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Illustrative Analysis: Age at First Marriage in Sri Lanka and Thailand

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The World Fertility Survey is an international research programme whose purpose is to assess the current state of human fertility throughout the world. This is being done principally through promoting and supporting nationally representative, internationally comparable, and scientifically designed and conducted sample surveys of fertility behaviour in as many countries as possible.
The WFS is being undertaken, with the collaboration of the United Nations, by the International Statistical Institute in cooperation with the International Union for the Scientific Study of Population. Financial support is provided principally by the United Nations Fund for Population Activities and the United States Agency for International Development.
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Preface

One of the main concerns of the World Fertility Survey has been the analysis of the data collected by the participating countries. It was decided at the outset that, in order to obtain quickly some basic results on a comparable basis, each country would produce soon after the field work a 'First Country Report', consisting of a large number of cross-tabulations with a short accompanying text. Precise guidelines for the preparation of the tables were produced and made available to the participating countries.

It was also recognised, however, that at later stages many countries would wish to study in greater depth some of the topics covered in their first reports, or indeed new but related subjects, using more refined analytic techniques. In order to assist the countries at this stage a general 'Strategy for the Analysis of WFS Data' was outlined, a series of 'Technical Bulletins' was started, dealing with specific methodological issues arising in the analysis, and a list of 'Selected Topics for Further Analysis of WFS Data' was prepared, to serve as a basis for selecting research topics and assigning priorities.

It soon became evident that many of the participating countries would require assistance and more detailed guidelines for further analysis of their data. Acting upon a recommendation of its Programme Steering Committee, the WFS then launched the present series of 'Illustrative Analyses' of selected topics. The main purpose of the series is to illustrate the application of certain demographic and statistical techniques in the analysis of WFS data, thereby encouraging other researchers and other countries to undertake similar work.

In view of the potentially large number of research topics which could be undertaken, some selection was necessary. After consultation with the participating countries, 12 subjects which are believed to be of top priority and of considerable interest to the countries themselves were selected. The topics chosen for the series span the areas of fertility estimation, levels, trend and determinants, marital formation and dissolution, breastfeeding, sterilization, contraceptive use, fertility preferences, family structure, and infant and child mortality.

It was envisaged that each study would include a brief literature review summarizing important developments in the subject studied, a clear statement of the substantive and methodological approach adopted in the analysis, and a detailed illustration of the application of such an approach to the data from one of the participating countries, but with emphasis on the general applicability of the analysis. These studies have been conducted in close collaboration with the country concerned, where possible with the active participation of national staff.

It should perhaps be emphasised that the studies in the 'Illustrative Analyses' series are meant to be didactic examples rather than prescriptive models of research, and should therefore not be viewed as cookbook recipes to be followed indiscriminately. In many cases the investigators have had to choose a particular course of action from several possible, sometimes equally sound, approaches. In some instances this choice has been made more difficult by the fact the demographers or statisticians disagree among themselves as to the approach most appropriate for a particular problem. In the present series we have, quite intentionally, resisted the temptation to enter the ongoing debates on all such issues. Instead, and in view of the urgency with which countries require guidelines for analysis, an attempt has been made to present what we believe to be a basically sound approach to each problem, spelling out clearly its drawbacks and limitations.

In this difficult task the WFS has been aided by an *ad hoc* advisory committee established in consultation with the International Union for the Scientific Study of Population (IUSSP) and consisting of Ansley Coale (Chairman), Mercedes Concepcion, Gwendolyn Johnson-Ascadi and Henri Leridon, to whom we express our gratitude. Thanks are also due to the referees who have generously donated their time to review the manuscripts and to the consultants who have contributed to the series.

Many members of the WFS staff made valuable contributions to this project, which was co-ordinated by V.C. Chidambaram and German Rodriguez.

Sir Maurice Kendall
WFS Project Director

Acknowledgments

I am greatly indebted to Ansely Coale, David Smith, and German Rodriguez for helpful comments which improved the clarity of the discussion.

1 Introduction

1.1 OVERVIEW

Although age at marriage is a topic of interest to demographers in its own right, it has been singled out for intensive study primarily because of the impact of nuptiality on fertility. In most countries fertility is predominantly confined to marriage (or stable unions) and marriage itself signals the beginning of exposure to risk of pregnancy. In societies in which control of marital fertility is absent, the pattern of first marriage, the proportion who ever marry, and the patterns of marital dissolution and remarriage jointly determine the overall level of fertility; the most important of these determinants are the first two. Even in populations in which marital fertility is modestly controlled, marriage patterns still play a dominant role in governing fertility levels. Lesthaeghe (1971) has shown that it would be impossible to achieve a replacement level of fertility in most developing countries by increasing (within the range of plausibility) the level of control of marital fertility alone; age at marriage and/or the proportion who never marry would have to rise as well. Recently Trussell, Menken, and Coale (1979) have examined the impact of nuptiality on fertility in more detail through the use of models; their conclusions support the commonsense notion that nuptiality can influence strongly the level of fertility.

In this report, we will be concerned with the pattern of first marriage by age and the proportion who ever marry and not with the influence of nuptiality on fertility. Specifically, we will analyse three topics in detail: (1) description of trends in nuptiality patterns and levels over time (2) prediction of the future course of first marriage experience for cohorts which have not yet reached age 40 (or 50) and (3) analysis of the quality of data. Finally, in a brief section concluding the report, we extend the analysis to first birth data.

The analysis will be conducted using data from Sri Lanka and Thailand, collected as part of the World Fertility Survey. The choice of these two countries is largely due to considerations of data availability, but has other justification as well. The principal religion of both countries is Hinayana Buddhism, and both have substantial Moslem minorities. Literacy is relatively high, development has been rapid since the 1960s, and in recent years both countries have experienced rapidly declining fertility rates.

The analysis of marriage patterns will be principally accomplished by model fitting, using the Coale (1971) marriage function. The fitting procedure that is used is described in Rodriguez and Trussell (1980) and will not be repeated here. Readers intending to apply the model to other country data should refer to that paper, and should carefully note the problems in the model's use that are brought out in the present report. The value of the model is that it provides estimates for the mean age at marriage, its variance, and (when data are available for *all* women) the proportion ultimately marrying among cohorts whose marriage experience is not yet complete. The model appears to be well-suited to this task, providing estimates that are intuitively reasonable even for age groups in which as few as half of all women have ever married. Where it does not work well, the model usually produces estimates of the proportion of women ultimately marrying that are out of line with those for other cohorts. When this happens, the model can be refitted with the proportion ultimately marrying arbitrarily fixed, and a constrained mean and variance can be produced for comparison with the unconstrained values. An example is included in this report.

For a perspective on marriage patterns in other parts of Asia, the reader may consult Blayo (1978) or Smith (1978). A companion paper on marriage dissolution and remarriage in Sri Lanka and Thailand has been written by Smith (1980).

1.2 THE DATA

There are two sources of data on marriage provided by WFS surveys. The household survey (of 6922 women in Thailand, 13,846 women in Sri Lanka) contains information on the current marital status of women aged 12 to 49. A subset (3,780 women in Thailand, 6,810 women in Sri Lanka) of these women who were ever married completed the intensive interview schedule, from which age at marriage as well as other background information was obtained. The household survey can be expected to provide information on the age-pattern of first marriage and the proportion who ever marry. The individual survey (since it was administered only to ever-married women) can of course provide no information about the proportion who ever marry but can be expected to yield much richer information about the age-pattern of first marriage, since age at first marriage is available for each woman.

1.3 PRELIMINARY ANALYSIS

Each of these data sources can be examined directly in order to extract information about nuptiality. For example the number of ever-married and never-married women at the time of the survey is displayed in Table 1 for Thailand and Sri Lanka. If there had been no change in nuptiality in the recent past, then these cross-sectional tables would represent the experience of an actual cohort. If one wishes to use these data to infer age-patterns of marriage, then one must make the assumption that nuptiality has remained essentially unchanged. Otherwise, the cross-sectional snapshot will not reflect the experience of any real cohort. Treated as pertaining to a cohort, Table 1 would indicate that marriage is fairly universal with approximately 97 percent and 98 percent of women marrying in Thailand and Sri Lanka. Using the well-known technique proposed by Hajnal (1953), the singulate mean age at marriage

(SMAM) can be calculated to be 22.5 in Thailand and 25.0 in Sri Lanka. Hence, in Thailand marriage can be summarised as both nearly universal and early. Direct examination of Table 1 confirms this statement; 25 percent have married by age 18.5, 59 percent by age 21.5 and 80 percent by age 26.5. In Sri Lanka, marriage is also nearly universal but rather late. As Table 1 shows, only 11 percent have married by age 18.5, 31 percent by age 21.5, and 63 percent by age 26.5.

