

Lecture 14: Stages and Limitations

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STAGES IN MODELLING

Modelling requires a through review of what is known and what is not known. Then the process to be modelled is analysed and represented in the form of mathematical equations, statistical relationships and/or probability distributions. The equations would contain some unknown characteristics of the population to be modelled. They are estimated using an appropriate method of fitting. This is followed by testing whether the model reproduced the old data accurately. If it did, then the model can be used for predictions or theorising. Thus modelling is done in four steps:

- specification of model;
- estimation of parameters;
- validation;
- and forecasting.

LIMITATIONS OF MODELLING

Modelling has certain limitations. The first and foremost is the limitation caused by lack of perfect measurements. This problem is a general problem of mathematical social sciences and is not unique to population studies. Regression models for different measures of fertility, for example, may provide very different results. Therefore, demographers have to select their dependent and independent variables carefully.

Accuracy of models depends on whether the process has been correctly specified, whether observed data are accurate, whether appropriate method of fitting is used, and whether the fitness of the model to data is good. Error creeping in the modelling at any stage will introduce error in the results of modelling. Lack of literature, lack of reliable data or lack of data of certain kind, and inappropriate specification or curve fitting will cause serious problems.

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When the validation of the model is made on the basis of past data, the used length of historical period may influence the results. One has to pay attention to periods and causes of abrupt and irregular changes, if irregular changes can be isolated, plausibility of outcomes, and whether the recent changes observed in the study variables justify the outcomes (Jansen and Kunst, 2007).

A serious limitation of modelling in population studies is that statistical data are not available on measures of socioeconomic changes used by sophisticated socioeconomic theories such as mobility strategies, opportunity cost of time spent with children, and non-familial mechanisms for obtaining labour and insuring against risk (Bryant, 2007). Correlation between fertility and growth of GDP per capita may not capture the process by which couples tend to limit family size in order to avoid further impoverishment.

CONCLUSION

Modelling in population studies has helped in answering questions which could not be answered due to lack of data, or even lack of possibility of observations and experimentation. Yet, the models have certain limitations. The prediction based on models depends on various factors including state of art understanding in the field, nature of models employed, and accuracy of data. Modelling is a growing field of research and more and more advanced models have been developed in different branches of population to take care of advanced understanding of the subject, and to benefit from richer data available from diverse sources. Modelling will never be sociology particularly because they cannot help in understanding the subjective worldview of people.

Questions and Exercises

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1. What is model? How does model building advance knowledge in a particular field?
2. What is the difference between mathematical and statistical models?
3. Describe the assumptions of stable population model? When does a stable population become stationary?
4. How did stable population model help in indirect estimation of fertility and mortality rates for countries for which reliable data were lacking?
5. What are current issues in modelling of demographic processes?
6. Discuss the major limitations of mathematical modelling.
7. What is logistic growth model? For what purposes was logistic model used?
8. Describe Zipf's model of migration. What improvements were made in this model to fit the empirical data?
9. What are Ravenstein laws of migration?
10. What is Brass's method of estimating total fertility rate?

References

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- Alho, Juha M., and Spencer, Bruce D., 2005. *Statistical Demography and Forecasting*. New York: Springer.
- Arthur, W. Brian, and McNicoll, Geoffrey, Large Scale Simulation Models in Population and Development: What Use To Planners? *Population and Development Review*, Vol.1, No. 2: 251-265.
- Bongaarts, John, 2006, How Long will we Live? *Population and Development Review*, Vol. 32, No. 4: 605-628.
- Bongaarts, John, Buettner, Thomas, Heilig, Gerhard, and Pelletier, Francois, 2008, Has the HIV Epidemic Peaked? *Population and Development Review*, Vol. 32, No. 4: 199-224.
- Brass, W., 1979, Screening Procedures for Detecting Errors in Maternity History Data. In United Nations, Regional Workshop on Techniques of Analysis of World Fertility Survey Data, *Asian Population Studies Series No. 44*, Economic and Social Commission for Asia and the Pacific, United Nations.
- Bryant, John, 2007, Theories of Fertility Decline and the Evidence from Development Indicators. *Population and Development Review*, Vol. 33, No. 1: 101-127.
- Coale, Ansley, J., and Hoover, Edgar M., 1958, *Population Growth and Economic Development in Low-Income Countries*. Princeton: Princeton University Press.
- Crimmins, E.M., 2005, Socioeconomic Differentials in Mortality and Health at the Older Ages. *Genus*, Vol. LXI, No. 1: 149-183.
- Dorigo, Guido, and Tobler, 1983, Waldo, Push Pull Migration Laws. *Annals of the Association of American Geographers*, Vol. 73, No.1: 1-17.
- Gabrielli, G. and Borgoni, R., 2007, Age at First Sexual Intercourse in Italy: A geographical approach. *Genus*, Vol. LXIII, No. 2: 149-183.
- Guo, Guang, and Harris, Kathleen Mullan, 2000, The Mechanisms Mediating the Effects of Poverty on Children's Intellectual Development. *Demography*, Vol. 37, No. 4: 431-447.

