Mobile and Forensics
Vol. 4, No. 2, September 2022, pp. 75-88
ISSN: 2714-6685 (online), 2656-6257 (print)
DOI: 10.12928/mf.v4i2.6032

Decision Making for Insurance Eligibility based on Mortality Differential in Southeast Asian Countries

Syafnides Winda[a,1*], Hyuk-Sung Kwon[a,2]
[a]Department of Statistics and Actuarial Science, Soongsil University, Seoul, South Korea
[1]windasyafni7@gmail.com, [2*]hskwon@ssu.ac.kr
[*]Correspondence email

Abstract

Indonesia, Malaysia, and Singapore are each at different stages of economic development, all have achieved sufficient size and economic strength that they are being prospected by several global life insurance and life annuities. Their economies have speedily been moving out of their traditional agrarian bases and becoming far more urbanized and industrialized. This study aims to compare the characteristics of various mortality risk factors between three countries in Southeast Asia (Indonesia, Malaysia, and Singapore) and analyze differences in mortality rates for the development of the life insurance business.

Keywords: Economic Development, Insurance Business, Global Life Insurance, Life Annuities, Risk Factors

INTRODUCTION

Over the past decade, the smaller nations of Southeast Asia have grown rapidly and taken significant developmental strides, with several becoming attractive markets for life insurance and life annuity. Indeed, although Malaysia, Indonesia, and Singapore - three of 11 countries that make up the Association of Southeast Asian Nations (ASEAN) - are each at different stages of economic development, all have achieved sufficient size and economic strength that they are being prospected by several global life insurance and life annuities. Their economies have speedily been moving out of their traditional agrarian bases and becoming far more urbanized and industrialized. Reference [1] established the opportunity index to identify which countries with a desirable mix of profitability, potential growth, and relatively stable political environment. Table 1 shows the Quartile 1 markets ranked by this index. Indonesia, Malaysia, and Singapore tied this year for the number one position. All three have exhibited low combined ratios healthy premium growth and GDP growth, and a stable political environment. Indonesia, Malaysia, and Singapore are the top three of Quartile 1 in this index. According to this index, there is an opportunity for life insurance companies to expand their business for these three countries. Year after year, life expectancy in Indonesia, Malaysia, and Singapore is increasing. Rising life expectancy is expected to drive demand for life insurance and annuities products. But one of the key risk factors that life insurance and pension companies which must be considered is longevity risk. If life expectancy increases more than expected, pension fund and insurance companies will

Article History: *Received April 04, 2022; Revised December 15, Year; Accepted December 15, 2022*

have to pay out more than projected, resulting in a loss to those companies. Table 2 shows the life expectancy at birth in Indonesia, Malaysia, and Singapore per five-year period.

Table 1. Aon Benfield Country Opportunity Index [1]

Quartile 1	Country	5 years Cumulative Net Combined Ratio	5 years Annualized Premium Growth	Real GDP 5 years Growth	Population 5 years Annualized Growth	Political Risk Assessment
1	Indonesia**	87.4%	11.8%	7.2%	1.4%	Medium
1	Malaysia**	89.6%	7.3%	6.9%	1.5%	Medium Low
1	Singapore**	88.1%	3.2%	5.6%	1.7%	Low
4	Ecuador**	88.9%	16.2%	6.2%	1.6%	Medium High
5	Chile**	95.8%	12.2%	5.6%	1.1%	Medium Low
5	Saudi Arabia**	96.3%	17.0%	6.5%	2.6%	Medium
5	Nigeria**	84.8%	7.5%	6.7%	2.7%	High
5	Australia*	96.8%	6.7%	4.4%	1.5%	Low
5	U.A.E	90.9%	0.1%	5.9%	3.0%	Medium Low
10	Brazil**	86.6%	14.1%	3.1%	0.9%	Medium
10	South Africa*	87.3%	8.1%	3.8%	1.6%	Medium
10	Norway**	89.0%	3.5%	3.1%	1.2%	Low

*Indicates top quartile performer in 2014.