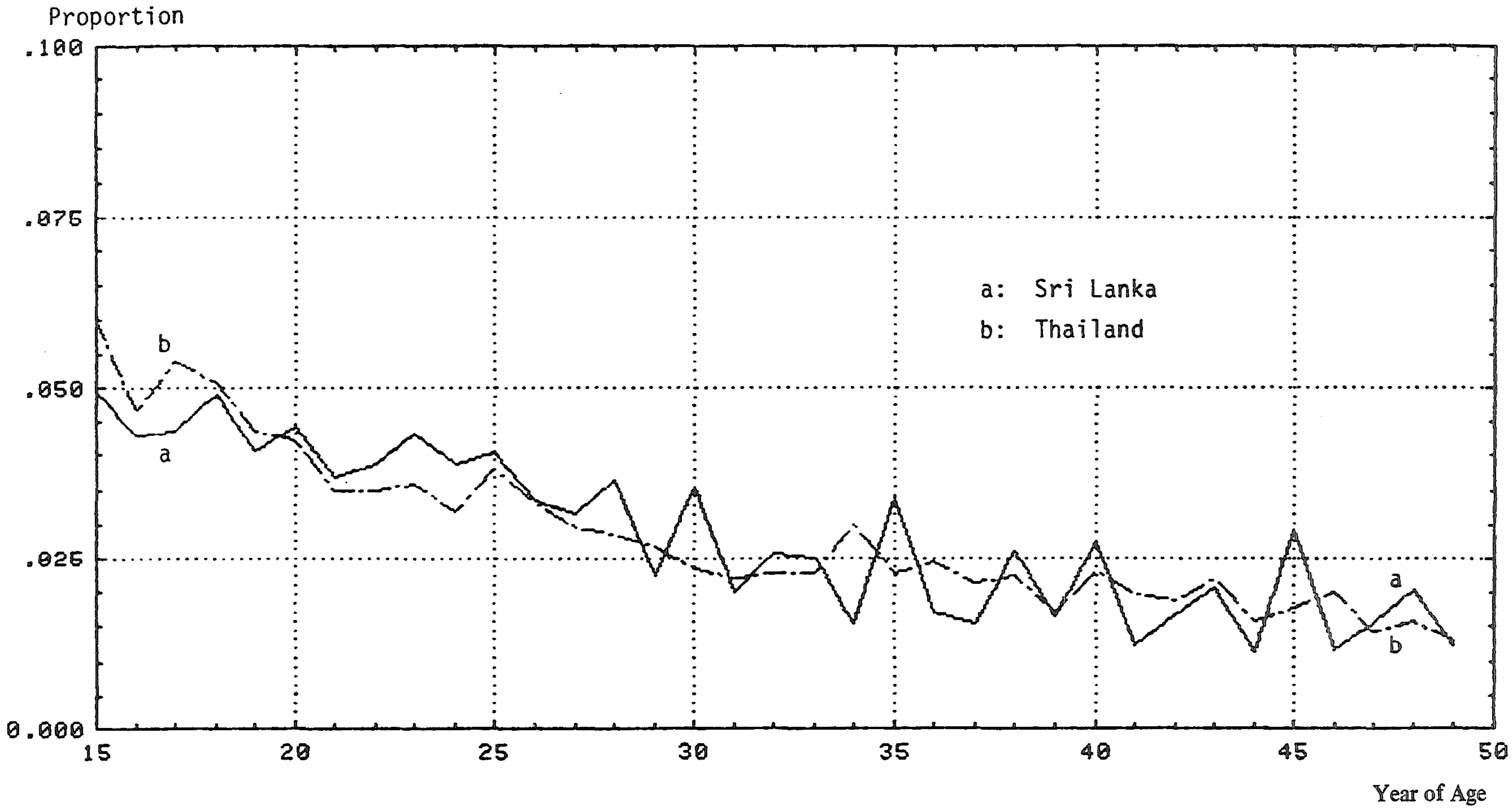
Irregularities are clearly evident in the data. There are far too few people in some age groups, for example, at age 39 and 44 in Thailand. In Sri Lanka, there are far too many women at ages divisible by 5 (Figure 1). Other inconsistencies appear as well; for example the proportions ever married at age 44 in Thailand and at age 38 in Sri Lanka are not consistent with those for surrounding ages. The deficits or surfeits of women in some age groups are almost certainly caused by age mis-statement. Other inconsistencies result from an unknown combination of mis-statement of age or marital status and sampling variability. On the whole, however, both sets of data appear to be reasonable.

By treating the cross section of women from age 12 to age 49 as a cohort, we necessarily eliminate any possibility of discovering whether there have been any trends over time in age at marriage. If there have been changes in

Table 1 – Number of Ever-Married and Never-Married Women at the Time of the Survey, Household Data, Thailand and Sri Lanka

	Sri Lanka			Thailand		
Age	Ever-Married Women	Never-Married Women	Proportion Married	Ever-Married Women	Never-Married Women	Proportion Married
12	1.	681.	.0015	1.	310.	.0032
13	1.	589.	.0017	1.	345.	.0029
14	0.	620.	.0000	3.	306.	.0097
15	5.	584.	.0085	14.	343.	.0392
16	16.	499.	.0311	13.	263.	.0471
17	17.	506.	.0325	38.	284.	.1180
18	67.	520.	.1141	78.	223.	.2591
19	79.	409.	.1619	89.	171.	.3423
20	148.	382.	.2792	103.	150.	.4071
21	137.	304.	.3107	123.	85.	.5913
22	168.	295.	.3629	123.	84.	.5942
23	243.	276.	.4682	142.	72.	.6636
24	256.	207.	.5529	137.	53.	.7211
25	303.	181.	.6260	162.	65.	.7137
26	254.	147.	.6334	160.	38.	.8081
27	248.	128.	.6596	146.	30.	.8295
28	323.	113.	.7408	145.	25.	.8529
29	210.	57.	.7865	139.	19.	.8797
30	348.	78.	.8169	119.	21.	.8500
31	200.	38.	.8403	118.	13.	.9008
32	263.	44.	.8567	125.	11.	.9191
33	272.	25.	.9158	121.	15.	.8897
34	168.	15.	.9180	166.	13.	.9274
35	373.	32.	.9210	124.	12.	.9118
36	196.	10.	.9515	136.	9.	.9379
37	178.	7.	.9622	123.	4.	.9685
38	291.	21.	.9327	124.	9.	.9323
39	192.	6.	.9697	95.	7.	.9314
40	310.	18.	.9451	131.	6.	.9562
41	136.	10.	.9315	115.	3.	.9746
42	191.	10.	.9502	107.	4.	.9640
43	241.	6.	.9757	129.	3.	.9773
44	127.	6.	.9549	88.	7.	.9263
45	340.	8.	.9770	102.	3.	.9714
46	134.	2.	.9853	115.	5.	.9583
47	182.	3.	.9838	82.	2.	.9762
48	240.	4.	.9836	92.	3.	.9684
49	142.	5.	.9660	74.	3.	.9610

Figure 1 Proportional Distribution of Women 15–49, by Age: Sri Lanka and Thailand.



nuptiality, it is inappropriate to make inferences about age at marriage from the synthetic cohort, since no real cohort or person would ever pass through the hypothesized regime. The data from the individual survey can be examined directly for evidence on this question. The main problem with these data is that the nuptiality experience of only a few cohorts can be considered to be complete. Hence no direct comparison of, for example, the mean age at marriage for different cohorts can be made, since *ceteris paribus* the mean would be higher the older the age of the cohort at the time of the survey. One easy test which eliminates this bias is to compare the mean age at marriage of those who marry before, say age 25 for cohorts aged 25 and over at the time of the survey. This is the approach adopted by WFS in the First Country Reports. The results are reproduced in Table 2. Examination reveals that there is no indication of a trend in age at first marriage in Thailand. Indeed, the means for the age groups 25-29, 30-34, and 35-39 are identical. On the other hand, there does appear to be an upward trend in age at first marriage in Sri Lanka. The mean age at marriage (before age 25) is one year higher for those aged 25-29 (18.9) than for those aged 35-39 (17.9).

It is possible for these results to be incomplete or misleading for at least three reasons. First the data are incapable of revealing anything about the trend in the proportion who will ever marry. One might expect that if the mean age at marriage (below age 25) is rising then the proportion who never marry would also rise, but there is no necessary connection. Second, the experience of the youngest cohorts is omitted from the analysis. Hence, recent trends would fail to be revealed. One could, of course, compute the mean age at marriage of those who marry before age 20, so that the cohort aged 20-24 could be included, but the nuptiality experience at ages less than 20 (comprising fewer than 40 percent in marriages in Thailand and 25 percent in Sri Lanka, if Table 1 is accepted) may not be representative of the pattern at ages above 20.

The third reason is more serious but less obvious. Imagine two populations, one in which marriage begins early but is spread out over a large number of ages, and the other in which marriage is concentrated in a short age range. The mean age at marriage among marriages that take place before age 25 could be 19 in both populations, but for very different reasons. In the first, marriage might begin at age 12 and rise slowly, so that a high proportion still marry after age 25; in the second, marriage might be concentrated in the ages 15-23. The ultimate mean age at marriage might be 23 in the first population and 20 in the second, once marriages above age 25 are included. For example, in Table 2, the mean age at marriage is higher in Thailand than in Sri Lanka for every cohort except the 25-29 group. As we shall see later, the ultimate mean age at marriage is estimated to be higher in Sri Lanka for all cohorts below that aged 40-44. Hence, by examining only the truncated mean, a misleading conclusion would be drawn.

2 Age Patterns of Marriage

2.1 REFINED ANALYSIS

Although direct examination of the data is useful, and indeed essential, we would hope to supplement it with a more refined analysis.

We would hope to answer these questions:

(1) Are there trends in the porportion of women who will ever marry?

(2) Are there trends in the age pattern of first marriage?

(3) Are there irregularities in the data?

To answer the first two questions we clearly need to be able to extrapolate future experience from limited data. None of the questions can be answered without reference to a model, or standard, nuptiality schedule which, with appropriate changes in location (the mean) and scale (the standard deviation) and in the proportion who ever marry, can be used to compare the experience of different populations.

Fortunately Coale (1971) has proposed such a model, and considerable experience has been accumulated to show that it adequately represents the age-specific schedule of first marriage rates in a wide variety of populations. In the original version, formulated by Coale and McNeil (1972), [the nuptiality schedule is a function of three parameters: a, the age at which a substantial number of first marriages begin to occur; k, the speed at which] marriage takes place; and C, the proportion who ever (eventually) marry. Recently Rodriguez and Trussell (1980) have modified the first two parameters so that they are more readily interpretable (the mean and the standard deviation) and have written a computer package for finding maximum likelihood estimates (MLE) of the 3 parameters. Interested readers are referred to their paper for a complete description of the model, the estimation procedure, and tests of goodness of fit. Parameter estimates presented below were computed using their package NUPTIAL, which is available from WFS.

Table 2 Mean Age at First Marriage for Women who Marry Before Age 25, Individual Data, Thailand and Sri Lanka

	Thailand		Sri Lanka	
Age at Survey	Number	Mean	Number	Mean
25–29	693	19.2	1108	19.4
30–34	535	19.2	944	18.6
35–39	529	19.2	889	18.4
40–44	509	18.9	753	18.2
45–49	421	19.3	763	18.4

Source: World Fertility Survey (1977). World Fertility Survey (1978). Note that a half-year has been added to the published figures to correct for an error in computing the mean.

