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RESEARCH PROPOSAL'S TITLE:

SURVIVAL ANALYSIS ON BRUNEI DARUSSALAM'S UNDERGROWING
POPULATION

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Abstract

Population data has always been researched and condensed into summarized content annually. This research involves gathering existing data from annual reports made by JPES of Brunei's population and third-party websites (such as WHO) and then analyze and compile them into a life table. Eventually, the results can help indicate common factors as to why the population of Brunei is decreasing year by year by compiling them into a graph and then use linear regression as the ideal method of analyzing them. The objective of the research is to compile population data into a life table and then reform it as a graph whilst linear regression being a method used with the intention to find factors that discourage the public from population increase. The results can help the researchers to be able to give suggestions from the findings to improve situations within the country and provide better initiatives that encourage the public about the impending situation.

Table of Contents

Abstract	2
Table of Contents	3
Introduction	4
General Background	4
Significance of Study	5
Research Objectives	5
Literature Review	6
Methodology	8
Description of Study Area	8
Target Population	8
Data Collection	8
Method of Data Analysis	8
Variables Identification	11
People Involved	12
Tangible Outputs	12
Timeline	12
Considerations	12
Summary	12
References	

Introduction

General Background

The ever-growing population throughout the world is a never-ending debate between world leaders, politicians, including the general people. The increase in population in Brunei Darussalam since gaining independence in 1984 has been a steady one. Yet, the question of is if the population growth since then has been enough to conjure a steady or stable country. Despite this, there is little to non-existent within the country of talks on this delicate subject. Upon close inspection, the growth rate of the population has been recently declining. According to data from World Population Review (2022), population growth has been decreasing since 1955. The recent growth rate is 0.97% in 2022 whereas the growth rate in the year 2000 was 2.32%. The shrinking population count in recent years ultimately because of the shortage of foreigners entering the country. As the small increase of Bruneian citizens is overshadowed by the indefinite decline in foreign workers in the country (The Scoop, 2021). Shown below is the Brunei population table by year since the year 2000.

Year	Total Population	Growth Rate
2022	445.431	0.0097
2021	441.532	0.0101
2020	437.479	0.0097
2019	433.285	0.0101
2018	428.963	0.0106
2017	424.473	0.0111
2015	414.907	0.0132
2010	388.646	0.0126
2005	365.114	0.0185
2000	333.165	0.0232

Source: <https://worldpopulationreview.com/countries/brunei-population> (Data is approximated, not entirely accurate, for example from JPES website)

The use of life tables will be used to take a closer look into Brunei's recent population data. A life table is a demographic tool using the appropriate data of a certain species as the variable to analyze and study environmental or biological factors as well as the death rates and life expectancies in a population level (Richmond, 1922). Life tables also illustrates the pattern of survivorship of a population considering the probability of death (and other factors) at each consecutive age.

Significance of research

The goal of the study is to provide further insight on Brunei's population stats in terms of the yearly mortality and birth rate. This in mind will then enable further focus on the factors that have influenced these stats, especially the decreasing population growth rate of the country. The study would also be able to help provide valuable suggestions and opinions to create a better solution in tackling Brunei's population problem. The government or convenient organizations could be encouraged to do further research and look to take a positive outlook to improve conditions in the country.

Research objectives

The objective of the study is to provide further research and a closer look on Brunei's population throughout the years. The annual death rates, birth rates as well as life expectations of the population would be identified with the use of the life table. After further inspection, some factors limiting Brunei's population growth can be determined. This is also another objective of the study, where the correlation between such factors and the growth rate of the population will be discussed. Factors and research questions included:

1. Relationship between mortality rate and growth rate.
2. Relationship between life expectancy and growth rate.
3. Relationship between birth rate and growth rate.
4. Is the growing unemployment rate stopping population growth?
5. Are the limitations of the country's resources depleting population?
6. Did the Covid-19 outbreak affect population growth?