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Halli, Shiva S., and Rao, K. Vanandha, 1992, *Advanced Techniques of Population Analysis*. New York: Plenum Press.

Jansen, Fanny, and kunst, Anton, 2007, The Choice among Past Trends as a Basis for the Prediction of Future Trends in Old-Age Mortality. *Population Studies*, Vol. 61, No. 3: 315-326.

Judson, D.H., and Popoff, Carole L., 2004, Selected General Methods. In Siegel, Jacob S., and Swanson, David A. (eds.), *The Methods and Materials of Demography, Second Edition*. New York: Elsevier Academic Press.

Kendall, David G., 1949, Stochastic Processes and Population Growth. *Journal of Royal Statistical Society*, B, 11.

Keyfitz, Nathan, 1968, *Introduction to the Mathematics of Population*. London: Addison-Wesley Publishing Company.

Keyfitz, Nathan, 1975, How Do We Know the Facts of Demography? *Population and Development Review*, Vol. 1, 2: 267-288.

Keyfitz, Nathan, and Hal, Caswell, 2005, *Applied Mathematical Demography, 3rd edition*. New York: Springer.

Knud, Juel, 1983, Demographic Factors and Cancer Mortality. A Mathematical Model for Cancer Mortality in Denmark 1943-78. *International Journal of Epidemiology*, Vol. 12, 4: 419-425.

Krishnamoorthy, S., 1989, Estimation of Fertility of Parents Generation from Data on Surviving Siblings. In Singh, S.N., Premi, M.K., Bhatia, P.S. and Bose, Ashish (eds.), *Population Transition in India*, Delhi: B.R. Publishing Corporation.

Leach, Donald, 1981, Re-Evaluation of the Logistics Curve for Human Populations. *The Journal of the Royal Statistical Society*, Series A (General), Vol. 144, No. 1: 94-103.

Lutz, W. Sanderson and Scherbov, S., 2003, The End of World Population Growth. *Vienna Yearbook of Population Research, 2003*, Vienna Institute of Demography, Austrian Academy of Sciences, Vienna: 1-18.

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Lutz, Wolfgang, and Scherbov, Sergei, 2005, Will Population Ageing Necessarily Lead to an Increase in The Number of Persons with Disabilities? *Vienna Yearbook of Population Research*, 2005, Vienna Institute of Demography, Austrian Academy of Sciences, Vienna: 243-259.

Mensch, Barbara S., Grant, Monica J., and Blanc, Ann K., 2006, The Changing Context of Sexual Inclination in Sub-Saharan Africa. *Population and Development Review*, Vol. 32, No. 4: 699-727.

Misra, B. D., 1980, *An Introduction to the Study of Population*. New Delhi: South Asian Publishers Pvt. Ltd.

Nath, D.C., 1989, A Two-Sex Quasi-Stable Population in the Presence of Immigration. In Singh, S.N., Premi, M.K., Bhatia, P.S. and Bose, Ashish (eds.), *Population Transistion in India*, B.R. Publishing Corporation, Delhi.

Pathak, K.B. and Ram, F.1989, An Application of Life Approach in the Analysis of Fertility in India. In Singh, S.N., Premi, M.K., Bhatia, P.S. and Bose, Ashish (eds.), *Population Transistion in India*, B.R. Publishing Corporation, Delhi.

Pathak, K.B., 1989, Some Approaches to Estimate Levels and Tempo of Fertility from Data on the Current Status of Women. In Singh, S.N., Premi, M.K., Bhatia, P.S. and Bose, Ashish (eds.), *Population Transistion in India*, B.R. Publishing Corporation, Delhi.

Ravenstein, E. G., 1885, The Laws of Migration. *Journal of the Statistical Society of London*, Vol. 48, No. 2.

Ravenstein, E. G., The Laws of Migration, 1889. *Journal of the Royal Statistical Society*, Vol. 52, No. 2.

Roy, T.K., 1987, Measurement of Trends in Fertility – an Overview. In Saxena, P.C., and Talwar, P.P. (eds.), *Recent Advances in the Techniques for Demographic Analysis*, Bombay: Himalaya Publishing House.

Shryock, Henry S., Siegel, Jacob S., and associates, 1971, *The Methods and Materials of Demography*. New York: U.S. Bureau of Census.

Smith David, and Keyfitz, Nathan, 1977, *Mathematical Demography*. Berlin: Springer-Verlag.

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Smith, David P., 1992, *Formal Demography*. New York: Plenum Press.

Stouffer, Samuel A., 1940, Intervening opportunities: Mobility and distance. *American Sociological Review*, Vol. 5.