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Evaluating Fluctuations in Sex Ratios at Birth in Small Areas

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The sex ratio at birth is an important analytical measure across several disciplines such as biology, genetics, sociology and demography. As a demographic measure it can provide valuable information regarding other demographic trends. For example, the doubling time of a population rises as the ratio of males to females at birth increases. As the number of males in an area increases over time, it can lead to a marriage squeeze and slow the overall natural increase in a population. Data on sex ratio at birth has also been used to understand trends in low birth weight and infant mortality since male babies have higher infant mortality rates. (Mathews and Hamilton, 2005)

The sex ratio at birth can also be indicative of other societal trends. An extremely imbalanced sex ratio at birth has been associated with a son preference in some Asian countries (Anderson and Silver, 1995; Belanger et al., 2003; Goodkind, 2004). While in Nordic countries, there is some evidence of a relationship between birth order and gender preference (Andersson et al., 2006).

Globally, national sex ratios at birth tend to fluctuate very little. While this contributes to the usefulness of the sex ratio at birth as an analytical measure, it has left relatively unexamined how sex ratios at birth in smaller geographies can fluctuate considerably from year to year. There has been little research to document or understand the magnitude of variations in sex ratios below a national level. A reliable evaluation measure of the sex ratio at birth at lower levels of geography could prove to be very helpful in identifying any potential data quality or methodological concerns in research utilizing sex ratio at birth as an analytical measure.

Using a theoretical model to calculate probability ranges of sex ratios at birth, this research examines how well actual birth data from several countries over a series of years matched the model's probability ranges, given the randomness of the outcome of a male birth compared to a female birth for any given number of births. The model assumes a binomial distribution of births, using the expected outcome of 105 male births for every 205 total births. Then, setting bounds for the probability ranges, the actual birth data are matched against the probability ranges to examine how the birth data compare to the probabilities in the theoretical model. At the lower bound, the probability range was set at 90%. At the upper bound, the probability range was set at 99%. The expectation of the model is one to ten percent of the geographies examined in the data would have sex ratios at birth that would fall outside the expected number of births in any given year. However, since an assumption of this research is sex at birth is a random event, there should be no pattern in which geographies fall beyond the bounds set by the model.

The model is tested with vital statistics and/or census data from the United States, Denmark and Kenya. U.S. Census data at the county level from 2000 and 2010 and Kenyan Census data at the division or constituency level from 1989, 1999, and 2009 on reported zero year olds by sex are compared to the theoretical model. U.S. vital statistics data on births by sex at the county level from 2000 – 2009 and Danish vital statistics data on births by sex at the municipality level from 2000 – 2009 are also compared

to the theoretical model. If time permits, additional years of vital statistics from the U.S. and Denmark will be included as well as additional countries for a more robust analysis of the model.

Initial findings indicate the model can provide meaningful bounds of "statistical significance" in sex ratios at birth. The model has provided insight into how sex ratios at birth in smaller geographies behave, where births are infrequent events in any given year. Annual fluctuations in sex ratios at birth, in many counties, previously thought to be problematic, are found to be within the expected bounds set by the probability model. Conversely, the sex ratio at birth in areas with a very high number of births are found to have a much narrower range of acceptable fluctuation than previously understood. For example, the model indicates it takes almost 58,000 births to achieve an expected sex ratio range of 104 – 106, at the 90 percent threshold in the model. There are only 4 counties in the United States that regularly have approximately that number of births each year. The majority of counties in the United States have less than 500 births a year. At the 90 percent threshold for 500 births, the model predicts a sex ratio at birth between 91 and 121 would be acceptable.

The number of male births compared to the total number of births can also be adjusted in the model to reflect a different national sex ratio at birth for a country and the model still provides statistically sound results.

A model such as this can be a valuable evaluation tool in research and estimates production. It would allow researchers to focus on sex ratio outliers that may indicate real data problems rather than those due to random chance.

Works Cited

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