2.2 HOUSEHOLD DATA

Data on proportions ever married by age are available from the household survey. Moreover, such data are frequently encountered in published census or survey tables. The model nuptiality schedule can easily be fit to the schedule of proportions ever married by age. The estimates will, of course, not pertain to the experience of any particular cohort unless there has been little change in nuptiality patterns and the proportion ever marrying over time. The analysis to follow is intended to illustrate how the investigator can use the nuptiality model to assess the quality of data on proportions ever married and to infer that nuptiality has been changing. But, as we shall see, interpretation of the results when marriage patterns have been changing is extremely difficult. Thus, if there is evidence of change, we suggest that an alternative approach, described in the next sections, be employed if data on age at marriage are available. Such data, of course, are routinely collected in marriage histories such as those included in surveys of the WFS.

Suppose once again that the data on proportions ever married obtained from the household survey are treated as pertaining to a (synthetic) cohort. Estimates of the mean and standard deviation of age at first marriage and the proportion who will eventually marry are shown in Table 3. In this table, the starting age for each synthetic cohort is 15 but the last age varies by decrements of 5 years from 49 to 24. As in the case in which all data were treated as pertaining to a single cohort, if one wishes to draw inferences about the age pattern of marriage in the population, then one must assume that nuptiality has been unchanging. However, use of the model allows one to test this assumption directly. If nuptiality had been changing in a regular fashion we would expect to find a pattern in the estimates over these synthetic cohorts. First we note that the estimated means for Thailand and Sri Lanka are 22.2 and 25.2 respectively when the entire synthetic cohort 15–49 is considered; these estimates compare with the SMAMs of 22.5 and 25.0 obtained earlier by the Hajnal technique, which of course makes no reference to a model. Hence, it can be seen that the two procedures yield very similar estimates. It should be noted that if the Hajnal technique is applied to the fitted data on proportions ever married the estimate of the mean is identical to the MLE; hence differences in the estimates are due entirely to the fact that the observed data are not identical with the fitted. Examination of Table 3 reveals a very nice pattern of the estimates for Thailand. The means, standard deviations, and proportions ever marrying fall very slightly as the last age in the synthetic cohort is decreased. The trend is so small as to have no demographic significance (and no statistical significance either) so that there is no evidence of a trend in either the pattern of age at first marriage or the proportion who will eventually marry. In Sri Lanka there appears to be little trend except when the two earliest cut-off ages are considered. The mean for the two youngest synthetic cohorts is more

Table 3 **Estimates of the Mean and Standard Deviation of Age at Marriage and the Proportion Who Eventually Marry, Household Data, Thailand and Sri Lanka**

	Thailand				Sri Lanka			
Age group	$\hat{\mu}$	$\hat{\sigma}$	$\hat{c}$	p-value	$\hat{\mu}$	$\hat{\sigma}$	$\hat{c}$	p-value
15–49	22.2 (.159)	5.2 (.179)	.959 (.006)	.449	25.2 (.132)	6.5 (.146)	.985 (.004)	.116
15–44	22.1 (.168)	5.1 (.188)	.954 (.007)	.309	25.1 (.148)	6.4 (.166)	.982 (.006)	.067
15–39	22.0 (.192)	4.9 (.212)	.944 (.009)	.425	25.3 (.192)	6.6 (.200)	.999 (.010)	.107
15–34	21.9 (.227)	4.8 (.239)	.935 (.014)	.364	25.3 (.300)	6.6 (.278)	.997 (.021)	.092
15–29	21.9 (.337)	4.8 (.332)	.935 (.029)	.210	24.7 (.500)	6.1 (.434)	.930 (.042)	.070
15–24	21.9 (.663)	4.8 (.548)	.945 (.085)	.099	24.6 (1.107)	6.1 (.774)	.927 (.145)	.039

Note: estimated standard errors of the estimates in this and subsequent tables are shown in parentheses.

Table 4 **Observed and Fitted Proportions Ever Married, by Age, Household Data, Thailand and Sri Lanka**

	Thailand			
Age	Number of Cases	Observed	Fitted	Difference
15	357.	.039	.031	.008
16	276.	.047	.076	–.029
17	322.	.118	.145	–.027
18	301.	.259	.231	.028
19	260.	.342	.326	.017
20	253.	.407	.420	–.013
21	208.	.591	.508	.083
22	207.	.594	.587	.008
23	214.	.664	.654	.009
24	190.	.721	.711	.010
25	227.	.714	.758	–.045
26	198.	.808	.797	.011
27	176.	.830	.829	.001
28	170.	.853	.854	–.001
29	158.	.880	.875	.005
30	140.	.850	.892	–.042
31	131.	.901	.905	–.004
32	136.	.919	.916	.003
33	136.	.890	.924	–.035
34	179.	.927	.931	–.004
35	136.	.912	.937	–.025
36	145.	.938	.941	–.003
37	127.	.969	.945	.024
38	133.	.932	.948	–.015
39	102.	.931	.950	–.019
40	137.	.956	.952	.004
41	118.	.975	.953	.021
42	111.	.964	.955	.009
43	132.	.977	.956	.022
44	95.	.926	.956	–.030
45	105.	.971	.957	.015
46	120.	.958	.957	.001
47	84.	.976	.958	.018
48	95.	.968	.958	.010
49	77.	.961	.958	.003

(Cont.) Table 4

Age	Sri Lanka Number of Cases	Observed	Fitted	Difference
15	589.	.008	.009	–.001
16	515.	.031	.026	.005
17	523.	.033	.056	–.024
18	587.	.114	.103	.011
19	488.	.162	.165	–.003
20	530.	.279	.237	.043
21	441.	.311	.314	–.004
22	463.	.363	.393	–.030
23	519.	.468	.468	.000
24	463.	.553	.538	.015
25	484.	.626	.602	.024
26	401.	.633	.658	–.025
27	376.	.660	.708	–.048
28	436.	.741	.750	–.010
29	267.	.787	.787	.000
30	426.	.817	.818	–.001
31	238.	.840	.845	–.004
32	307.	.857	.867	–.011
33	297.	.916	.886	.030
34	183.	.918	.902	.016
35	405.	.921	.916	.005
36	206.	.951	.927	.025
37	185.	.962	.936	.026
38	312.	.933	.944	–.012
39	198.	.970	.951	.019
40	328.	.945	.957	–.011
41	146.	.932	.961	–.030
42	201.	.950	.965	–.015
43	247.	.976	.968	.007
44	133.	.955	.971	–.016
45	348.	.977	.974	.003
46	136.	.985	.975	.010
47	185.	.934	.977	.007
48	244.	.984	.978	.005
49	147.	.966	.980	–.014

than half a year younger than the means for the older cohorts. One might interpret these findings to mean that age at first marriage and the proportion ever marrying have started to decline.

The model can be used to assess the quality of data. Observed and fitted proportions ever married for the synthetic cohort 15–49 are displayed in Table 4 and Figures 2 and 3. It is important to note that the use of the model is quite revealing even if it is judged to fit poorly, for example by a X^2 goodness of fit test, about which more is said below. Examination of the differences between the observed data and fitted model for Thailand reveals big discrepancies (of over .03) at ages 25, 30, 33, and 44. The inconsistency at age 44 was noted above. It is interesting to observe that negative residuals occur at ages 20, 25, 30, and 35; this observation suggests that women are, on balance, overstating their ages or that single women are selectively heaped on digits 0 and 5. Curiously, at these same ages in Sri Lanka, the residuals are non-negative. Ages with large residuals in Sri Lanka include 20, 22, 27, 33, and 41. The *patterns* of residuals in both countries are not random; there are concentrations of negative and positive residuals, suggesting that the deviations of the data and the model are systematic, and not due to chance fluctuations.

In the above description the model was taken to represent truth. Of course, it may well be true that the nuptiality pattern in Thailand and Sri Lanka does not conform to the model, and thus that comparison with it does not reveal anything of use. There is no way to decide unambiguously whether the *true* nuptiality pattern conforms more to the observed data or to the model. Our feeling, however, is that the model is flexible enough to conform to a wide variety of smooth, single peaked patterns and that the data themselves are not smooth. Rodriguez and Trussell (1980) have developed a test of goodness of fit. The null hypothesis is that the nuptiality schedule can be fitted with only 3 parameters. One can then determine the significance level at which the null hypothesis can just barely be rejected. If one chooses a significance level below this value (called the p-value), then the null hypothesis cannot be rejected. P-values are shown in Table 3 and in the tables to follow. By this X^2 test, the model fits the household data very well. At a signifiance level of .05, only the estimated model for Sri Lanka at ages 15–24 can be rejected. It must be emphasized that though statistically valid, the test may be demographically very conservative. Errors (random or systematic) in the data may cause the p-value to be very low. One may nevertheless wish to use the estimates of the parameters, especially if inconsistencies in the data are quite evident. This point is discussed below.