Literature Review

There are a significant number of studies carried out by multiple researchers using the life table method. A life table is a mathematical model that presents history of survival of a theoretical birth group of different ages in terms of probabilities of survival as well as longevities as age passes (Lahiri, 2018). Life tables are also useful for planning purposes as well as comparing populations with other countries. However, it is worth to note that present life tables may produce a misleading picture. This is because mortality experiences or birth rate may rapidly increase or decrease in different generations of time as certain events may have happened in different decades (Lew & Seltzer, 1970). Several researchers get quite confused with a mortality table or a life table, two seemingly different designations for the same applications. Hence, life tables' uses may be classed into two categories, which are applications primarily for mortality and death rates and secondly, applications primarily for survival rate (Dublin & Lotka, 1937). Nevertheless, modern life tables tend to collectively apply both applications in one table (example shown in method of data analysis section below).

When data is analyzed and compressed, comparisons with other neighboring countries can be made. As of 2022, South-Eastern Asia's current population is estimated to be around 680,837,156 based on United Nations estimates (Worldometers.info, 2022) where Indonesia is dominating in population count as of 2020.

Throughout Southeast Asia, despite Brunei's small population, the country's birth rate is still a positive one, albeit growing in a very slow rate and decreasing year by year. As of 2020 (TheGlobalEconomy, 2022), Laos has the highest growth rate at around 1.47%, with Brunei having 0.96% and Singapore having the lowest percentage of -0.31%. Despite this, Brunei still has the lowest population count throughout Southeast Asia. In 2020, Brunei had a population of 453,600. In comparison in 2019, Brunei had 459,000 in population. This shows a 1.3% decrease in between the two years (Department of Economic Planning and Statistics, 2021). In comparison (as an example), Singapore has a population of around 5,850,342 as of 2020 whilst having a decline in growth rate in that year. However, in 2019, Singapore had a growth rate of 1.14% which is ultimately bigger than Brunei's within the same year.

With the information in mind, a lot of factors are to be factored in that have influenced the year-by-year decline in growth rate of Brunei Darussalam as well as the growth rates in other countries in Southeast Asia. Some factors include the fertility, mortality, birth rates, unemployment rate, country resources (food supplies and environmental factors) as well as the recent Covid-19 pandemic outbreak. Pros and cons of population growth must be considered to discuss how population increase can help Brunei in the long run. Several advantages of a population growth include the increase in country innovations and economic growth. Bigger population means having a greater pool of human capital which then increases the possibility of technological and cultural discoveries (Pettinger, 2021). Like economic growth, more people equate to having an increase in the production of more goods. On the contrary, several disadvantages include food and property shortages. However, Brunei has high natural resource income, in terms of GDP, compared to the world average GDP. It is reported as of 2019, Brunei's average GDP is estimated to be 22% compared to the world average of 5%

(TheGlobalEconomy, n.d.). Today, Brunei currently has one of the highest age dependency ratios for a dependent population. In 2019, it was reported that Brunei has a dependency ratio of 52.3% of which is a high value in a global average of 40.1% (World Economics, n.d.). This means that those of the working age in the country, face the great responsibility to support the dependent population.

Other countries have adapted with different types of ways to increase or decrease their population count. Population policies usually are quite complex and unclear. Population problems and its consequences are handled differently by different governments depending on its degree of urgency (Heitlinger, 1979). The most used policies are the pro-natalist and anti-natalist policies. Pro-natalist policy is a policy that involves the use of incentives to encourage more births. An anti-natalist policy is the opposite where births are discouraged through proper education on family planning as well as an increase in access to contraception or like China (One Child Policy), stricken by law. Examples of countries adopting the pro-natalist are Singapore and Taiwan, and an example of an anti-natalist country is China.