**Indicates top quartile performer in both 2013 and 2014

Table 2. Life Expectancy at Birth

Year	2000		2005		2010		2015	
Country	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*
Indonesia	68.0	64.6	69.2	65.3	70.2	66.1	71.2	67.1
Malaysia	74.9	70.2	75.8	71.2	76.5	71.9	77.3	72.7
Singapore	80.9	75.9	82.6	77.8	84.7	79.2	86.1	80.0

Longevity risk is systematic risk which cannot be reduced by doing diversification. To manage this risk, pension fund and insurance companies can transfer such risks to other parties, such as reinsurers, investment banks, and capital markets. There are also three other possibilities of managing longevity risk, namely hedging, reserving, and risk sharing [3][4].

This paper also provided the instruments to manage and hedge longevity risk which called "longevity derivative" instruments. Longevity bond is one of the longevity derivatives instruments. Its cash flows are designed to help pension funds and insurance companies hedge their exposure longevity risk and transfer to the investors by paying an issue price called longevity bond price to receive annuity bond payments which floating coupon payments are proportionate to the realization of cohort survivor index.

This study aims to compare the characteristics of various mortality risk factors between three countries in Southeast Asia (Indonesia, Malaysia, and Singapore) and

also analyze differences in mortality rates for the development of the life insurance business.

In chapter 1, the background and purpose of this research will be introduced. Chapter 2 discusses the differentiation of risk factors for mortality between Indonesia, Malaysia and Singapore and compares mortality standards with other countries such as Thailand, Cambodia, Vietnam, Japan, Korea, and China. In Chapter 3, we introduce the structure of the dataset and a more detailed description of the interpolation method we use throughout this paper, in addition we compare APV life insurance and life annuities between Indonesia, Malaysia and Singapore. In Chapter 4, we focus on how to hedge longevity risk using the most appropriate method called longevity bonds and their calculations and some analyses. Finally, we close the chapter in Chapter 5 to summarize all the results and areas of future study.

RESEARCH LITERATURE

Mortality Risk Factor

Based on [5] in their paper entitled "Factors Affecting Retirement Mortality", in particular, factors that seem to be important in predicting retirement mortality include age, gender, race and ethnicity, education, income, occupation, marital status, religion, health behaviors, smoking, alcohol, and obesity. The explanation for each of mortality risk factors will be present in detail.

- ***Age.*** References [6][7] states that mortality rates increase exponentially with age. Indonesia has the lowest expectancy than Malaysia and Singapore. In 2015, life expectancy for Indonesian female is about 71.2 years and Indonesian male has 67.1 years. The Life expectancy for Malaysian female is about 77.3 years and Malaysian male has 72.7 years. The life expectancy for Singaporean female is 86.1 years and Singaporean male has 80 years.
- ***Alcohol.*** Reference [8] find that moderate alcohol consumption is associated with a small reduction in mortality. The relation between drinking and mortality varies according to specific causes of death, like cirrhosis, alcoholism, and cancers of the mouth, esophagus, pharynx, larynx, and liver are three to seven times higher if at least four drinks are consumed per day, compared with non-drinkers. Based on data from World Health Organization (WHO) 2014, Indonesia consumed 7.1 liters of pure alcohol, Malaysia consumed 10.5 liters of pure alcohol, and Singapore consumed 3.9 liters of pure alcohol.
- ***Education.*** Reference [9] find that one of the most important predictors of successful aging is a high level of education. Reseearch [10] find that death rates fall consistently with increasing level of education.
- ***Gender.*** Reference [11] comments that the gender interacts with mortality for both overall mortality and cause specific mortality. Factors that influence gender differences in mortality include biological factors such as hormonal influences on psychology and behaviour, and environmental factors, such as cultural influences on gender differences in health behaviours. The ratio of gender population based on [12] in Indonesia is 1 male(s)/female, Malaysia has 1.03 male(s)/female, and Singapore has 0.96 male(s)/female.
- ***Health Behaviours.*** Reference [13] comment that some health behaviours are associated with a significantly higher risk of death for specific causes of death. The distribution of four behavioural risk factors (cigarette smoking, alcohol drinking,

sedentary lifestyle, and relative body weight) significantly various by educational attainment and annual household income. The least education and lowest income are significantly more likely to be current smokers, overweight, and in the lowest quintile for physical activity. Education is strongly related to health behaviours, whereas income is more predictive of mortality. The information about health behaviours for Indonesia, Malaysia, and Singapore explain in Table 3.