Figure 2 **Observed and Fitted Proportions Ever Married for the Synthetic Cohort Aged 15–49 at the Time of the Survey, Household Data, Thailand.**

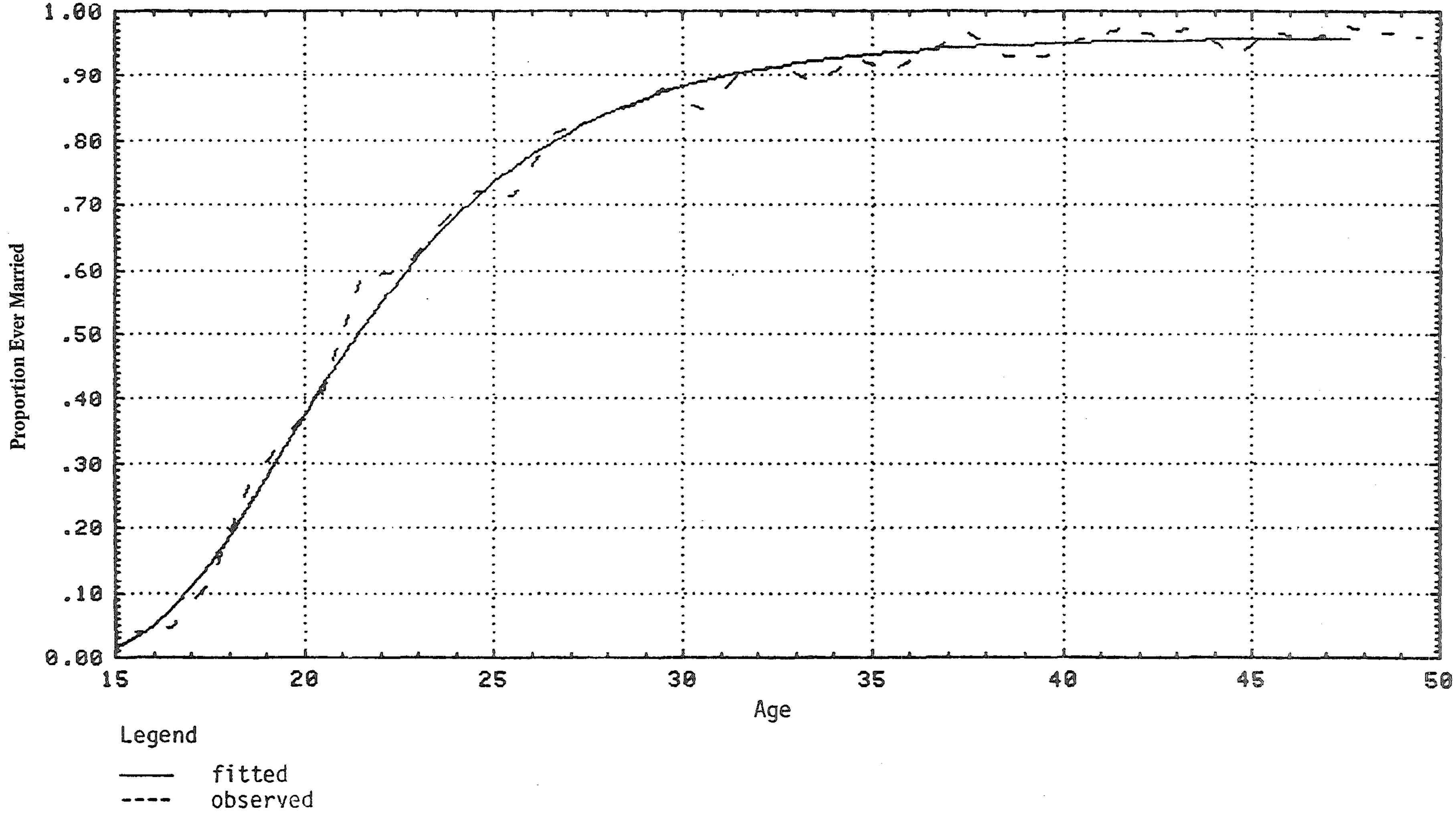
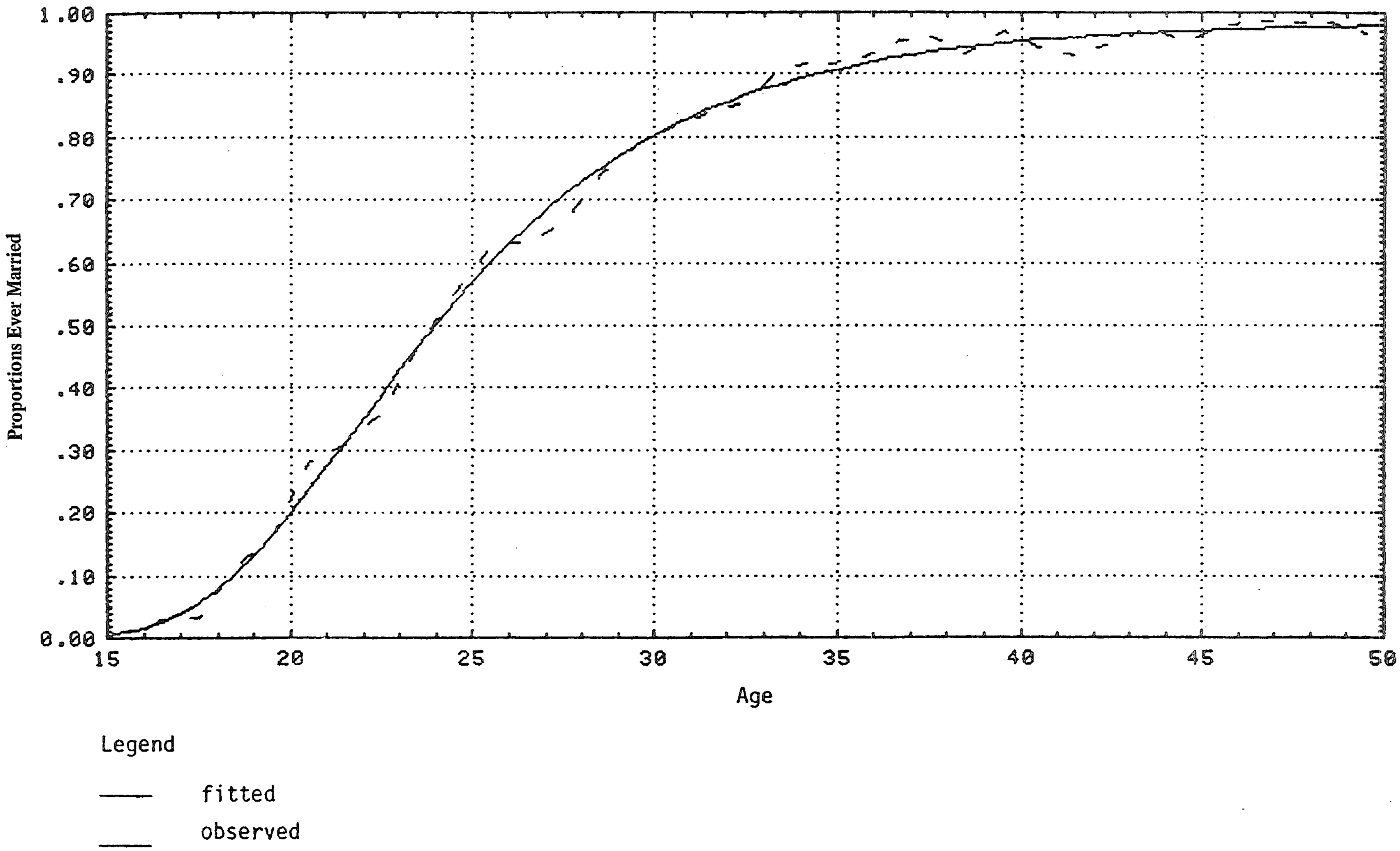


Figure 3 Observed and Fitted Proportions Ever Married for the Synthetic Cohort aged 15–49 at the Time of the Survey, Household Data, Sri Lanka.



2.3 INDIVIDUAL DATA

The data on age at first marriage for each ever-married woman in the intensive survey can provide rich information on the age pattern of first marriage. We have fit the model to standard age cohorts 20–24 through 45–49; the results are presented in Table 5. In general, these results show that age at marriage has been rising both Thailand and Sri Lanka; the difference across cohorts in Thailand is small, however. Thus, we see that there is little evidence of a trend in age at first marriage in Thailand but strong evidence of a rising age at first marriage in Sri Lanka. These differences are clearer when one fits the model to 10-year cohorts, for which results are shown at the bottom of the table. The estimated mean rises by 0.4 years in Thailand (to 21.1) and by 2.9 years in Sri Lanka between the (average) 10-year periods separating the cohorts aged 30–39 and 20–29.

Perhaps the most striking result is that this table appears to conflict sharply with Table 3. In Table 3 it was seen that the younger the cut-off age, the lower was the mean. In fact the two tables are consistent; one must be very careful when interpreting Table 3. We deliberately did nothing to dispel the impression that the results in Table 3 indicated a falling age at marriage. Closer analysis reveals the opposite. When age at marriage is rising (abstracting from changes in the proportion ever marrying – if it is falling then the tendency is reinforced) then for each current age group the proportion ever married at each previous age for that same cohort, inferred as being the proportion ever married at that age in the cross-section, is too low. In fact, the proportions ever married at each age are increasingly understated as the age falls if one infers the proportion ever married in the true cohort from the synthetic cohort.

It can be seen that the estimated mean is increasingly *overstated* as the upper age in the synthetic cohort increases. Thus, the observed fall in the estimated mean age at first marriage as the upper age of the synthetic cohort decreases is indicative of a true rise (not fall) in the mean over time.

One perhaps disturbing feature of Table 5 is the very low p-value for most cohorts. The model appears to fit poorly. In fact when one examines the data closely, it is clear that no model of a smooth pattern of first marriage rates with a single peak could possibly fit these data well. An example is provided by the cohort 25–29 in Sri Lanka, presented in Table 6 and Figures 4 and 5*. The column labelled "pooled" is the combined observed proportions marrying at each age. One can see clearly that the observed data are quite irregular. The model must be viewed as a smoothing device which is intended to replicate the underlying nuptiality pattern once distortions in the data have been removed. Of course, distortions in the data will affect the estimates of the parameters and systematic influences on the estimates may go unnoticed. The problem of low p-values will once again be encountered when the household and individual data are combined; hence, this discussion will not be presented again.

* The observed data in Figures 4 and 5 have been adjusted by multiplying each element in a cohort by the estimated (model) proprotion ever married at the end of the last age observed; for example, the proportions marrying for the cohort aged 25 are multiplied by F(25), where F(25) is the estimated proportion ever married by exact age 25. This procedure allows a direct comparison of all cohorts on the same graph. Without this adjustment, since the proportion marrying for each cohort sum to one, the rate of age 17, for example, for the cohort age 29 would, *ceteris paribus*, be lower than that for the cohort age 25. The adjustment does not, of course, affect the *pattern* for a cohort.