An example of a pro-natalist neighboring country is Singapore. Initially, Singapore had an anti-natalist policy between 1972 until 1987 called “Stop at Two” (jkgeography, n.d.). This initiative involves limiting the citizens of Singapore into having up to only two children. However, because of the initial success of the policy, Singapore instead faced a major decrease in their population in 1987. Worried that the population of workers is aging as well as future citizens having to depend on the older generation, the previous policies were overturned and instead changed into a pro-natalist policy called “Have three or more if you can afford it” (jkgeography, n.d.). Now, the people are then encouraged to have more children where the government would then give appropriate benefits towards these families. Since the introduction of the first pro-natalist policy in 1987, the policy underwent changes in 2004, 2008 and 2013 (Jones & Hamid, 2015). In present day, out of any country in Southeast Asia, Singapore has proven to have the most complete policy that encourages marriage, provide incentives and support families, and in turn boost their fertility rate.

In correlation for this study, Brunei Darussalam should take these incentives as examples to recuperate and handle the declining growth rate as well as increase the country’s population count.

Methodology

Description of Research Area

Brunei Darussalam is country located in Southeast Asia. The country is divided into four districts, namely Brunei-Muara, Tutong, Belait and Temburong, where Bandar Seri Begawan is its capital which is in the Brunei-Muara district.

Target Population

For this study, the whole population of Brunei will be accounted for. As of 2021, Brunei has a population count of 429,999, comprising of 226,102 males and 203,897 females (Department of Economic Planning and Statistics, 2021). This is of which 353,313 persons are of Bruneian citizenship and permanent residents, and 76,686 persons are temporary residents. Ages include from 0 year/s to 65 and over, years old.

Data Collection

There are a lot of different sources of data that can be collected. The main resource of data that will be collected from is on the Department of Economic Planning and Statistics reports made annually. Other sources include third party websites, most prominently from the World Health Organization. These platforms are easily accessible and available to use from the internet.

Method of Data Analysis

The core methods of data analysis used in this study are:

1. Life table method

As an example, based on the World Health Organization website (2021), a life table based on Brunei's recent population was made, up to 2019. The life table shown below is estimated data and might not be as accurate since it is from a third-party website.

		2019	2019	2019
Indicator	Age Group	Both sexes	Male	Female
nMx - age-specific death rate between ages x and x+n	<1 year	0.01049	0.011609	0.009326
nMx - age-specific death rate between ages x and x+n	1-4 years	0.00046	0.000505	0.000411
nMx - age-specific death rate between ages x and x+n	5-9 years	0.000263	0.000289	0.000235
nxq - probability of dying between ages x and x+n	<1 year	0.010392	0.011489	0.009248
nxq - probability of dying between ages x and x+n	1-4 years	0.001837	0.00202	0.001644
nxq - probability of dying between ages x and x+n	5-9 years	0.001312	0.001442	0.001173
lx - number of people left alive at age x	<1 year	1.00E+05	1.00E+05	1.00E+05
lx - number of people left alive at age x	1-4 years	98960.84	98851.14	99075.18

lx - number of people left alive at age x	5-9 years	98779.04	98651.51	98912.34
ndx - number of people dying between ages x and x+n	<1 year	1039.159	1148.862	924.8157
ndx - number of people dying between ages x and x+n	1-4 years	181.8013	199.6312	162.8403
ndx - number of people dying between ages x and x+n	5-9 years	129.6158	142.253	116.0696
nLx - person-years lived between ages x and x+n	1-4 years	395407	394925.4	395909.9
nLx - person-years lived between ages x and x+n	5-9 years	493571.2	492901.9	494271.5
Tx - person-years lived above age x	<1 year	7432442	7338683	7535551
Tx - person-years lived above age x	1-4 years	7333378	7239717	7436383
Tx - person-years lived above age x	5-9 years	6937970	6844792	7040473
ex - expectation of life at age x	<1 year	74.32442	73.38683	75.35551
ex - expectation of life at age x	1-4 years	74.10383	73.23858	75.05798
ex - expectation of life at age x	5-9 years	70.23727	69.38355	71.17892

Source: <https://apps.who.int/gho/data/view.searo.60230?lang=en> (Only as an example, where the age group shown is only from 1 – 9 years old).