- ***Income.*** Reference [14] concludes that mortality rates are not equal at different income and employment status have significant net effects on both all-cause mortality and cause-specific mortality for all age-sex groups, except for older females. Based on [15], Indonesia's GDP is 16.112 USD per capita, Malaysia's GDP is 26.141 USD per capita, and Singapore's GDP is 84.901 USD per capita.
- ***Marital Status.*** Reference [11] also finds that marital status differentially affects mortality, with married people consistently exhibiting lower mortality than those who are not married. However, those under 65 who live with others have lower mortality than those who live alone, for those over 65, women who live alone have lower mortality, whereas men living alone have higher mortality. According to Department of Statistics of each country in 2014, age at first marriage only, Indonesia men get married at age 26 on average, while women get married at age 22. Malaysia men get married at age 28 on average, while women get married at age 26. Singapore men get married at age 30 on average, while women get married at age 28 [16][17].
- ***Obesity.*** Reference [18] finds that hazard ratios for obesity decrease steadily with advancing age. There is a continued growth in the population proportion that is obese and severely obese. Table 3 shows the detail information about obesity and category of Body Mass Index (BMI) for each country, Indonesia, Malaysia, and Singapore.
- ***Occupation.*** Reference [19] observe that specific occupational status can also have an impact on mortality. Reference [20] also finds that occupational structures for men and women are quite different, with respect to physically demanding jobs and high mortality groups.
- ***Race and Ethnicity.*** Reference [14] also finds that race has significant effects on all-cause mortality among all age-sex groups. Readers will be aware that most jurisdictions would not allow "Race and Ethnicity" for risk classification for annuity pricing. The reasons are: first, the mortality differential by race decreases or disappears at advanced ages, and second, there exist excellent proxies for the race variable, including the education and income. The detail information about race and ethnicity for Indonesia, Malaysia, and Singapore will be presented in Table 3.
- ***Religion.*** Reference [21] highlight that they compare religion with non-religion and comment that the effects of religion on mortality may actually vary according to the faith or denomination. The pension valuation actuary could allow "religion" to impact the calculation of the intermediate pension liability so long as the ultimate (initial) benefits are not function of religion. Indonesia is the largest population of Muslim in the world either in Southeast Asia. Indonesia has 87.2% Muslim population. Followed by Malaysia (the second largest Muslim population in Southeast Asia after Indonesia) with 61.3% Muslim population. But in Singapore, 33% of Singapore population is Buddhism.
- ***Smoking.*** Reference [8] also comment that smoking approximately doubles the risk of death. Reference [11] also find the odds of dying for both heavy and light smokers

are about twice that of those who never smoke. Although all smoking categories have significantly higher odds of dying compared with non-smokers, the highest are for current heavy smokers. The mortality of former smokers depends on the volume of their previous smoking and whether they quit before or after contracting a serious illness. Rogers also suggest that smoking is a major contributor to the current sex gap in mortality. Indonesia has the highest male smoking rate among countries surveyed to date, according to results from the nation's first Global Adult Tobacco Survey (GATS) [22].

Table 3. Summary of Comparing Factor Affecting Mortality among Malaysia, Indonesia, and Singapore

Factor	Indonesia	Malaysia	Singapore
Age	Life Expectancy at birth (WHO 2015): Female 71.2, Male 67.1	Life Expectancy at birth (WHO 2015): Female 77.3, Male 72.7	Life Expectancy at birth (WHO 2015): Female 86.1, Male 80.0
Alcohol	7.1 liters (WHO 2014)	10.5 liters (WHO 2014)	3.9 liters (WHO 2014)
Education	Literacy rate 92.81%	Literacy rate 95%	Literacy rate 96.1%
Gender	1 male(s)/female (index mundi 2014 est.)	1.03 male(s)/female (index mundi 2014 est.)	0.96 male(s)/female (index mundi 2014 est.)
Health Behaviors	degree of risk: very high food or waterborne diseases: bacterial diarrhea, hepatitis A, and typhoid fever vectorborne diseases: dengue fever and malaria (Index Mundi 2014)	degree of risk: intermediate food or waterborne diseases: bacterial diarrhea vectorborne diseases: dengue fever water contact disease: leptospirosis (Index Mundi 2014)	NUS (National University of Singapore) Saw Swee Hock School of Public Health 2015 covers Singapore's tackling past major infectious diseases like malaria, cholera, and typhoid.
Income	GDP: 16,112 USD per capita (IMF 2015)	GDP: 26,141 USD per capita (IMF 2015)	GDP: 84,901 USD (IMF 2015)
Marital Status	Marriage rate is dropping while divorce (divorce as long as they alive or divorce caused by death) rate is rising.		
Obesity	Total obesity: 4.8% (2008) Obesity: 8.81 (Male), 19.6 (Female) Overweight: 22.33 (Male), 29.27 (Female) Normal weight: 55.2 (Male), 40.26 (Female) Underweight: 13.66 (Male), 10.87 (Female) (BMI by Ministry of Health Indonesia)	Total obesity: 14% (2008) Obesity: 0.2 (Male), 0.4 (Female) Overweight: 3.8 (Male), 7.2 (Female) Normal weight: 20.1 (Male), 21.4 (Female) Underweight: 11.5 (Male), 14.1 (Female) (BMI by Ministry of Health Malaysia)	Total obesity: 7.1% (2008) Obesity: 6.4 (Male), 7.3 (Female) Overweight: 28.6 (Male), 22.6 (Female) Normal weight: 58.8 (Male), 57.9 (Female) Underweight: 6.2 (Male), 12.2 (Female) (BMI by Ministry of Health Singapore)

