CHAPTER 4

MULTIVARIATE ANALYSES OF FACTORS AFFECTING AGE AT FIRST BIRTH

In the previous chapter, age at first birth was found to be closely related to a number of socio-economic and demographic variables. These variables are inter-correlated, and they often operate simultaneously in influencing age at first birth. In this chapter, multivariate analyses will be performed to examine the combined effects and the independent effects of the pertinent variables.

Given the large sample size and that data on age at first birth is normally distributed, parametric statistical tests such as ANOVA, multiple regression, logistic regression and multiple classification analysis (MCA) can be applied to the data. However, relevant statistical tests will be carried out to assess if the assumptions of equality of variance, independence of error terms and additivity are violated.

4.1 ANALYSIS OF VARIANCE

The analysis of variance (ANOVA) decomposes the total variation of the dependent variables into two components--between group differences and within group differences. The technique is used to test if the differences in group means are statistically significant or not. An analysis of variance on age at first birth was performed on a number of independent variables: birth cohort, ethnicity, place of residence, wife's educational level, premarital work, husband's educational level and

age difference between spouses. Age at first marriage will be entered as covariate in a separate model. A covariate is a variable that has a substantial correlation with the dependent variable and is included in the experiment to adjust the results for differences existing among subjects before the start of the experiment (George and Mallery, 2000). Given its strong correlation with age at first birth and predictor variables, age at marriage is introduced as a covariate to partition out its influence on the relationship between dependent variable and the predictor variables under study.

Table 4.1 shows that the model with seven explanatory variables can explain 30 per cent of the variance in age at first birth. Each of these variables is significantly related with age at first birth ($p < 0.01$), net of the effects of other variables in the model.

Table 4.1: Analysis of Variance (ANOVA) on Age at First Birth by Selected Variables

Sources of Variation	Hierarchical Method				
	Sum of Squares	df	Mean Square	F	Sig.
Main Effect (Combined)	15897.531	16	993.596	72.659	.000
Birth Cohort	258.485	3	86.162	6.301	.000
Ethnic Group	2078.648	2	1039.324	76.003	.000
Place of Residence	1398.236	1	1398.236	102.250	.000
Respondent's Education	5129.830	3	1709.943	125.044	.000
Premarital Work Experience	3363.100	1	3363.100	245.936	.000
Husband's Education	438.483	3	146.161	10.688	.000
Spousal Age Difference	3230.750	3	1076.917	78.752	
Explained	15897.531	16	993.596	72.659	.000
Residual	36320.051	2656	13.675		
Total	52217.582	2672	19.543		.000

R-Square = 0.304

Adding age at first marriage as covariate increases the explanatory power of the model by as much as 58 percentage points (see Table 4.2). However, ethnicity, place of residence and spousal age difference would become insignificant in explaining differentials in age at first birth, once age at marriage is taken into account (p-value >0.05). This shows that the effects of these three variables on age at first birth are largely mediated through age at first marriage. In other words, the differentials in age at first birth observed across categories of these variables are largely due to the differences in age at first marriage.

The two-way interactions are generally insignificant (see Table A.1 in Appendix I). Hence, it would be appropriate to use MCA, an additive model, in analyzing the differentials in age at first birth within the multivariate context.

Table 4.2: Analysis of Variance (ANOVA) on Age at First Birth by Selected Variables with Age at First Marriage as Covariate

Sources of Variation	Hierarchical Method				
	Sum of Squares	df	Mean Square	F	Sig.
Age at First Marriage [a]	45836.752	1	45836.75	19506.13	.000
Main Effect (Combined)	141.941	16	8.871	3.775	.000
Birth Cohort	34.853	3	11.618	4.944	.002
Ethnic Group	8.861	2	4.431	1.885	.152
Place of Residence	2.894	1	2.894	1.232	.267
Respondent's Education	43.352	3	14.451	6.150	.000
Premarital Work	13.234	1	13.234	5.632	.018
Husband's Education	29.205	3	9.735	4.143	.006
Spousal age difference	9.541	3	3.180	1.353	.255
Explained	45978.693	17	2704.629	1150.972	.000
Residual	6238.890	2655	2.350		
Total	52217.582	2672	19.543		