Table 5 Estimates of the Mean and Standard Deviation of Age at Marriage, Individual Data, Thailand and Sri Lanka

	Thailand			Sri Lanka		
Cohort	$\hat{\mu}$	$\hat{\sigma}$	p-value	$\hat{\mu}$	$\hat{\sigma}$	p-value
20–24	21.2 (.420)	5.0 (.318)	.311	23.4 (.632)	7.0 (.445)	.307
25–29	21.1 (.253)	5.1 (.205)	.000*	24.3 (.483)	8.5 (.378)	.000*
30–34	20.8 (.233)	5.0 (.195)	.002	21.4 (.242)	6.6 (.210)	.004*
35–39	20.7 (.204)	4.9 (.176)	.000*	20.8 (.221)	6.6 (.193)	.001*
40–44	20.2 (.183)	4.4 (.151)	.059	20.0 (.195)	5.9 (.164)	.000*
45–49	20.3 (.197)	4.3 (.161)	.417	19.8 (.177)	5.5 (.145)	.001*
20–29	21.1 (.211)	5.0 (.166)	.000	24.0 (.387)	7.9 (.311)	.000*
30–39	20.7 (.153)	4.9 (.129)	.000*	21.1 (.158)	6.6 (.140)	.000*
40–49	20.2 (.134)	4.4 (.109)	.173	19.9 (.129)	5.7 (.108)	.000*

* X^2 test for homogeneity of cohorts reveals that the group is not homogeneous

Figure 4 Adjusted Observed and Fitted Proportions Marrying at Each Age for the Cohort Aged 25–29 at the Time of the Survey, Individual Data, Sri Lanka.

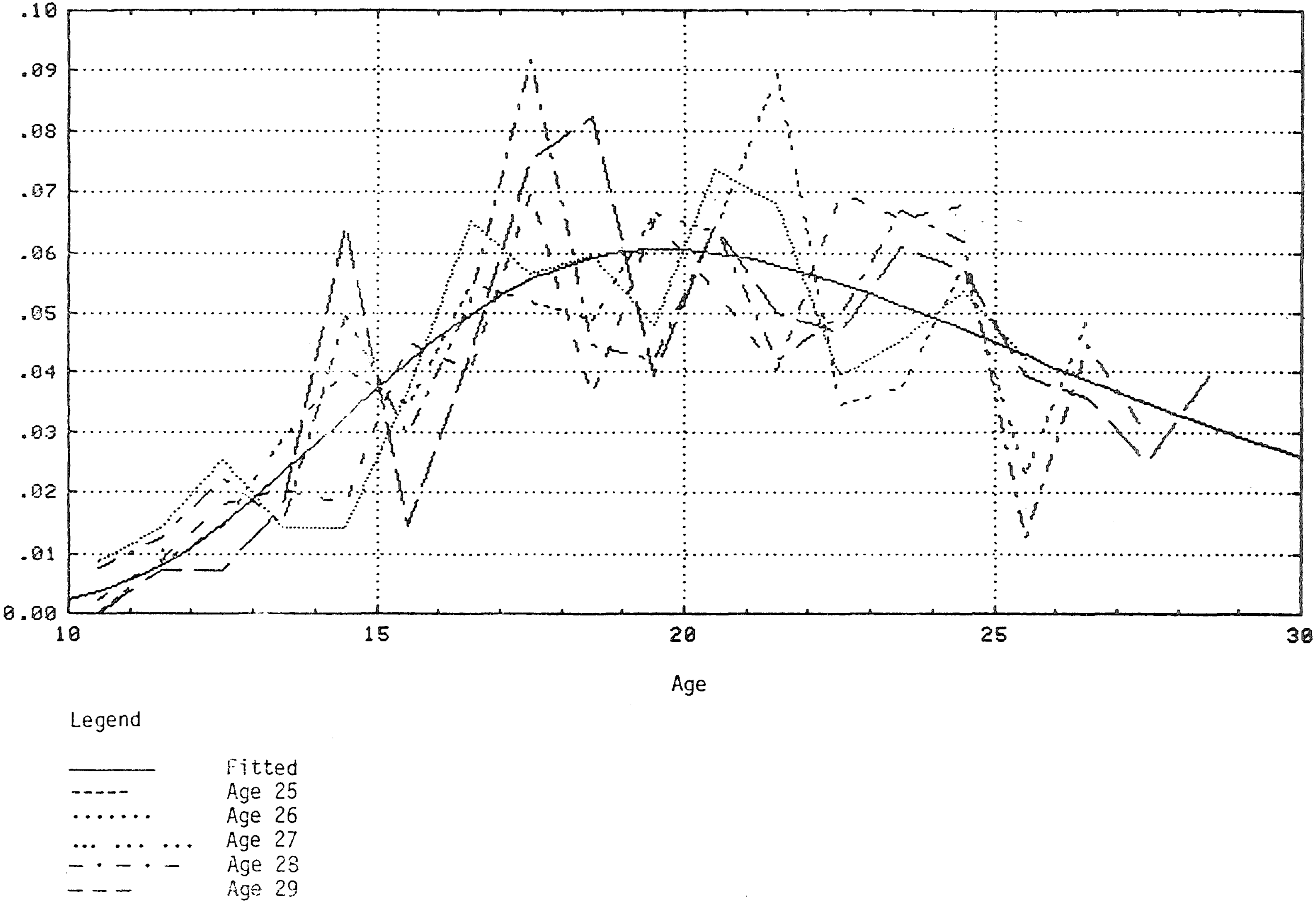


Figure 5 Adjusted Pooled and Fitted Proportions Marrying at Each Age for the Cohort aged 25–29 at the Time of the Survey, Individual Data, Sri Lanka

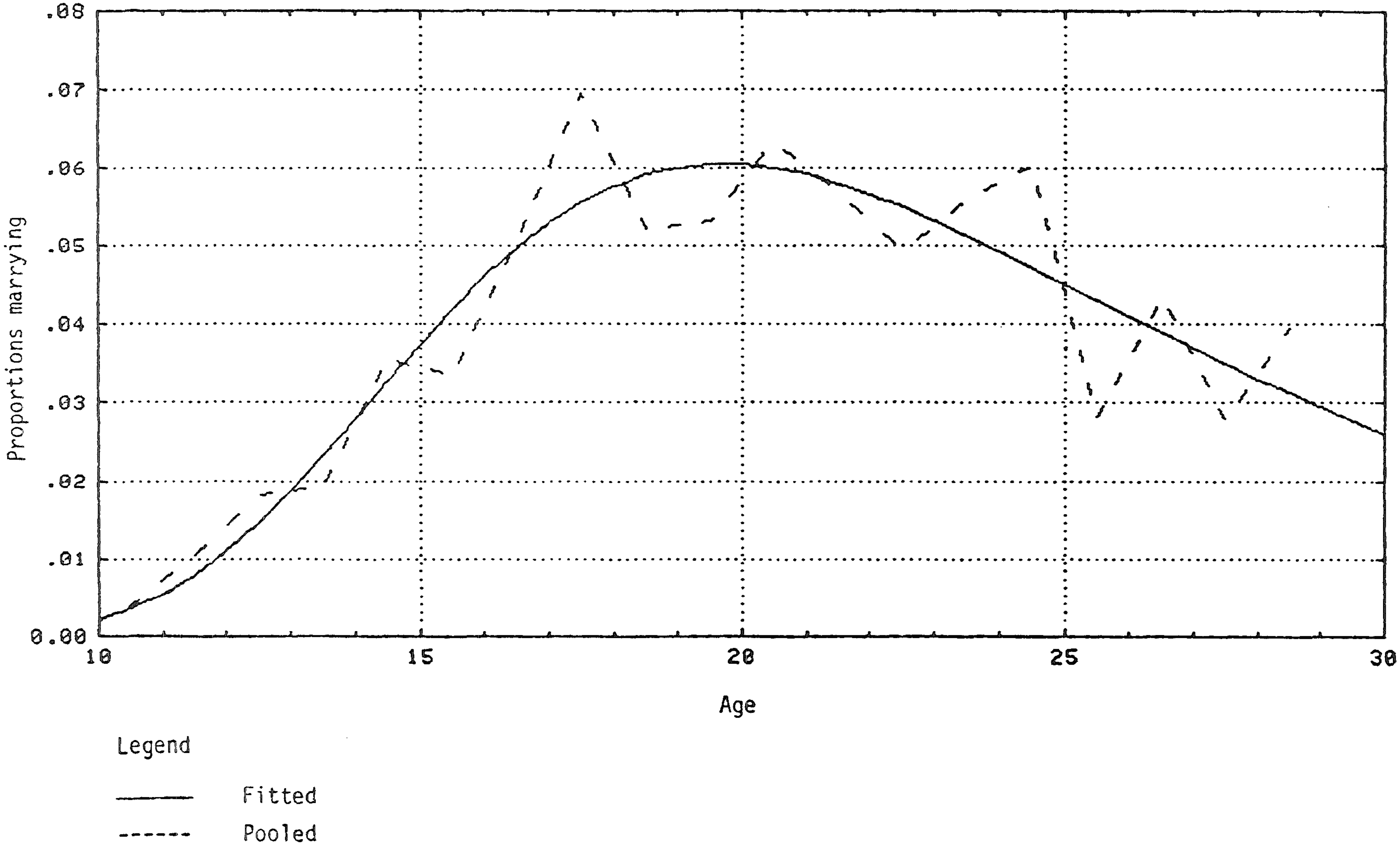


Table 6 Observed and Fitted Proportions Marrying at Each Age, Among Women Married by the End of Each Current Age, Cohort 25–29, Individual Data, Sri Lanka

Age at Marriage	Cohort 25	26	27	28	29	Pooled	Fit	Difference
10	.004	.013	.000	.010	.000	.005	.007	–.002
11	.014	.021	.012	.017	.009	.014	.010	.003
12	.029	.038	.020	.030	.009	.023	.019	.004
13	.033	.021	.041	.020	.023	.025	.030	–.005
14	.029	.021	.057	.067	.084	.046	.042	.004
15	.072	.055	.049	.040	.019	.043	.054	–.011
16	.065	.098	.078	.070	.056	.066	.065	.002
17	.112	.085	.074	.124	.098	.090	.072	.018
18	.058	.089	.070	.060	.107	.068	.077	–.009
19	.105	.072	.094	.057	.051	.069	.078	–.010
20	.087	.111	.090	.087	.084	.082	.078	.005
21	.065	.102	.127	.057	.065	.074	.075	–.001
22	.112	.060	.049	.067	.060	.064	.071	–.007
23	.105	.068	.053	.091	.079	.072	.067	.006
24	.109	.081	.082	.084	.074	.078	.061	.017
25		.064	.033	.017	.051	.036	.056	–.019
26			.070	.060	.047	.057	.051	.006
27				.040	.033	.036	.045	–.009
28					.051	.051	.041	.011
Cases	276.	235.	244.	298.	215.			