Factor	Indonesia	Malaysia	Singapore
Occupation	Occupational structures for men and women are quite different, but it gives same affect to mortality.		
Race and Ethnicity	Javanese 40.1%, Sundanese 15.5%, Malay 3.7%, Batak 3.6%, Madurese 3%, Betawi 2.9%, Minangkabau 2.7%, Buginese 2.7%, Bantenese 2%, Banjarese 1.7%, Balinese 1.7%, Acehnese 1.4%, Dayak 1.4%, Sasak 1.3%, Chinese 1.2%, other 15% (Index Mundi 2010 est.)	Malay 50.1%, Chinese 22.6%, indigenous 11.8%, Indian 6.7%, other 0.7%, non-citizens 8.2% (Index Mundi 2010 est.)	Chinese 74.2%, Malay 13.3%, Indian 9.2%, other 3.3% (Index Mundi 2013 est.)
Religion	Islam (87.18%), Christianity (9.87%), Hinduism (1.69%), Buddhism (0.72%), Confucianism and others (0.56%). Wikipedia (2010).	Islam (61.3%), Buddhism (19.8%), Christianity (9.2%), Hinduism (6.3%), Confucianism, Taoism, and other traditional Chinese religion (1.3%), None (3.2%). Wikipedia (2010).	Buddhism (33%), Christianity (18.8%), Islam (14%), Taoism and folk religion (11%), Hinduism (5%), other religions (0.7%), not religious (18.4%). Wikipedia (2015).
Smoking	Two-thirds of Indonesian males (67%) smoke tobacco. About 61 million Indonesians currently use tobacco, almost all of whom smoke tobacco. (GATS 2012)	About half of all Malaysian men smoke. Every day about 50 teenagers below the age of 18 start smoking. (WHO Smoking Statistics 2002).	The prevalence of smoking in Singapore has increased from 12.3% in 2004 to 14.3% in 2010, reversing a previous long-term decline. (National Health Survey (NHS) 2010).

Source: Adapted from several source

Standardized Mortality

Based [23] states that standardized mortality is a quantity, expressed as either a ratio or percentage quantifying the increase or decrease in mortality of a study cohort with respect to the general population. Reference [24] also reviews comparing mortality in different populations. An important use of mortality data is to compare two or more population in different time periods. Such populations may differ in regard to many characteristics that affect mortality, of which age distribution is the most important. Age is the single most important predictor of mortality. There are two types of age adjustment: direct age adjustment and indirect age adjustment which represents.

- ***Direct Age Adjustment.*** Standard population is used to eliminate the effects of any differences in age between two or more populations being compared. A hypothetical

standard population is created to which we apply both the age specific mortality rates from the early period and the age specific mortality rates from the later period.