R-Square = 0.881

[a] Covariate entered first

4.2 MULTIPLE CLASSIFICATION ANALYSES (MCA) OF AGE AT FIRST BIRTH

As explained in Chapter 2, multiple classification analysis (MCA) is used to determine the interrelationships between a dependent variable and several explanatory variables within the context of an additive model. Table 4.3 summarizes the main findings from a series of multiple classification analyses on age at first birth, with different sets of independent variables. The first MCA model contains only birth cohort, ethnicity and place of residence as independent variables. Respondent's educational level, premarital work experience, husband's educational level, age difference between spouses and age at first marriage were added successively in the five subsequent models.

The unadjusted effects, expressed in terms of deviation of each category of the independent variable from the grand mean, are the same as in the bivariate context. The eta values show the zero-order correlations between age at first birth and the independent variables with several categories. The beta values show the relative importance of each explanatory variable net of the effects of other variables in the model.

Table 4.3: Effects[a] of Selected Socioeconomic Characteristics on Age at First Birth in Peninsular Malaysia[b], 1994/95

Variables		Deviations (Grand Mean = 23.06)						
		(Gross Effect)	Adjusted for Factors (Net Effect)					
			1	2	3	4	5	6
Birth Cohort	Before 1951	-0.50	-0.55	0.12	0.30	0.36	0.20	0.17
	1951–1955	0.10	0.13	0.22	0.32	0.33	0.32	0.14
	1956–1960	0.29	0.29	0.11	0.0023	-0.012	0.005	-0.08
	1961–1965	0.12	0.14	-0.48	-0.66	-0.71	-0.54	-0.22
Eta / Beta		**0.07**	**0.077**	**0.06**	**0.086**	**0.094**	**0.072**	**0.036**
Ethnicity	Malays	-0.65	-0.51	-0.66	-0.44	-0.43	-0.43	0.022
	Chinese	1.29	1.09	1.28	0.82	0.80	0.83	-0.085
	Indians	0.072	-0.17	0.16	0.20	0.20	0.12	0.12
Eta / Beta		**0.196**	**0.162**	**0.196**	**0.128**	**0.125**	**0.127**	**0.014**
Place of Residence	Urban	0.83	0.69	0.32	0.27	0.19	0.22	0.002
	Rural	-0.99	-0.81	-0.38	-0.32	-0.22	-0.27	-0.003
Eta / Beta		**0.205**	**0.169**	**0.079**	**0.066**	**0.046**	**0.055**	**0.001**
Respondent's Education	No schooling	-1.93		-1.91	-1.91	-1.51	-1.13	-0.13
	Primary	-1.09		-1.13	-0.99	-0.82	-0.75	-0.086
	Secondary	1.11		1.13	1.05	0.86	0.80	0.099
	Tertiary	3.60		3.67	3.22	2.59	2.28	0.18
Eta / Beta		**0.337**		**0.344**	**0.312**	**0.253**	**0.228**	**0.024**
Premarital Work	Never worked	-2.31			-1.79	-1.77	-1.45	-0.11
	Worked	1.01			0.79	0.78	0.64	0.048
Eta / Beta		**0.347**			**0.269**	**0.266**	**0.218**	**0.016**
Husband's Education	No schooling	-2.23				-1.13	-0.74	-0.23
	Primary	-1.19				-0.44	-0.30	0.019
	Secondary	0.75				0.35	0.21	-0.067
	Tertiary	2.77				0.86	0.69	0.31
Eta / Beta		**0.304**				**0.116**	**0.081**	**0.027**
Spousal Age Difference	Wife Older	2.96					2.20	0.054
	0-5 years	0.25					0.10	0.028
	6 – 10 years	-1.61					-1.19	-0.10
	> 10 years	-2.13					-1.15	0.051
Eta / Beta		**0.364**					**0.259**	**0.014**
Age at First Marriage								0.954
R-Square			0.071	0.17	0.234	0.243	0.304	0.881

[a] Expressed as deviation from the grand mean of the dependent variable

[b] Sample consists of married women aged 30 years and above at the time of interview and with at least one live birth

In the first model, both ethnicity and place of residence had rather similar eta and beta values, indicating that age at first birth differed significantly across the ethnic groups as well as between rural and urban women. Controlling for the additive effects of birth cohort and place of residence makes little difference in the ethnic effects on the timing of first birth. Chinese women would give birth to the first child about 1.6 years later than their Malay counterparts.

