EVALUATION OF THE PEARSONIAN TYPE I CURVE OF FERTILITY BY AGE OF WOMEN OF ABORIGINAL IDENTITY GROUPS IN CANADA, 1996-2001

By
Ravi B. P. Verma and Shirley Loh
Development and Demographic Methods Section
Demography Division, Statistics Canada, Ottawa, Ontario, Canada K1A 0T6
Email: vermrav@statcan.ca

Abstract

In 2005, Statistics Canada published new projections of the Aboriginal Populations (North American Indians, Métis and Inuit) in Canada, Provinces and Territories: 2001 to 2017. To derive the number of births in these projections, the age-specific fertility rates were simulated by fitting the Pearsonian Type I curve using the fertility parameters: total fertility rates, mean and modal ages of fertility. These parameters were estimated for 2001 by the own-children method using data on children aged 0-4 and women within the age groups, 15-49 from the 2001 Census of Canada. The purpose of this paper is to evaluate the goodness of fit between the age-specific fertility rates developed by the Type I curve and the estimated age-specific fertility rates for Aboriginal identity groups for the period 1996-2001 at the Canada level and two fertility regions. Tests of validity of the Type I curve will be addressed in the paper.

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Extended Abstract

1. Introduction

In 2005, Statistics Canada published new projections of the Aboriginal populations (North American Indians, Métis and Inuit) in Canada, provinces and territories: 2001 to 2017 (see, Statistics Canada, 2005). These projections are also produced by types of residence, namely on-reserve, Census Metropolitan Areas (CMAs), non-Census Metropolitan Areas (NCMAs) urban and rural areas. It is estimated that in 2001, 1,066,500 people identified themselves as Aboriginal in Canada. According to selected scenarios based on demographic factors, by 2017 this number could increase to between 1,390,200 and 1,431,800. Compared with the total Canadian population, the Aboriginal population is likely to continue its faster growth, 1.8% vs. 0.7% per annum. Under the medium growth scenario, the North American Indians group was projected to increase from 713,100 in 2001 to 971,200 in 2017, the Métis from 305,800 in 2001 to 380,500, and the Inuit population was projected to grow the fastest, reaching 68,400 in 2017 from 47,600 in 2001.

The higher growth of the aboriginal population was largely due to the higher fertility over the Canadian population. The number of births in these projections are based on the age-specific fertility rates simulated by fitting the Pearsonian Type I curve using three parameters: total fertility rates , mean and modal ages of fertility. Due to the unavailability of vital statistics for the three Aboriginal identity groups in Canada, these parameters of fertility were projected based on estimated fertility rates by five year age groups generated by the own-children method using data on the number of children aged 0-4 and the number of women by age groups, 15-49 from the 2001 Census of Canada.

For the general Canadian population, it was observed that when the mean age of fertility rates were consistently larger than the modal age , the distribution of age-specific fertility rates could be reasonably well approximated by the Pearsonian Type I curve (Verma and Loh, 1992 , Verma et al 1996, Statistics Canada,1975). This curve was being used in Canada until the release of the population projections for Canada, provinces and territories, 1993-2016 (Statistics Canada, 1994). For this and subsequent publications on population projections (Statistics Canada,1994 and 2001) the Pearsonian type III curve was being used to graduate the age-specific fertility rates, as the mean and modal ages of fertility were approaching similar values for the Canadian population. However, for the Aboriginal identity groups, it is estimated that the mean ages of fertility in 2001 for the North American Indians, Métis and Inuit women were 26.29, 26.31 and 28.40 years, respectively which were considerably higher than their respective modal ages of 21.90, 22.93 and 23.38 years. So, we decided to graduate age–specific fertility rates based on the Type I curve to project the number of births. However, the goodness of fit of the Type I curve for the aboriginal populations was not examined. Therefore, two questions are explored in this paper. How well does the Type I curve fit the estimated age-specific fertility rates? What will be the level of closeness of fit between the derived number of births from the Type I curve and the estimated number of births using the own-children method? The findings of this research will be useful to assess the quality of the projected aboriginal population, particularly the projected number of births.

In the following sections, we will describe the data sources and methods, results and concluding remarks.

