is a major goal of this study.

2 This program, called FERTEV, is an extension of the program NUPTIAL used by Rodriguez and Trussell (1980). It was developed at Harvard University by Clint Cummins. Copies of the program can be obtained by contacting the Department of Economics at the University of Ottawa.

3 Period factors, such as wars and business cycles, can worsen the fit of the Coale-McNeil model to the cohort marriage data. Period factors can thus increase the variance of projection errors by generating irregularities in the uncensored portion of a first marriage distribution. However, period factors do not seem to be of substantial importance during the years under study and they are not modelled herein.

4 The estimated proportion ever-marrying for the cohort aged 25-29 in 1971 (97.4 per cent) should be rejected because the same cohort, in 1981, aged 35-39, shows a much lower proportion (93.2 per cent).

5 This is done by performing a likelihood ratio test (see Maddala, 1977). For each cohort, we take the difference between the values of (-log L) calculated in Tables 1 and 2. This difference multiplied by two is distributed Chi-squared with $K$ degrees of freedom, where $K$ is the number of parameters tested ($K = 10$ in 1971 and $K = 9$ in 1981). For all the comparisons made, we can reject with a high level of confidence the hypothesis that the explanatory variables should not be included in the model.

6 Note, however, that part of the discrepancy between the two estimates may be due to the exclusion of the variable "Rural" in the 1981 census.

7 Of course, those ten regressions refer only to seven cohorts of women, since three of them overlap. However, in the analysis that follows, we will sometimes ignore this overlap and discuss the results in terms of ten different regressions, i.e., the number of independent samples from which the effect of each variable was estimated.

8 The computer program that we used can allow all three basic parameters of the model (the mean, the standard deviation and the proportion ever-marrying) to depend simultaneously on explanatory variables. However, because the likelihood function to be maximized is complicated and because there are many parameters to estimate, it would have been very difficult to estimate such a model, except possibly at a very high cost. In order to limit the scope of the paper, we decided not to let the standard deviation be a function of explanatory variables. We also decided to let the mean and the proportion ever-marrying depend on explanatory variables separately but not together. Actually, a few test runs that we did showed that the coefficients do not vary much, whether we allow both the mean and the proportion ever-marrying to depend on explanatory variables or only one of them.

9 We can show this by performing a likelihood ratio test similar to the one described in note 3. The differences between the values of (-log L) in Tables 1 and 3 are smaller than in the previous case (Table 1 and 2). However, the test still rejects the hypothesis that the explanatory variables should be excluded from the model.

10 We note that the coefficient of the variable "Foreign" does not appear for the cohort aged 40-44 in 1971. Because of the small number of sample observations in that cell, the algorithm that maximizes the likelihood function did not converge for that cohort. After several attempts, we were able to achieve convergence by removing that variable.

## *References*


Basavarajappa, K.G. 1983. Trends and Differences in Mean Age at Marriage in Canada. In K. Ishwaran (ed.), Marriage and Divorce in Canada. Toronto: Methuen.

Becker, G.S. 1981. A Treatise on the Family. Cambridge, Massachusetts: Harvard University Press.

Coale, A.J. 1971. Age patterns of marriage. Population Studies 25:193-214.

__________, and D.R. McNeil. 1972. The distribution by age of the frequency of first marriage in a female cohort. Journal of the American Statistical Association 67:743-749.

Ewbank, D. 1974. An Examination of Several Applications of the Standard Pattern of Age at First Marriage. Unpublished Ph.D. dissertation. Princeton University, Princeton, New Jersey.

Gee, E.M.T. 1980. Female marriage patterns in Canada: changes and differentials. Journal of Comparative Family Studies 11:457-473.

Keeley, M.C. 1979. An analysis of the age pattern of first marriage. International Economic Review 20:527-544.

Maddala, G.S. 1977. Econometrics. New York: McGraw-Hill.

Mertens, W. 1976. Canadian nuptiality patterns: 1911-1961. Canadian Studies in Population 3:57-71.

Norland, J.A. 1983. A Statement on Comparability of Census Data on Age at First Marriage, 1961-1971-1981. Mimeographed. Ottawa: Demography Division, Statistics Canada.

Rodriguez, G. and J. Trussell. 1980. Maximum Likelihood Estimation of the Parameters of Coale's Model Nuptiality Schedule from Survey Data. Technical Bulletin No. 7. London, England: World Fertility Survey.

Statistics Canada. 1984. Current Demographic Analysis: Report on the Demographic Situation in Canada, 1983. Catalogue 91-209. Ottawa: Minister of Supply and Services Canada.

Trussell, J. 1981. Illustrative Analysis: Age at First Marriage in Sri Lanka and Thailand. Scientific Reports No. 13. London, England: World Fertility Survey.

__________, and D.E. Bloom. 1983. Estimating the covariates of age at first marriage and first birth. Population Studies 37:403-416.

*Received December 1985; revised July 1986.*