

*HOW ACCURATELY CAN WE FORECAST
WHETHER SINGAPORE WILL ACHIEVE ITS
TARGET POPULATION OF 6 MILLION BY
THE YEAR 2020 ?*

Mathematics Extended Essay

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Introduction

In Singapore, population is of great importance, as evident of Singapore's Government's relentless implementation of policies that promote population growth such as the "Baby Bonus" subsidy or the "National Night" propaganda. The main reason why Singapore regards the country's population with such high importance is due to it having a positive impact on the country's economy. The only natural resource Singapore produces is educated people, more specific, skilled workers. Singapore is also a first world country which tend to have an ageing population, this would be bad for the county's economy. During this investigation, I will explore 2 different analysis methods and their ability to forecast Singapore's population. With the values collected from the application of each of the methods, I will then compare them with actual data on Singapore's population to establish which method is more effective in forecasting population values in the short run. The established method will then be used to forecast the value of Singapore's population in the year 2020.

Context

In an attempt to accurately project Singapore's population effectively, an equation for Singapore's must first be established. The population of a country in year n can be calculated from the population of the previous year P_{n-1} added to the net migration into the country M_n in year n as well as the natural increase in the population N_n in year n . In a particular year n , M_n can be calculated from the number of migrations into

the country I_n subtracted by the number of migrations out of the country E_n and N_n can be calculated from the number of births B_n subtracted the number of deaths D_n .

$$P_n = P_{n-1} + (I_n - E_n) + (B_n - D_n)$$

The formula for the population of a country in year n , will be the following.

$$P_n = P_{n-1} + M_n + N_n$$

For this formula to work, the assumption that non-resident population, population living outside of Singapore, is accounted for with the total population.

Time series analysis

1.0 Introduction to time series analysis

A univariate time series are a sequence of observations of a variable over different discrete times made in regular time intervals. Time series analysis is the statistical technique which recognises data trends, called time series decomposition, allowing us to adjust our forecast of future data points in the time series accordingly. There are a number of standard linear time series models that have been developed in an attempt to capture behaviours observed with time series data. An autoregressive process (AR) which involves regressing a variable on its own previous values, a moving average process (MA) which involves modelling the error term through a linear combination of error terms at various previous points in time as well as those occurring simultaneously and an autoregressive moving average process (ARMA), as the name suggests, involves both of these. Following a report “Modelling and forecasting population by time series: the Swedish case” (Joao L. M. Saboia, 1974) which projects the population of Sweden using ARMA, similarly I will use ARMA to forecast Singapore’s population. In this essay, the aim in using time series analysis, is to create time series models from available data for M_n and N_n . From these models, we can