2. Sources of data and Methodology

In Canada, the most comprehensive source on births is birth registration data compiled by the Health Statistics Division of Statistics Canada. Unfortunately, this dataset does not provide information on the fertility of populations defined by their Aboriginal identity. In fact, direct data on the fertility of the Aboriginal peoples are not available. Indian and Northern Affairs Canada (INAC) compiles data on the First Nations (Registered Indian) population through the Indian Registry database, but there is no administrative source specific to the Non-Status Indian, Métis or Inuit populations. To maintain internal consistency for all three aboriginal groups, birth data from the Indian Registry system were not used in this paper. Instead, we used the 2001 Census data and an indirect technique, known as the "own-children method" to derive the fertility level of the three Aboriginal groups (Grabile and Cho, 1965 Cho, Grabile and Bogue, 1970, Cho, 1971, 1973, Ram, 1991, 2003, 2004, Ram and Romaniuc, 1985). Also, we calculated the mean and modal ages of fertility required by the Pearsonian Type I curve of fertility in the projection model of Statistics Canada.

2.1 Pearson's System of Frequency Curves

An effective approach to select a particular type of Pearson's curve is by examining the κ, β_1 and β_2 criteria and then estimate the parameters of that distribution by Maximum Likelihood (Stuart and Ord, 1987, Elderton 1930, Verma and Ford 1992, Verma and Loh, 1992).

2.2 The Kappa Criterion

The κ criterion is given by

$$\frac{\beta_1(\beta_2+3)^2}{4(2\beta_2-3\beta_1-6)(4\beta_2-3\beta_1)}$$

$$\beta_1=\frac{\mu_3^{\,2}}{\mu_2^{\,3}}$$

$$\beta_2=\frac{\mu_4}{\mu_2^{\,2}}$$

μ_2, μ_3, and μ_4 are the second, third and fourth moments about the mean. The kappa criterion measures the extent of deviation from the symmetrical curve. A negative value of kappa indicates that the curve in question is negatively asymmetrical while a positive value of kappa indicates that the curve is positively asymmetrical. The κ criterion may have any value from $-\infty$ to $+\infty$, and the different types of Pearsonian curves cover all these possible values without overlap.

We have computed kappa values from age-specific fertility rates for the three Aboriginal groups for the period 1996-2001 at the Canada level and its two fertility regions, high and low levels. (See, Table 1). For each area, the kappa values are negative for each group and the total aboriginal population.

The decision process to select a Pearson curve using the kappa value is not always reliable. The value of kappa is found to be abnormal when the value of $2\beta_2 - 2\beta_1 - 6$ is in the neighbourhood of zero (Mitra, 1992). In view of this, Verma and Ford (1992) explored the values of β_1 and β_2 to determine the appropriate curve which will best fit the fertility data.

2.3 β_1 and β_2 Coefficients

Stuart and Ord (1987) have also devised a β_1 and β_2 chart for the Pearson system. From the chart, it appears that the Type I should be accepted under the following limits of β_1 and β_2.

For Type I, $\beta_1 > 0$, $2 < \beta_2 < 3$.

At the Canada level and its two fertility regions, analyses of the β_1 coefficients showed that they are all positive for each aboriginal identity groups (See Table 1). The β1 coefficients are very low.

In general, β_2 coefficients of the fertility distribution computed for each aboriginal identity group are between 2 and 3 (see Table 1).

The values of the above-mentioned three parameters of fertility distribution support that regardless of fertility regions, the Type I curve is an appropriate curve for graduating age-specific fertility rates for each aboriginal identity group in Canada.

2.4 Method of Fitting Pearsonian Type I Curve

The method of graduating the distribution of age-specific fertility rates from given values of total fertility rates, the mean and the modal age is based on two assumptions. First, the distribution can be approximated by a Pearsonian Type I curve and second the fertility curve is bounded by ages 15 and 50.