Urban residence is found to be associated with later age at first birth. Holding constant ethnicity and cohort would have reduced the urban/rural differentials from 1.82 years to 1.5 years. In this model, birth cohort produces a much smaller differential in age at first birth.

Adding education level into the model increases the explanatory power to 17 per cent, up from 7 per cent for the first model. The adjusted figures shows that the effect of urban residence in the postponement of childbearing was largely mediated through respondent's educational level. Besides providing greater access to educational opportunities, urban influences on the timing of family formation are negligible (Hirschman, 1985). It is worth noting that while the effects of place of residence is largely explained away with the inclusion of respondent's education level (as shown by the much smaller deviations from the grand mean and beta value), the ethnic effect remains very significant. This may be explained by the fact that while education level differs significantly between urban and rural women, the ethnic differentials in education level were less pronounced.

Of the four variables included in the second model, respondent's educational level was by far the most important predictor of age at first birth, with a beta value of 0.344. On average, women who had tertiary education would have the first birth about 5.6 years later than those with no schooling. The difference in the age at first birth between those with no schooling compared to those with some primary schooling was only 0.8 year.

The addition of premarital work in model 3 increases the explanatory power of the model to 23.4 per cent. Controlling for premarital work, the effects of respondent's educational level on timing of the first birth changed only slightly. If women had the same premarital work experience, those with tertiary education would have given birth slightly earlier (26.3 years instead of 26.7 years), while it makes little or no difference to those from other education categories. Compared with the second model, age at first birth among Chinese women would have declined by about 0.47 year in the third model, while that of Malay women would have increased slightly by about 0.22 year. This indicates that Chinese women were more likely to work before entering marriage as compared to Malay women. Controlling for education level and other variables in the third model, women who worked before marriage tended to give birth to their first child some 2.6 years later than those who did not work.

Adding husband's educational level (model 4) produces only slight changes compared to the earlier model. Controlling for husband's education adds a mere 1

percentage point to the explanatory power of the model. However, given the strong correlation in spousal educational level, the addition of husband's educational level tended to reduce the effects of wife's education on age at first birth rather substantially (see Table 4.3).

The addition of spousal age difference increases the variance explained by 6 percentage points. Based on the beta value, spousal age difference was the most important predictor of age at first birth, followed by respondent's educational level, premarital work and ethnicity (for Model 5). Women who married younger men would have their first birth about 3.4 years later than those who married men ten years their senior, after taking into account the effects of other variables in the fifth model. Comparing the results in the fourth and fifth models, it can be seen that part of the effects of wife's education and pre-marital work were mediated through spousal age difference.

In the final model in Table 4.3, the effects of each of the variables were examined net of age at first marriage. Given the high correlation between age at first birth and age at first marriage, adding the latter as covariate would have increased the explanatory power of the model to as high as 88 per cent. However, as the independent variables are all closely correlated with age at first marriage, model 6 shows that the effects of each of all these variables on age at first birth have diminished drastically had they married at the same age. Hence, it may be inferred that the differentials in age at first birth were largely caused by differences in age at

first marriage, and there would only be slight difference in the first birth interval (between marriage and first birth) for all segments of the Malaysian populations.

4.3 REGRESSION ANALYSES ON AGE AT FIRST BIRTH

In building a predictive model of age at first birth, a set of multiple regression models was estimated using both dummy and quantitative variables. The explanatory variables are birth cohort, ethnicity, place of residence, respondent's educational level, premarital work experience, husband's educational level, spousal age difference and age at first marriage. The six independent variables that are not measured in interval scale are recorded into dummy variables for inclusion in the regression equation. The dummy variables and their respective reference categories are shown in Table 4.4.