- ***Indirect Age Adjustment.*** Indirect age adjustment is often used when number of deaths for each age specific stratum is not available. Thus, for each age group, the number of deaths expected is calculated, and these numbers are totalled. The numbers of deaths that were observed in that population are also calculated and totalled. The ratio of the total number of deaths observed to the total number of deaths expected, if the population of interest had had the mortality experience of the known population, is then calculated. This ratio is called the standardized mortality ratio (SMR). The SMR is defined as follows:

$$SMR = \frac{(Observed\ no.of\ deaths\ per\ year)}{(Expected\ no.of\ deaths\ per\ year)} \quad (1)$$

METHODS

Dataset

The mortality datasets in this paper are taken from the Life Tables of World Health Organization [2]. In these datasets, the mortality data gives in 5-year ages group for female and male in each country per year from 2000 until 2015. We concern to Indonesia, Malaysia, and Singapore for further analysis. This following Table 4 shows the structures of mortality datasets.

Table 4. Structure of Mortality Datasets

Age interval	Female				Age interval	Male			
	Year					Year			
	2015	***…***	***…***	***2000***		***2015***	***…***	***…***	***2000***
<1years	q_x	q_x	q_x	q_x	<1years	q_x	q_x	q_x	q_x
1-4 years	q_x	q_x	q_x	q_x	1-4 years	q_x	q_x	q_x	q_x
5-9 years	q_x	q_x	q_x	q_x	5-9 years	q_x	q_x	q_x	q_x
…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…
95-99 years	q_x	q_x	q_x	q_x	95-99 years	q_x	q_x	q_x	q_x
>100 years	q_x	q_x	q_x	q_x	>100 years	q_x	q_x	q_x	q_x

Source: WHO Life Tables

Data Interpolation

Beer Graduation Method

Beer Graduation is one method that can apply the principle of interpolation for grouped data into single data. Formulas for interpolation can be expressed in linear compound form, that is, in terms of coefficients or multipliers that are applied to the given data. The multiplier is called Beers Graduation Ordinary and Modified formula. Sets of multipliers are given for subdividing intervals into fifths, that being the most common need. These are suitable for subdividing age data given in 5-year groups into single years of age. The multiplier can be manipulated in various ways (e.g., used in combination) to meet special needs.

Beer Graduation Ordinary Method. Beer graduation ordinary method is one of graduation techniques are often used to eliminate the anomalies (age reporting can be problematic when using vital statistics and census data by single years). Graduation method is used to derive a smooth curve by age. Beer's ordinary minimized fifth difference formula is such a technique and has been used in the construction of the previous U.S. decennial life tables as well as annual life tables. Population data were aggregated into 5-year age intervals except for those aged 100 years and over, which are allocated into a single category. Values of Px by single years of age were obtained by interpolation using Beer's formula. Beer's general formula adapted to calculate Px is:

$$P_{x+k} = C_{k,x-10\,5}P_{x-10} + C_{k,x-5\,5}P_{x-5} + C_{k,x\,5}P_5 + C_{k,x+5\,5}P_{x+5} + C_{k,x+10\,5}P_{x+10} \quad (2)$$

Where Px+k is the population aged x+k (k=0,1,2,3,4), 5Px is the total population aged x to x+k, and Ck,x is Beer's interpolation coefficient for the kth fifth of the age interval x to x+5 applied to 5Px. To interpolate single year single-year values from 5P0 and 5P5, the formula is slightly different. To obtain single-year value for these 5-year intervals, the formulas below are used.

$$P_{0+k} = C_{k,0\,5}P_0 + C_{k,5\,5}P_5 + C_{k,10\,5}P_{10} + C_{k15\,5}P_{15} + C_{k,20\,5}P_{20} \quad (3)$$

$$P_{5+k} = C_{k,0\,5}P_0 + C_{k,5\,5}P_5 + C_{k,10\,5}P_{10} + C_{k15\,5}P_{15} + C_{k,20\,5}P_{20} \quad (4)$$

Beer Graduation Modified Method. The modified formulas assume that the observed data are subject to error and in effect, they substitute weighted moving averages of the observed point or group data for these observed data. Thereby they obtain more smoothness in the interpolated results although at a cost of some modification of the original data. Modified formulas will give poor results when used with data that are good quality. Modified formulas should only be used when there is a desire to obtain a smooth series of interpolations from data that are known to be somewhat erratic.

Actuarial Present Value

The Actuarial Present Value (APV) is the expected value of the present value of a contingent cash flow stream. APV are typically calculated for the benefit payment or series of payments associated with life insurance and life annuities. The probability of future payment is based on assumptions about the person's future mortality which is typically estimated using a life table.