Formulas include:

$${}_nq_x = \frac{2n_n m_x}{2 + n_n m_x}$$

- nMx – age – specific death rate between ages x and x+n
- nqx – probability of dying between x and x+n
- lx – of people left alive at age x
- ndx – number of people dying between ages x and x+n
- nLx – person – years lived between ages x and x+n
- Tx – person – years lived above age x
- ex – expectation of life at age x
- mx - total calendar year deaths/mid-year population
- qx – mortality rate between age x and x+1
- dx – number of a specific gender dying between ages x and x+1

$dx = qx * lx$ – number of people dying between exact age x and age x+1

$lx+1 = lx - dx$ – number of survivors to age x+1

Specific probabilities can be calculated given from the lx values.

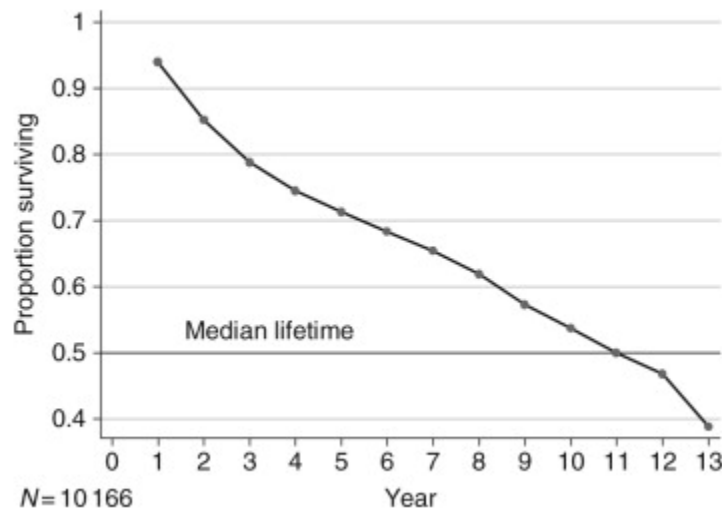
$$CDR = \frac{\text{Number of deaths}}{\text{Total population}} = \frac{l_x}{T_x} = \frac{1}{e_x}$$

$$CBR = \frac{\text{Number of births}}{\text{Total population}} = \frac{l_x}{T_x} = \frac{1}{e_x}$$

Where:

- CBR (crude birth rate) – number of births which occur in a given year per 1000 population
- CDR (crude death rate) - number of deaths which occur in a given year per 1000 population

Hence for this study, once the life table is produced, graphs would then be produced for linear regression. Specific columns (such as life expectancies) can be used as a factor or variable to correlate with Brunei’s population growth.



Example of surviving probability graph extracted from a life table (James, Fosnacht, Stolzeberg & Thirumalai, 2010).

2. Linear regression: Linear regression explain the relationship between one dependent variable with one or more explanatory variables. This method is used to identify relationships and correlations between factors or variables (independent variable) that affect Brunei’s population/growth rate (dependent variable).

Variable Identification

Dependent variable: Population growth rate

Independent variables: Factors withstanding/decreasing population such as:

- Increase in mortality rate
- Decrease in birth rate
- Life expectancy
- Unemployment rate
- Country resources
- Covid-19 outbreak

People Involved

This study involves Muhammad Syahmi as the main researcher, gathering data, analyzing, and compiling them into a life table and a graph in linear regression form, creating a research proposal and a journal article under the supervision of Dr Haziq Jamil (Assistant Professor in Statistics).

Tangible Outputs

The life table produced would be a more substantial method for taking a closer look into Brunei's population as well as specific probability questions. The results would therefore help create the necessary results needed that ensure future planning that suggest improvement for the betterment of the country.

Timeline

The table shown below is the summarized stages of work handled during the year.

Stage	Task	Date	Duration (Weeks)
1	Topic Choosing	8 th January – 1 st March	7 weeks
2	Research proposal (writing and draft)	2 nd March – 15 th May	10 weeks
3	Data Collection and Analysis (after proposal submission)	18 th May – 1 st August (Semester break)	14 weeks
4	Writing Journal Article	2 nd August – 1 st October	8 weeks
5	Presentation	2 nd October – 30 th November	9 weeks

Considerations

Life table formed for the study is from data collected in recent years, approximately from 2010 until present year. Data analyzed may not be as accurate if calculated from data years before. Factors presented for the study is of self-conduct, hence, several factors that are not inputted for the study may be missed.