Table 4.4: Dummy Variables and the Corresponding Reference Categories

Dummy Variables	Reference Category
Birth Cohort	1961 – 1965
Ethnic Group	Indian
Place of Residence	Rural
Respondent's Educational Level	Tertiary
Premarital Work Experience	Never Worked
Husband's Educational Level	Tertiary

Stepwise regressions were used to select a parsimonious model. Three different graphs are produced in the process of testing the normality assumptions of the error terms. Histogram and P-P Plot of regression standardized residual show that the error term is approximately normally distributed. Heteroscedasticity does not

seem to pose serious problem in violating the assumptions for regression analysis since the graph of residual squared versus the predicted value does not show a systematic pattern (refer to Figure 4.3).

Figure 4.1: Histogram of Regression Standardized Residual

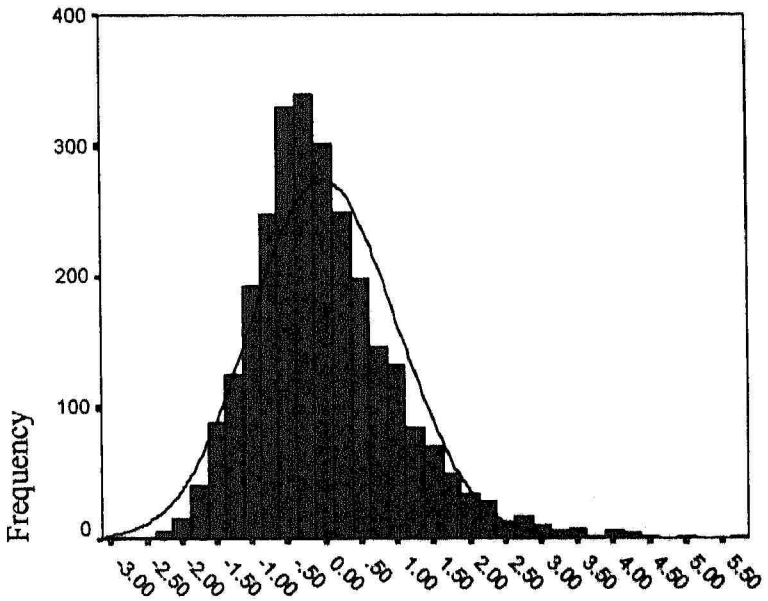

Figure 4.2: Normal P-P Plot of Regression Standardized Residual

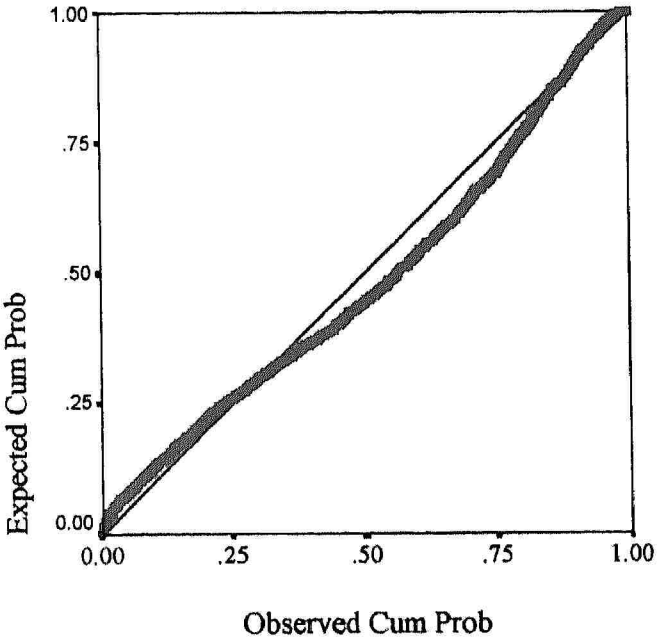

Figure 4.3: Pattern of Estimated Squared Residuals

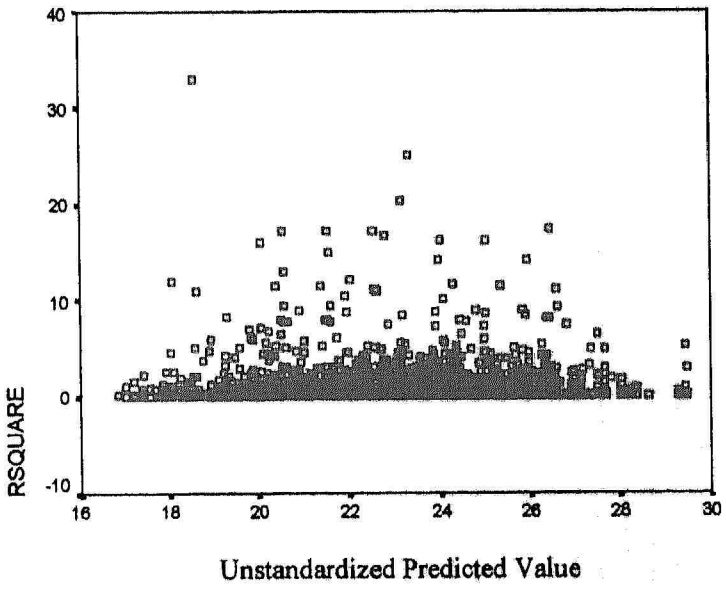

Table 4.5 shows the regression model of age at first birth on birth cohort, ethnicity, place of residence, respondent's educational level, premarital work experience, husband's educational level and spousal age difference. The R-square value shows that all the explanatory variables entered in the model explain some 28.2 per cent of the variation in age at first birth.

Premarital work, spousal age difference and respondent's educational level are the three most important factors affecting age at first birth, in that order. Controlling for all the other variables, women who had ever worked before marriage would have delayed their first birth by 2.3 years as compared to those had never worked. An increase of one year in spousal age difference would result in a reduction of age at first birth by 0.18 year, ceteris paribus. Women with no schooling would have their first birth about 3.38 years earlier compared to those with tertiary education, while those with primary and secondary education would have their first birth 3.98 years and 1.82 years earlier respectively, as compared to those with tertiary education.

