

**NANYANG TECHNOLOGICAL UNIVERSITY**

**EE5087 Living with Mathematics**

**REPORT**

**Topic of Project:**

**Income affecting Birth Rates**

Group Number: 7

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# Introduction

In recent years, Singapore suffered a decline in birth rate. This can be due to various factors including employment related matters. Thus, this report aims to find a connection between newly graduates starting salary to the birth rate of Singapore. Linear Regression will be used to predict the birth rates Singapore might observe soon. Additionally, this report also aims to find other factors that might contribute to the decline of birth rate.

# Data Collection

There will be 2 datasets used for this project. Both are retrieved from https://data.gov.sg/. The mean of both Basic and Gross Salary will be compared with each other to determine if there is an increase of workload. The salary is then compared against the birth rate of that year to determine the correlation between them. We will also compare the different racial groups birth rates and compare it to the salary rate to see which ethnic groups have the strongest correlation to the salary income.

# Exploratory and Data Analysis

One dataset contains data collected from the graduate employment survey over the years by the universities in Singapore. There are variables like employment rate by different degrees and universities, mean monthly salary and more. Another dataset contains the crude birth and death rate by ethnic groups over the years in Singapore.

Exploratory Data Analysis (EDA) is done on both the graduate employment survey dataset and the crude birth and death rate dataset. We will be comparing the data from the year 2013 to 2021. All findings will be done with Python and Machine learning, using packages like ‘numpy’, ‘pandas’, ‘seaborn’ and ‘matplotlib’.

## Average Birth Rate

This graph compares the average crude birth rate across all racial groups from 2013 to 2021. This demonstrates that Singapore has been having a decline in birth rates, which is accelerating. (Authority, 2022)

Chart, line chart

Description automatically generated

Figure 1: Average Birth Rate from 2013 to 2021

## Basic Mean Salary

From 2013 to 2021, this graph compares the average Basic Mean Salary of all graduates who participated in the graduate employment survey. This graph shows that the Basic Mean Salary has been gradually increasing from 2013 to 2021. (Education, 2022)

Chart, line chart

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Figure 2: Basic Mean Salary from 2013 to 2021

## Average Birth Rate vs Basic Mean Salary

When comparing the graphs above, we can see that while the Basic Mean Salary increases, the birth rate falls from 2013 to 2021. Even during the year 2013-2014, when wages were declining, the fertility rate increased. This shows that there is some correlation between the two outcomes. (Authority, 2022) (Education, 2022)

Chart, line chart

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Figure 3: Average Birth Rate Vs Basic Salary Mean

## Correlation between Average Birth Rate and Basic Mean Salary

To identify the strength of the relationship between the two outcomes, a correlation table is created. There is a significant inverse correlation between the two outcomes, with the correlation = -0.961479. This demonstrates the strong relationship between financial stability and the declining birth rates.

|  |  |
| --- | --- |
| **Correlation between Outcomes** | Basic Mean Salary |
| Average Crude Birth Rate | -0.961479 |

Chart, waterfall chart, treemap chart

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Figure 4: Correlation Table between Average Birth Rate and Basic Mean Salary

# Mathematical Derivations

Linear regression

to predict for the upcoming years. – create formula for each.

# Observation

# Additional Observations

## Birth Rate of Ethnic Groups vs Income Salary

### Birth rates

We investigate the birth rates of various racial groups in Singapore using the idea of how higher income salary inversely relates to declining birth rates. According to the graph, all races, with the exception of Malays, are witnessing a decrease in birth rates.

Chart, line chart

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Figure 5: Birth Rates of different Ethnic Groups

### Ethnic Birth rates and Income Salary correlation

# Conclusion

# References

Authority, M. o.-I. (22 August, 2022). *Crude Birth, Death & Natural Increase Rates by Ethnic Group*. Retrieved from data.gov.sg: https://data.gov.sg/dataset/crude-death-rates-by-ethnic-group-from-1971-onwards?view\_id=61a6e3af-03dc-4e66-88a9-8726d372925f&resource\_id=1c8ea8a5-3f1f-43be-ad36-3e510adbd2d3

Education, M. o. (21 November, 2022). *Graduate Employment Survey - NTU, NUS, SIT, SMU, SUSS & SUTD*. Retrieved from data.gov.sg: https://data.gov.sg/dataset/graduate-employment-survey-ntu-nus-sit-smu-suss-sutd