2.4 COMBINING HOUSEHOLD AND INDIVIDUAL DATA

We have seen that individual data on age at marriage can provide information on the age pattern of first marriage. Data on the proportion ever married for relatively small groups of ages (say, standard five-year cohorts) can provide reasonable estimates of the proportion ever marrying. Hence, it is natural to combine the two sources of data to obtain simultaneous estimates of the mean and standard deviation of age at marriage and the proportion ever marrying. Of course, the individual data overwhelmingly determine the estimates $\hat{\mu}$ and $\hat{\sigma}$, while the household data govern the estimate of C. Results of this exercise are presented in Table 7.

Not surprisingly, one sees that the estimates of the mean rise for the younger cohorts since this pattern was already detected in the individual data. Estimates of the proportion ever marrying (or, more precisely, the proportion who will ever marry) fall smoothly in Thailand the younger is each cohort. In Sri Lanka there is no smooth pattern, but the estimate of C is smallest for the youngest cohort. The cohort 25–29 is seen to be an anomaly; if it is omitted one obtains a smoother trend.

One might suspect that the estimated value of C for the youngest age group is too low, that, for example, more than 82.5 percent of women now aged 20–24 in Sri Lanka will eventually marry. Unfortunately, there is not any more information about C which can be squeezed from the data. Either there are irregularities in the data, or the experience at young ages is not indicative of what will happen at older ages, or in fact only about 85 percent will eventually marry. If one believes that the estimate of C is too low (or too high, for that matter), it can be fixed at a pre-assigned level and the remaining 2 parameters can be reestimated. This procedure can be used to try to extract a more refined estimate of the mean (or the standard deviation) from the young age groups. Illustrative results are shown in Table 8. The value of C in Table 7 for Thailand (.9) may be thought to be a bit low; let us suppose that we feel in fact that the value is more likely to be .95. Then, as Table 8 reveals, the estimated mean rises to 21.8 (from 21.4). The change in C does not make a huge difference in the estimate of the mean, but it does serve to increase it, as one would expect, since in effect the cumulative schedule of proportions ever-married rotates counterclockwise about the age group in question. The same procedure has been used for the age group 15–19 in Thailand, with the result that the estimated mean falls considerably to 22.4 from the absurd unconstrained estimate of 28.3. Hence, with a fixed value of C, even the youngest age group, for which there is little data indeed, can yield reasonable estimates at the mean.

In Sri Lanka much the same qualitative results emerge. Raising C from its unconstrained estimate of .825 to a perhaps more plausible .90 increases the estimated mean from 24.2 to 25.0; a further increase in C to .95 pushes the mean still higher to 25.5. Hence it would appear that one has a choice of a low value of C and a (relatively) low mean or a higher value of C and a (relatively) higher mean. Under either assumption about the level of C, the youngest cohort appears to be embarked on a nuptiality regime under which a larger fraction of a women's reproductive carrier will be spent in a never-married state. It should be noted in closing that no reliable estimates for the cohort 15–19 could be produced since the sample size was extremely small for the individual data.

Table 7 Estimates of the Mean and Standard Deviation of Age at Marriage and the Proportion Eventually Marrying, Both Household and Individual Data, Thailand and Sri Lanka

	Thailand				Sri Lanka			
Cohort	$\hat{\mu}$	$\hat{\sigma}$	$\hat{c}$	p.value	$\hat{\mu}$	$\hat{\sigma}$	$\hat{c}$	p.value
20–24	21.4	5.1	.900	.253	24.2	7.5	.825	.093
	(.397)	(.303)	(.046)		(.705)	(.490)	(.065)	
25–29	21.2	5.1	.921	.000*	24.4	8.6	.968	.000*
	(.260)	(.212)	(.020)		(.483)	(.377)	(.032)	
30–34	20.8	5.0	.929	.003	21.4	6.7	.932	.002*
	(.235)	(.201)	(.012)		(.248)	(.218)	(.012)	
35–39	20.7	4.9	.945	.000*	20.8	6.6	.968	.001*
	(.209)	(.170)	(.010)		(.224)	(.193)	(.007)	
40–44	20.2	4.4	.963	.059	20.0	5.9	.959	.000*
	(.188)	(.151)	(.008)		(.194)	(.164)	(.007)	
45–49	20.3	4.3	.967	.493	19.8	5.5	.981	.001*
	(.199)	(.162)	(.008)		(.177)	(.146)	(.004)	
20–29	21.3	5.2	.918	.000	25.2	8.7	.969	.000*
	(.194)	(.156)	(0.18)		(.399)	(.297)	(.032)	
30–39	20.7	4.9	.937	.000*	21.2	6.7	.955	.000*
	(.161)	(.131)	(.008)		(.168)	(.149)	(.007)	
40–49	20.2	4.4	.965	.217	19.9	5.7	.970	.000*
	(.144)	(.113)	(.006)		(.130)	(.109)	(.004)	

*X^2 test for homogeneity of cohorts reveals that the group is not homogeneous

Table 8 Estimates of the Mean and Standard Deviation of Age at Marriage Obtained When C is Fixed, Household and Individual Data, Thailand and Sri Lanka

Cohort	$\hat{\mu}$	$\hat{\sigma}$	Fixed C	$\hat{\mu}$	$\hat{\sigma}$	Fixed C
			Thailand			
15–19	22.3	5.4	.93	22.4	5.4	.95
(Unconstrained)	(28.3)	(8.6)	(3.1)			
20–24	21.6	5.3	.93	21.8	5.4	.95
			Sri Lanka			
20–24	25.0	8.0	.90	25.5	8.3	.95

3 Extensions of the Analysis

3.1 DIFFERENTIALS AMONG SUBSECTIONS OF THE POPULATION

One additional use of the model might be noted. Often differentials in demographic experience of various subcategories of the population are of interest. For example, one might want to look at differentials in age at marriage. Interpretation of such differentials is difficult if cause and effect are not obvious. For example, differentials of age at marriage by urban-rural residence or current occupation category are difficult to interpret; marital status might affect decisions to migrate or current employment. This analysis is not the place to attempt to resolve the difficulties involved. Instead we present differentials by selected background variables whether or not the causal mechanism is clearly unambiguous. In Table 9 are presented estimates of the (eventual) mean age at marriage for cohorts 20–24 through 35–39 for subcategories of the population by place of childhood residence, religion, work status before marriage, and education. Results for these background variables are shown only for Sri Lanka, since the sample sizes for Thailand are relatively small. Differentials are shown in Thailand for region of current residence, except for the South and Bangkok, for which the sample sizes are too small. These background variables might not be ones of most interest to the reader, but the background data collected in the WFS are limited. In Sri Lanka, the results are precisely those one would expect. In general the means decrease as one moves down each column, indicating that mean age at marriage is rising. The cohort 25–29 is again the only anomaly. Without exception, the differentials across category once cohort is controlled are as one would expect. Marriage takes place earlier when women grew up on an estate than when they were raised in an urban area, with rural women showing an intermediate mean. Marriage takes place earlier among Hindus than Buddhists, earlier among those who did not work before marriage than among those who did, and earlier among women with fewer years of schooling. In the selected regions in Thailand, a trend toward later age at marriage is evident only in the Central area. Indeed, the North and Northeast regions, in addition to showing no trend, are remarkably similar to one another.

Table 9 Mean Age at Marriage for Selected Subgroups of the Population, Individual Data, Thailand and Sri Lanka

	Sri Lanka											Thailand		
	Childhood Residence			Religion		Work before Marriage		Years of Schooling				Region of Residence		
Cohort	Urban	Rural	Estate	Buddhist	Hindu	Yes	No	None	1–5	6–9	10+	North	North-east	Central*
20–24	27.9	23.1	22.0	24.1	21.6	24.7	22.8	19.5	21.2	22.8	––	20.6	19.9	22.0
25–29	24.4	24.3	22.5	25.9	21.0	27.3	22.6	19.8	20.2	25.4	31.2	19.6	20.5	22.0
30–34	23.6	21.2	19.0	21.9	19.2	23.3	20.4	17.6	19.2	22.4	29.9	20.6	20.5	21.2
35–39	21.9	21.1	17.7	21.9	17.9	21.9	20.2	17.0	19.5	21.9	28.4	20.0	19.9	20.9

* Except Bangkok.

3.2 ANALYSIS OF FIRST BIRTHS

Previous work (Trussell, Menken and Coale, 1979) has shown that the nuptiality model can be used as a model of first births as well. More recent extensions in a PhD. thesis by David Bloom for a wide selection of data confirms that the nuptiality model can replicate first birth schedules quite well. Examination of first birth data has revealed that period age – specific first birth rates are much more regular than cohort rates, implying that period effects can be quite strong determinants of first births. Hence, although logically the model should be applied to cohort schedules instead of period schedules treated as a synthetic cohort, it appears to fit period schedules better. Nevertheless, even when cohort first birth rates are irregular, the model can be used both to smooth and to extract information about the eventual mean age at first birth and proportions ever having a first birth implied by data censored by a survey.

In the WFS surveys in Thailand and Sri Lanka (unlike those in many other countries), no information on parity was collected in the household survey. A question on the date of the first birth was included in the individual survey, which was administered only to ever-married women. Hence, in order to conduct any analysis on first birth data which are supposed to be representative of the population as a whole, we must assume that births are confined to marriage (or at least that the first birth experience of ever-married women is no different from that of all women).

Using the information on age at first birth and age at interview, estimates of the mean and standard deviation of age at first birth can be obtained; results are displayed in Table 10. These estimates, like those for the mean age at first marriage, imply that there has been a small (but not statistically significant) increase in the mean age at first birth in Thailand and a larger increase in Sri Lanka.