Table 4.5: Model 1 of the Ordinary Least Squares Regression on the Age at First Birth of Women Aged 30 Years and Above with at Least One Live Birth

Analysis Of Variance					
Dependent Variable : Age at First Birth					
Sources	df	Sum of Squares	Mean Squares	F-Value	Sig.
Explained	12	15211.98	1267.665	89.732	.000
Residual	2735	38638.13	14.127		
Total	2747	53850.11			
R-Square	0.282		Standard Error of the Estimates		3.76
Adjusted R-Square	0.279				
Parameter Estimates					
Variables		B	Std. Error	T-Test	Sig.
Constant		23.963	0.352	68.085	.000
Premarital work		2.276	0.166	13.711	.000
Spousal age difference		-0.179	0.014	-12.455	.000
Woman no schooling		-3.382	0.324	-10.437	.000
Woman primary education		-3.976	0.400	-9.947	.000
Chinese		1.095	0.168	6.520	.000
Woman secondary education		-1.816	0.305	-5.955	.000
Urban		0.538	0.156	3.440	.001
Birth Cohort: 1951 – 1955		0.917	0.219	4.190	.000
Husband's primary education		-0.513	0.176	-2.908	.004
Birth cohort: Before 1951		0.836	0.219	3.813	.000
Birth cohort: 1956 – 1960		0.681	0.201	3.385	.001
Husband no schooling		-0.807	0.385	-2.095	.036

In terms of ethnicity, the model shows that Chinese women would have their first birth about 1.1 years later than the Indian women. Urban women would have their first birth half a year later than their rural counterparts, ceteris paribus. Contrary to expectation, older women who were born before 1961 had their first birth later than those who were born in 1961–1965, largely due to the censoring and truncation effects. As noted earlier, women in the younger cohort who had not given birth at the

time of the interview may give birth at later age. Women's age at first birth also varies significantly according to husband's educational level.