Summary

The study will represent an ideal look into Brunei Darussalam's population as well as in terms of its survival and morality rate. Factors will then be looked upon and compared with the country's growth rate. This can therefore help realize and bring the topic of the country's undergrowing population to light and encourage further outputs that can benefit Brunei's future. The core research methods used for this study is with the use of life tables and linear regression. Despite several considerations, the objectives of the study can be achieved. The study began on the 2nd of March 2022 and estimated to end in November the same year.

References

- Advantages and disadvantages of population growth. (n.d.). Economics Help. Retrieved May 15, 2022, from <https://www.economicshelp.org/blog/167320/economics/population-growth-pros-cons/>
- Brunei Darussalam age dependency ratio*. (n.d.). World Economics. Retrieved May 15, 2022, from <https://www.worldeconomics.com/Demographics/Age-Dependency-Ratio-Total/Brunei%20Darussalam.aspx>
- Department of Economic Planning and Statistics. (2021). Population. <https://deps.mofe.gov.bn/SitePages/Population.aspx>
- Dublin, L. I., & Lotka, A. J. (1937). Uses of the life table in vital statistics. *American Journal of Public Health and the Nations Health*, 27(5), 481-491.
- Heitlinger, A. (1979). Pro-Natalist Population Policies. In *Women and State Socialism* (pp. 177-190). Palgrave Macmillan, London.
- James, A., Fosnacht, K. J., Stolzenberg, E. B., & Thirumalai, D. (2010). Identifying Patterns of Doctoral Attrition Across Academic Fields.
- Jones, G. W., & Hamid, W. (2015). Singapore's pro-natalist policies: To what extent have they worked?. In *Low and lower fertility* (pp. 33-61). Springer, Cham.
- Lahiri, S. (2018). Survival Probabilities From 5-Year Cumulative Life Table Survival Ratios (T_{x+5}/T_x): *Some Innovative Methodological Investigations* ☆. In *Handbook of statistics* (Vol. 39, pp. 481-542). Elsevier.
- Lew, E. A., & Seltzer, F. (1970). Uses of the life table in public health. *The Milbank Memorial Fund Quarterly*, 48(4), 15-37.
- Life tables: Life tables by country Brunei Darussalam. (n.d.). World Health Organization. Retrieved May 15, 2022, from <https://apps.who.int/gho/data/view.searo.60230?lang=en>
- Pettinger, T. (2021). Advantages and disadvantages of population growth. Economics Help. <https://www.economicshelp.org/blog/167320/economics/population-growth-pros-cons/>
- Population growth in South East Asia. (2022). TheGlobalEconomy.Com. https://www.theglobaleconomy.com/rankings/population_growth/South-East-Asia/
- Pro-natalist and anti-natalist policies. (n.d.). GEOGRAPHY MYP/GCSE/DP. Retrieved May 15, 2022, from <https://www.jkgeography.com/pro-natalist-and-anti-natalist-policies.html>
- Richmond, G. W. (1922). Austrian National Life Tables. *Journal of the Institute of Actuaries*, 53(3), 209-250.
- South-Eastern Asia population (live)*. Worldometer. (2022). Retrieved May 12, 2022, from <https://www.worldometers.info/world-population/south-eastern-asia-population/>

The Scoop. (2021, April 12). *Brunei population falls for first time due to fewer foreigners - The Scoop*. Scoop Media. <https://thescoop.co/2021/04/12/brunei-population-falls-for-first-time-due-to-fewer-foreigners/>

World Health Organization. (2021). Life Tables by Country - Brunei Darussalam. <https://apps.who.int/gho//data/view.main.60230?lang=en>

World Population Review. Brunei Population 2022 (Demographics, Maps, Graphs). Retrieved May 15, 2022, from <https://worldpopulationreview.com/countries/brunei-population>