Table 10 Estimated Mean and Standard Deviation of Age at First Birth, Individual Data, Thailand and Sri Lanka

	Thailand			Sri Lanka		
Cohort	$\hat{\mu}$	$\hat{\sigma}$	p-value	$\hat{\mu}$	$\hat{\sigma}$	p-value
20–24	22.7	5.1	.363	24.7	6.8	.842
	(.575)	(.406)		(.879)	(.582)	
25–29	22.8	5.2	.009	25.3	8.1	.418
	(.295)	(.240)		(.513)	(.391)	
30–34	22.2	4.8	.008	22.1	6.4	.041*
	(.225)	(.193)		(.248)	(.213)	
35–39	22.7	4.9	.007	22.6	6.7	.045*
	(.210)	(.181)		(.223)	(.193)	
40–44	22.4	4.7	.085	21.6	5.9	.001*
	(.203)	(.176)		(.200)	(.167)	
45–49	22.4	4.4	.056	21.6	5.7	.000*
	(.210)	(.170)		(.182)	(.150)	

* X^2 test for homogeneity of cohorts reveals that the group is not homogeneous

These estimates may be used to compute the average delays between first marriage and first birth which are shown in Table 11. In both countries the interval between first marriage and first birth appears to have shrunk over time. This conclusion is supported by the results, also shown in Table 11, when the average delay is calculated directly from information on the date of marriage and the date of first birth, though the shortening of the interval is not as pronounced in Sri Lanka (and would be partly due to the truncation effect caused by the fact that a longer delay is possible the older is the woman). The likely explanation for this contraction of the interval is a combination of real factors, such as lessened adolescent subfecundity, and and artifact of the data, that older women tend more to omit reporting a first birth if it died.

If we assume that births are confined solely to married women, then we can estimate the proportion ever having a first birth at any age as the product of the proportion married and the proportion among married women who have given birth. Given this estimated proportion, we can then apportion women in the household survey into those estimated to be nulliparous and those estimated to have given birth to at least one child. We can then combine the household and individual data as before to produce estimates of all three parameters. Results are shown in Table 12.

Except for the cohort aged 20–24 in Sri Lanka, the estimates of the mean age at first birth are nearly identical to those obtained earlier using only the individual data. This result is expected since the proportion nulliparous at each age in a 5 year cohort contains little information about the pattern of the first birth schedule. The estimates of the proportion ever having a child are perhaps slightly less erratic than the estimates of the proportion ever married obtained earlier, but they are based on questionable assumptions, and therefore we cannot place much faith in their precision.

Table 11 Estimated Average Delay (in Years) Between Marriage and First Birth, Thailand and Sri Lanka

	From Tables 5 and 10		Calculated Directly	
Cohort	Thailand	Sri Lanka	Thailand	Sri Lanka
20–24	1.5	1.3	1.3	1.5
25–29	1.7	1.0	1.6	1.6
30–34	1.4	1.3	1.6	1.7
35–39	2.0	1.8	2.0	1.9
40–44	2.2	1.6	2.3	1.9
45–49	2.1	1.8	2.2	1.8

Table 12 Estimated Mean and Standard Deviation of Age at First Birth and the Proportion Ever Bearing a Child, Household and Individual Data, Thailand and Sri Lanka

	Thailand				Sri Lanka			
Cohort	$\hat{\mu}$	$\hat{\sigma}$	$\hat{c}$	p-value	$\hat{\mu}$	$\hat{\sigma}$	$\hat{c}$	p-value
20–24	22.7	5.1	.863	.332	25.6	7.3	.810	.669
	(.565)	(.417)	(.070)		(.871)	(.586)	(.090)	
25–29	22.9	5.3	.917	.009	25.4	8.2	.913	.389
	(.316)	(.264)	(.013)		(.431)	(.346)	(.030)	
30–34	22.2	4.8	.913	.015	22.8	6.5	.894	.019*
	(.236)	(.213)	(.014)		(.253)	(.219)	(.014)	
35–39	22.7	4.9	.937	.005	22.6	6.7	.942	.036*
	(.201)	(.167)	(.011)		(.226)	(.193)	(.009)	
40–44	22.4	4.7	.941	.078	21.6	5.9	.919	.001*
	(.206)	(.176)	(.010)		(.197)	(.169)	(.009)	
45–49	22.4	4.4	.944	.058	21.6	5.7	.951	.000*
	(.210)	(.171)	(.011)		(.183)	(.154)	(.007)	

* X^2 test for homogeneity of cohorts reveals that the group is not homogeneous

Nevertheless, the overall results are encouraging. The fits are at least as good as those to the marriage data.

3.3 ASSESSMENT OF QUALITY OF DATA

The analysis so far has been based on the implicit assumption that the data are accurate, or at least that they are not biased in a systematic way. Earlier discussion has pointed out that the pattern of observed first marriage and first birth rates by age is often highly erratic, and that there is considerable evidence of age heaping. It is possible to extend the analysis of quality of data further by comparing the proportions ever-married (or ever having a first birth) reported in censuses at specific dates in the past to the proportions which are implied by the WFS data.

The methodology involved in such a calculation is straightforward to explain. Since the individual surveys, which contained a question on the date of marriage and first birth, were administered to only ever-married women in Thailand and Sri Lanka it is possible to calculate, for any date in the past, the proportion of women ever married at the time of the survey who were married or had a first birth before that date in the past. Women are grouped by standard age groups at the reference date. To obtain the proportion of all women, in standard age groups, who had ever married or had a birth by the reference date, the proportion conditional on being ever married at the time of the WFS survey is multiplied by the proportion of the standard age group at the reference date who were ever married at the time of the WFS survey; this latter proportion is obtained from the household survey.

These calculations are easily carried out in Thailand, for the censuses used for comparison were held nearly exactly 5 and 15 years before the WFS survey. Hence to obtain, for example, the proportion married of women aged 40–44 in 1970 implied by the WFS data, one multiplies the following two proportions:

(1) The proportion of women aged 45–49 ever married at the time of the WFS survey who married more than 5 years before the date, obtained from the individual survey.

(2) The proportion ever married among women aged 45–49 in the household survey.

In Sri Lanka, the census dates were not spaced in such a convenient fashion, but the principle underlying the calculation is the same.*

Results for marriage in Sri Lanka are shown in Table 13 for the four relevant census dates before the WFS survey. By looking at the ratio of the proportion ever married in the WFS survey to that in the census, one can clearly see that the WFS figures are (with one exception) invariably higher. Hence, at any point in the past, WFS data imply a higher proportion ever married than is given by the census.

* In Sri Lanka the household members file was used to determine the proportions married in the highly non-standard age groups required. Women with invalid codes for month of birth were eliminated.

Table 13 Proportions Ever Married at Specific Dates in the Past, Sri Lanka.

	1946.25					1953.25					1963.583					1971.583		
			1971					1971					1971					
Age Group	Census	WFS	Ratio	Census	Ratio	Census	WFS	Ratio	Census	Ratio	Census	WFS	Ratio	Census	Ratio	Census	WFS	Ratio
15–19	.246	.377	1.53	.300	1.22	.243	.371	1.53	.326	1.34	.150	.246	1.64	.182	1.21	.105	.117	1.11
20–24						.675	.711	1.05	.718	1.06	.587	.631	1.07	.624	1.06	.466	.436	.94
25–29											.829	.850	1.03	.852	1.03	.752	.763	1.01
30–34											.917	.953	1.04	.940	1.03	.890	.917	1.03
35–39																.941	.960	1.02
40–44																.953	.966	1.01

Sources: Censuses: *Demographic Yearbook 1958,* Table 6.
Demographic Yearbook 1968, Table 7.
Statistical Abstract of the Democratic Socialist Republic of Sri Lanka 1977, Table 23.
Household and Individual Data, Sri Lanka World Fertility Survey.

1971 Census reconstruction: Goldberg (forthcoming).

The WFS figures agree fairly well with the 1971 census. That a higher proportion is ever married at 15–19 in the WFS and a lower proportion at 20–24 suggests that the discrepancy could be caused by simple transfer of women across age 20. For example, if some married women aged 15–19 were included with the 20–24 group in the census, perhaps because of a mis-statement of date of birth or because the date was supplied by the enumerator, then the proportion ever married at ages 15–19 would be too low and at ages 20–24 too high. Of course, the discrepancy could arise from errors in the reporting of date of birth in the WFS, or a combination of errors in both the census and WFS. The agreement between WFS and the census proportions ever married persists even further back in time for ages above 20. However, the proportion ever married at 15–19 is much higher in the WFS. One would suspect that the census proportion is more likely to be correct because it is based only on a question about current marital status, whereas the WFS proportion is based on a question asking the date of marriage. Both the census and the survey would be affected by misreporting of current age or date of birth. Hence, the basic discrepancy is that at the youngest ages, the census reports indicate a larger fraction single. This tendency is especially marked in the age group 10–14; in the census, virtually all women are single, whereas a not insignificant fraction of women in the WFS (about 10 percent) are married by age 15.

Without further information, we would be unable to resolve this basic discrepancy. Fortunately, ever-married women in the 1971 census were asked a question on their age at marriage. Hence one can reconstruct the proportions ever married at the time of the three prior censuses from information available from the 1971 census; these proportions are also shown in Table 13 (Goldberg, forthcoming). There it can be seen that all three sources agree fairly well at ages above 20. At ages 15–19, the 1971 census data imply proportions ever married at the time of the previous censuses that lie between the census and WFS figures. Therefore, we have apparently strong evidence that there is a general tendency for Sri Lankan women to understate age at marriage (either directly or through an understatement of date of marriage) for the younger ages at marriage. Since the 1971 census is closer in time to the previous censuses than is the WFS, one would expect that the bias for the youngest age group resulting from the understatement of age at marriage to be less pronounced for the 1971 census reconstruction; this expectation is confirmed by the results in Table 13. Moreover, the expectation that reporting errors would increase for events which occurred further in the past would imply that for each source (WFS and the 1971 census) the errors would increase for the earlier censuses. Relative proportionate errors do not, however, show this pattern for either source; absolute errors (differences) between the WFS and census figures rise as the date of the census recedes, but the same pattern is not evident for the 1971 census reconstruction. Hence, the discrepancy cannot be resolved quite as neatly as might be hoped, but we feel that the evidence does imply that the census figures, based on questions of current marital status and age, are more likely to be correct than reconstructions based on date or age at marriage.