Table 4.6 presents the second multiple regression model of age at first birth on all the earlier predictor variables, with the addition of age at first marriage. As expected, there is a strong direct effect of age at first marriage on age at first birth. The proportion of variance explained increases significantly and the standard error of the estimates is reduced to 1.55.

The estimated equation obtained is:

Age at First Birth = 3.050 + 0.944 (Age at First Marriage) – 0.270(Woman's Primary Education) – 0.177 (Husband's Secondary Education) – 0.341(Woman No Schooling) + 0.262(Born Before 1951) + 0.258(Born in 1951 – 1955) + 0.147 (Premarital Work)

The equation shows that, by holding all the other variables constant, an increase of 1 year in age at first marriage would increase age at first birth by 0.94 year. A comparison of the coefficients of all the other variables in Model 1 and Model 2 shows that effects of all other variables were reduced substantially with the inclusion of age at first marriage (see Tables 4.5 and 4.6).

Table 4.6: Model 2 of the Ordinary Least Squares Regression on the Age at First Birth of Women Aged 30 Years and Above with at Least One Live Birth

Analysis Of Variance					
Dependent Variable : Age at First Birth					
Sources	df	Sum of Squares	Mean Squares	F-Value	Sig.
Explained	7	47275.42	6753.631	2814.574	.000
Residual	2740	6574.69	2.400		
Total	2747	53850.11			
R-Square	0.878		Standard Error of the Estimates		1.55
Adjusted R-Square	0.878				
Parameter Estimates					
Variables		B	Std. Error	T-Test	Sig.
Constant		3.050	0.172	17.745	.000
Age at First Marriage		0.944	0.008	123.372	.000
Woman Primary Education		-0.270	0.069	-3.932	.000
Husband's Secondary Education		-0.177	0.064	-2.778	.006
Woman No Schooling		-0.341	0.113	-3.001	.003
Birth Cohort: Before 1951		0.262	0.075	3.501	.000
Birth Cohort: 1956 – 1960		0.258	0.077	3.375	.001
Premarital Work		0.147	0.069	2.134	.033

4.4 LOGISTIC REGRESSION ANALYSES OF THE PROPORTION WHO HAD FIRST CHILD BY AGE 25

In this section, the probability that a woman would have her first birth by age 25 will be analyzed with the use of logistic regression. With dichotomous dependent variables, the assumptions necessary for hypothesis testing in regression analysis are necessarily violated. For example, it is unreasonable to assume that the distribution of errors is normal. Another difficulty with multiple regression analysis is that predicted values cannot be interpreted as probabilities. They are not constrained to fall in the interval between 0 and 1.

Table 4.7 shows the logistic regression estimates of the effects of the independent variables on the likelihood of giving birth by age of 25 years. The odds of giving birth by age 25 years is the ratio that a woman who had given birth by age 25 to those who had given birth after age 25. A positive coefficient indicates an increase in the probability of giving birth by the specified age. On the other hand, a negative coefficient indicates a decrease in the log odds of giving birth by age 25.

By using dummy variables, the coefficient for the new variables represent the effect of each category compared to a reference category. Table 4.7 shows that the coefficient for Malays is the change in log odds when we compare the Malays with the Indians, ceteris paribus. Similarly, the coefficient for Chinese is the change in log odds when we compare the Chinese with the Indians. The coefficient for Indians is necessarily 0, since it does not differ from itself. It is evident that the probabilities of

a woman giving birth by age 25 years is lowest for the Chinese and highest for the Malays. Compared with the Indians, the Chinese show a decrease in the odds ratio by about 3 per cent, while the Malays an increase in the odds ratio by about 97 per cent when the values of the other independent variables are held constant.

The likelihood of a woman giving birth by age 25 years is lower for those who lived in the urban areas as compared to those who lived in the rural areas, with a decrease in the odds ratio by about 30 per cent.