The Type I curve can be expressed as:

$$Y = Y_0 \left(1 + \frac{x}{a_1}\right)^{m_1} \left(1 - \frac{x}{a_2}\right)^{m_2} \qquad (1)$$

$$a_1 \leq x \leq a_2$$

Where x is measured as the deviation from the mode, it follows that the specification of the mode immediately determines a_1 and a_2 due to the second assumption as

$$a_1 = \text{mode} - 15$$

and, $$a_2 = 50 - \text{mode} \qquad (2)$$

The origin at the mode also imposes restriction in the parameters, namely

$$\frac{m_1}{a_1} - \frac{m_2}{a_2} \qquad (3)$$

The density function as shown in (1) will be used to produce graduated age-specific fertility rates for each Aboriginal group in Canada and the two fertility regions. The results will be shown in Table 2.

Table 1 Fertility rates per 1,000 women (by Own Children Method) by age group and summary measures (TFR, mean age, modal age, B1, B2 and K values) for Aboriginal identity groups in two fertility regions in Canada, 1996-2001

	Total Canada				High Fertility Regions (1)						Low Fertility Regions (2)		
	Total Aboriginal	North American			Total Aboriginal	North American		Inuit			Total Aboriginal	North American	
Age Group	Population	Indian	Métis	Inuit	Population	Indian	Métis	N.L.	Que.	Territories	Population	Indian	Métis
15-19	82.86	94.13	59.17	82.64	99.00	120.69	66.81	63.53	81.43	91.16	73.74	81.61	55.13
20-24	169.64	182.05	140.71	178.49	200.29	230.52	155.40	156.16	173.25	203.04	152.38	159.78	132.30
25-29	141.61	145.62	126.43	165.59	162.17	170.93	141.53	151.50	183.27	175.65	130.72	134.70	118.07
30-34	85.18	89.01	71.02	113.74	94.75	96.45	79.96	81.21	140.48	116.95	80.99	86.37	67.04
35-39	38.28	41.47	28.27	65.11	49.56	53.32	35.42	5.42	98.46	83.66	33.09	37.18	24.51
40-44	14.28	16.40	6.70	49.36	22.05	25.90	5.88	3.87	69.85	61.22	11.06	13.26	6.85
45-49	3.00	2.70	1.99	18.31	4.54	3.72	0.88	0.00	23.77	23.79	2.48	2.53	2.38
TFR	2.67	2.86	2.17	3.37	3.16	3.51	2.43	2.31	3.85	3.78	2.42	2.58	2.03
Mean Age	26.39	26.29	26.31	28.40	26.55	26.24	26.30	25.59	29.49	28.68	26.37	26.41	26.31
Modal Age	23.80	21.90	22.93	23.53	23.46	20.98	23.11	23.38	25.22	23.28	24.11	22.50	22.87
B1 Value	0.37	0.38	0.30	0.26	0.41	0.48	0.22	0.09	0.10	0.23	0.32	0.32	0.34
B2 Value	2.90	2.86	2.99	2.44	2.86	2.89	2.75	2.91	2.19	0.23	2.89	2.82	3.09
K - Value	-0.23	-0.22	-0.26	-0.11	-0.23	-0.25	-0.15	-0.16	-0.04	-0.09	-0.22	-0.20	-0.33

Notes: (1) High Fertility Regions: Manitoba, Saskatchewan, Yukon Territory, Northwest Territories and Nunavut
(2) Low Fertility Regions: Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Alberta, and British Columbia

2.5 Tests of Validity

Besides using the two criteria to select a best fit model, in Table 3 we will compute and compare the ratios of the estimated number of births based on own-children method to the number of births generated by the Type I model for the same period.

3. Results

Tests of goodness of fit are in progress. For the general Canadian population, a comparison of the annual number of births for the period 1926-1970 generated by the Pearsonian Type I curve and the actual number of births for the same period was performed by Romaniuk (1975). The tests show that, in the whole, the values derived from the model almost coincide with the actual values, there are only a few deviations of 1%, and deviations of 2% are rare.

4. Concluding Remarks

The values of the three parameters of fertility distribution (κ, β_1 and β_2 criteria) support that regardless of fertility regions, the Type I curve is an appropriate curve for graduating age-specific fertility rates for each aboriginal identity group in Canada. The ratio of the number of births generated from the model (Type I curve) and estimated number of births based on own-children method multiplied by 100 is expected to deviate very little from 100%.