One possible explanation for the tendency for the proportions ever married to be overstated has been provided by Ansley Coale. Suppose that the random error attached to reports of age of marriage increases as the age at marriage decreases; for a given current age, this assumption could be derived from an increased memory error for earlier dates of events. Then, at the ages at which the number of marriages is increasing rapidly, more marriages would be transferred down than up. At ages near the mode, approximately equal numbers would be transferred up and down. The result would be a tendency for ages at marriage to be understated for the younger ages at marriage – exactly the tendency we observe.

For the reasons given above, let us suppose that the census figures are correct, and therefore that the WFS figures are too high. What then does Table 13 imply about the estimates of the mean age at marriage obtained earlier? At first blush, the results shown might seem to imply that the estimates are biased downwards, since age at marriage appears to be understated, leading to an overstatement of the proportion ever married: however, this reasoning is incomplete. Suppose that for a cohort, the proportion ever married were always too high by a constant multiplicative factor. Then the mean of the marriage schedule would be unaffected. Hence we need to untangle Table 13 to see what the ratios of WFS to census proportions are for cohorts. Results are shown in Table 14. There it can be seen that the WFS proportions ever married for cohorts are (roughly) overstated to a greater extent as the time in the past increases, especially for the youngest age groups. Hence, if the censuses are correct, then ages at marriage are indeed understated, primarily for the younger ages at marriage. Therefore, the observed schedule or proportion ever married is not a constant multiple of the true one; instead the multiplicative factor decreases with age. Hence, the estimated mean is biased downward at least for the older cohorts. But what does this finding imply about the estimates of the trend in age at marriage obtained earlier? We do not have much information which can be used to glean our answer. If the estimated means for the youngest cohorts are approximately correct, then the trend in age at marriage obtained earlier would start from a level which is too low, and therefore, rise too fast. The estimates for the youngest cohorts (20–24 and 25–29) are both above 24, and the true mean is unlikely to be any lower. It could be higher (by about one year) as was shown in Table 8, if the proportion ever marrying turns out to be higher than the estimated value of C. Hence, the estimated increase in the mean age at marriage over time may be too high (if the estimates for the youngest cohorts are correct) or too low (if the estimates for the youngest cohorts are too low). The uncertainty is caused by the questionable reliability of the estimates for the youngest cohorts. We can be more certain that the rise in the SMAM between the cohorts aged 45–49 and 30–34 is too steep, since the estimate for the oldest cohort is too low. We then restrict the uncertainty to the estimated continued rise in the SMAM from the cohort aged 30–34 through youngest cohorts. This estimated increase may be understated for the reason given above.

The results for marriage in data in Thailand are shown in Table 15. The WFS and census estimates of the proportions ever-married in 1970 agree remarkably well; for 1960, WFS proportions are consistently higher than the census figures. There is a huge disparity in the estimates at ages

15–19, and the census figure itself seems questionable, since there appears to be no reason why the proportion ever married at that age should rise between the two census dates from .138 to .190. Because the WFS proportions agree with the census figures in 1970 but are higher in 1960, age at marriage must be understated, especially at the youngest ages, in the WFS if the census figures are correct. Hence, the estimated mean age at marriage would be biased downward. Whether or not the trend estimate (of no trend) obtained earlier is incorrect cannot be assessed, since the timing of the censuses does not permit one to make comparisons for specific age groups as in Table 14.

Table 14 Ratio of Proportion Ever Married in the WFS to the Proportion Ever Married in the Census, by Approximate Age of the Cohort at the Time of the WFS Survey and by Age at the Time of the Census Dates

Age at Census	Approximate Age at Time of WFS Survey					
	45–49	40–44	35–34	30–34	26–29	20–24
30–34	1.04		1.03			
25–29		1.03		1.01		
20–24	1.05		1.07		.94	
15–19		1.53		1.64		1.11

Source: Table 13.

Table 15 Proportions Ever Married at Specific Dates in the Past, Thailand

Age Group	1960.33			1970.33		
	Census	WFS	Ratio	Census	WFS	Ratio
15–19	.138	.249	1.80	.190	.207	1.09
20–24	.613	.691	1.13	.621	.631	1.02
25–29	.859	.908	1.06	.844	.847	1.00
30–34	.933	.951	1.02	.919	.923	1.00
35–39				.948	.952	1.00
40–44				.961	.967	1.01

Sources: *Thailand Population Census,* 1960, Table 4.
Thailand Population and Housing Census, 1970, Table 5.
Household and Individual Data, Thailand World Fertility Survey.

Table 16 Proportions having at Least One Child at Specific Dates in the Past, Thailand

Age Group	1960.33			1970.33		
	Census 1	Census 2	WFS	Census 1	Census 2	WFS
15–19	.089	.059	.120	.111	.099	.110
20–24	.540	.474	.548	.577	.504	.518
25–29	.821	.779	.834	.821	.772	.800
30–34	.907	.874	.918	.904	.870	.894
35–39				.935	.906	.931
40–44				.948	.917	.942

Note: Census 1: All women of parity unknown are assumed to have had a birth.
Census 2: All women of parity unknown are assumed to be childless.

Sources: *Thailand Population Census, 1960,* Tables 4 and 14.
Thailand Population and Housing Census, 1970, Tables 5 and 7.
Household and Individual Data, *Thailand World Fertility Survey.*

Finally, one can apply the same procedure to first births, though the requisite census tabulations are available only for Thailand. In order to do so we must again assume that births are confined to marriage, since neither in the census nor in the WFS survey were fertility questions asked to never-married women. The results under such an assumption are displayed in Table 16. There two census figures for each date are shown, one based on the assumption that women with parity not stated were childless and the other based on the assumption that they had borne at least one child. In 1970, the WFS proportions ever having had a child fall between the two census estimates, but closer to the higher estimate calculated under the assumption that no women with unknown parity were childless. In 1960 the WFS proportions are higher than even the highest census figure. Since all these figures are derived from rather questionable assumptions, one is hesitant to draw conclusions; nevertheless the results are not inconsistent with an understatement of age at first birth which increases the further back in time it is reported. Again, estimates of the mean for each cohort are likely to be downward biased.

The magnitude of the bias involved is extremely difficult to assess, but some trial calculations can perhaps reveal the order of magnitude. Suppose that the schedule of proportions ever married (or ever having a birth) shown in panel A of Table 17 is typical. Then consider extreme factors of overstatement of 1.60 for age 15–19 falling to 1.00 at ages 45–49. The estimated mean based on the observed proportions would be biased downward by 1.2 years. It might be thought that the extremely high error factor for the age group 15–19 accounts for most of this bias; in fact, it does not, as a reduction to a factor of 1.2 in this age group causes the estimated mean to rise by only .3 a year.

The calculation of the SMAM is affected more by *differences* in the proportion ever married than by ratios. Hence, an overstatement of the proportion ever married

Table 17 Illustrative Calculation of the Magnitude of Bias in the Estimate of the Mean Age at Marriage or First Birth

A. Typical Population

Age (1)	Typical Proportion Ever-Married or Ever Having a Birth (2)	Extreme Factor of Overstatement (3)	Observed Proportion (2) x (3)
15–19	.162	1.60 (1.20)	.259 (.194)
20–24	.516	1.10	.568
25–29	.823	1.05	.864
30–34	.914	1.03	.941
35–39	.944	1.01	.953
40–44	.954	1.00	.954
45–49	.958	1.00	.958
50–54	.958	1.00	.958
SMAM	22.5		21.3 (21.6)

B. Sri Lanka, 1946*

Age	Proportion Ever Married	Over-Statement Factor	Observed Proportion
10–14	.0000	–	.0500
15–19	.2464	1.53	.3770
20–24	.7064	1.05	.7417
25–29	.8824	1.02	.9089
30–34	.9343	1.00	.9530
35–39	.9569	1.00	.9569
40–44	.9595	1.00	.9595
45–49	.9661	1.00	.9661
50–54	.9639	1.00	.9639
SMAM	20.7		19.4

Source: *Demographic Yearbook 1955*, Table 12.

by a factor of 1.6 would affect the estimated SMAM more the higher is that proportion. Since the proportion ever married at the youngest age group in Sri Lanka is higher than that in the illustrative example in panel A, it is instructive to examine what should happen to the estimated SMAM if the 1946 census figures were distorted in a manner suggested by Table 13. Results are shown in panel B of Table 17. There another distortion is imposed; virtually no women aged 10–14 were reported as married in the census, whereas the WFS data imply that perhaps 10 percent are married by age 15. Hence, the proportion ever married in the age group 10–14 has been distorted upward as well. The results are similar to those in panel A. The SMAM is biased downward by 1.3 years; approximately .27 year is accounted for by the differences in proportion ever married at 10–14. The assumptions underlying the calculations in Table 17 are probably a bit extreme; nevertheless, one might expect to find errors of as large as a year in the estimated mean.

Summary

An extensive analysis of data on nuptiality obtained from WFS surveys in Thailand and Sri Lanka has revealed that they are of reasonable quality. Certainly there are irregularities in the data, caused by sampling variability, age mis-statement, or mis-statement of marital status. When compared with census data, it would appear that age at marriage is understated in these two WFS surveys. However, useful information about patterns, levels and trends can probably be extracted. Nuptiality in Thailand appears to be rather static, with a mean age at marriage of roughly 21 and a proportion ever marrying of approximately .93. There is some evidence of a slight upward trend in both the proportion never marrying and the mean age at first marriage. In Sri Lanka these trends are more pronounced. It appears that the mean age at marriage will be about 2 years higher for the cohort aged 20–24 at the time of the survey than that aged 30–34. Trends in the proportion never marrying are estimated with less confidence, but it would appear that female celibacy is likely to increase. Similar conclusions about trends in age at first birth and the proportion remaining nulliparous follow from an analysis of first birth data.

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