With regard to education, women with higher education were less likely to give birth before age 25 as compared to those with little or no schooling. For instance, the odds of giving birth by age 25 years is 6.65 times higher for women with no formal education compared to women with tertiary education.

Women who never worked before marriage were more likely to give birth by age 25 as compared to those who worked. The effect of husband's educational level on women's age at first birth is not very significant. However, the probability of a women giving birth by age 25 was lower for those whose husband's are highly educated. As for the age difference between spouses, those with smaller age gaps are less likely to give birth by age 25.

Table 4.7: Logistic Regression Analysis on the Likelihood of Giving Birth by Age 25 Years Among Women Aged 30 Years and Above with at Least One Live Birth

Variables	Coefficients β	Standard Error	Sig.	Exp(β)
Ethnic Group				
Malays	0.679	0.158	0.000	1.973
Chinese	-0.034	0.168	0.836	0.967
Place of Residence				
Urban	-0.361	0.107	0.001	0.697
Education Level				
No Schooling	1.895	0.295	0.000	6.652
Primary	1.480	0.225	0.000	4.393
Secondary	1.008	0.205	0.000	2.739
Premarital Work Experience				
Never Worked	0.992	0.132	0.000	2.697
Husband's Education				
No Schooling				
Primary	0.155	0.332	0.641	1.167
Secondary	0.412	0.199	0.038	1.510
	0.293	0.176	0.095	1.341
Spousal Age Difference				
Husband younger than wife	-1.478	0.224	0.000	0.228
0 to 5 years	-0.380	0.209	0.069	0.684
6 to 10 years	0.200	0.225	0.374	1.221
Constant	-0.488	0.319	0.126	0.614

Reference Categories: Indians, Rural, Tertiary Education Level, Worked Before, and More than 10 Years (Spousal Age Difference)

One way to assess how well the model fits is to compare the predictions to the observed outcomes.

Table 4.8: Classification Table for Age at First Birth

Observed		Predicted		
		Age at First Birth		Percentage Correct
		> 25 years	≤ 25 years	
Age at First Birth	> 25 years	263	487	35.1
	≤ 25 years	138	1791	92.8
			Total	76.7

The Cut Value is 0.50

Table 4.8 shows that overall, 76.7 per cent of the 2679 women were correctly classified. The model correctly predicted 263 out of 401 women who gave birth after age 25. Similarly, 1791 out of 2278 women were correctly predicted to give birth by age 25. The off-diagonal entries of the Table 4.8 show the number of women who were incorrectly classified.

4.5 SUMMARY

The results obtained from analysis of variance shows that the differentials in age at first birth across categories of the selected independent variables (birth cohort, ethnicity, place of residence, woman's educational level, premarital work experience, husband's educational level and spousal age difference) were statistically significant when age at first marriage was not taken into account (refer to Table 4.1). Table 4.2 shows that some of the variables (ethnicity, place of residence, spousal age difference) became insignificant once age at first marriage is added into the model. Given a very close association between age at first marriage with the dependent and independent variables, it is to be expected that most of the effects of background characteristics would be mediated through age at marriage.

The results of multiple classification analyses, using six different models, support the evidence that the differentials in age at first birth were largely caused by differences in age at first marriage. Because of the statistical overlap between these two variables (age at first marriage and age at first birth), two separate multiple regression models were obtained. Model 1 in Table 4.5 shows that the three most important factors affecting first birth given as premarital work, spousal age difference and women's educational level. Besides that, urban place of residence and husband's educational level were also significantly related to age at first birth. Including age at first marriage into Model 2 (Table 4.6) increases the explanatory power of the model very substantially. However, the effects of all other variables are reduced drastically.

This indicates that the effects on age at first birth of most socio-demographic variables are mediated through age at first marriage.

Finally, logistic regression analysis shows that the Malays, those who grew up in rural areas and those who never worked before marriage have higher probability of giving birth by age 25 years. Women with tertiary education were very much less likely to give birth before age 25 as compared to those with lower education.