Whole Life Insurance

For a whole life insurance policy, the time at which the benefit will be paid is unknown until the policyholder actually dies and the policy becomes a claim. Since the present value of a future payment depends on the payment date, the present value of the benefit payment is the function of the time of death and is therefore modelled as random variable. Given a survival model an interest rate we can derive the distribution of the present value random variable for a life contingent benefit and can therefore

compute quantities such as the mean and variance of the present value. Table 6 shows the result of whole life insurance and whole life annuity for Indonesia, Malaysia, and Singapore.

Suppose now that the benefit of $1 is payable at the end of the year of death of (x), rather than immediately of death. To value this we use the curtate future lifetime random variable, Kx. Kx is measures the number of the year of complete years of future life of (x). The time to the end of the year of death of (x) is then Kx+1. We again use Z denote the present value of the whole life insurance benefit of $1, so that Z is the random variable.

$$Z = v^{K_x+1} \tag{5}$$

The APV of the benefit, E[Z], is denoted by Ax in actuarial notation. The APV of the benefit is:

$$A_x = vq_x + v^2{}_1|q_x + v^3{}_2|q_x + \cdots \tag{6}$$

Each term of the right-hand side of this equation represents the APV of a death benefit of $1, payable at time k conditional on the death of (x) in (k-1,k]. The second moment of the present value is :

$$^2A_x = (v^2)q_x + (v^2)^2{}_1|q_x + (v^2)^3{}_2|q_x + \cdots \tag{7}$$

The variance of the present value of benefit at the end of the year of death is:

$$Var[Z] = {}^2A_x - (A_x)^2 \tag{8}$$

RESULT AND DISCUSSIONS

Standardized and Mortality

In this paper, we are looking for the standardized mortality of three countries includes Indonesia, Malaysia, and Singapore. Table 5 describes about standardized mortality rate in year 2000, 2005, 2010, and 2015. Based on Table 5 we conclude that Indonesia has higher mortality followed by Malaysia, and Singapore is the lowest one.

Table 5. Standardized Mortality Rate

Year	Indonesia		Malaysia		Singapore	
	Female	***Male***	***Female***	***Male***	***Female***	***Male***
2000	0.010018	0.011058	0.004892	0.005776	0.002534	0.003287
2005	0.009275	0.010434	0.004711	0.005462	0.002293	0.003035
2010	0.008403	0.010389	0.004437	0.005857	0.001824	0.002921
2015	0.00813	0.010131	0.004327	0.005836	0.001827	0.002951

Beer's Graduation Coefficient

By using mortality data from WHO, the age range obtained is based on 5 years. To be used as insurance decision data, the data requested is data per year. By using the Beer Graduation method, the data can be broken down on the mortality rate per year. Table 6 shows the coefficient of Beer's Graduation Ordinary, and Table 7 shows the coefficient of Beer's Graduation Ordinary.

APV of Life Insurance

Table 8 shows the result of whole life insurance for Indonesia, Malaysia, and Singapore.

Table 6. Beer's Graduation Ordinary Coefficient

Interpolated Subgroup	Coefficient to be applied to					Panel
	G1	***G2***	***G3***	***G4***	***G5***	
First fifth of G1	0.3333	-0.1636	-0.021	0.0796	-0.0283	
Second fifth of G1	0.2595	-0.0780	0.0130	0.0100	-0.0045	
Third fifth of G1	0.1924	0.0064	0.0184	-0.0256	0.0084	First panel
Fourth fifth of G1	0.1329	0.0844	0.0054	-0.0356	0.0129	
Last fifth of G1	0.0819	0.1508	-0.0158	-0.0284	0.0115	
First fifth of G2	0.0404	0.2000	-0.0344	-0.0128	0.0068	
Second fifth of G2	0.0093	0.2268	-0.0402	0.0028	0.0013	
Third fifth of G2	-0.0108	0.2272	-0.0248	0.0112	-0.0028	Next to first panel
Fourth fifth of G2	-0.0198	0.1992	0.0172	0.0072	-0.0038	
Last fifth of G2	-0.0191	0.1468	0.0822	-0.0084	-0.0015	
First fifth of G3	-0.0117	0.0804	0.1570	-0.0284	0.0027	
Second fifth of G3	-0.0020	0.0160	0.2200	-0.0400	0.0060	
Third fifth of G3	0.0050	-0.0280	0.2460	-0.0280	0.0050	Middle panel
Fourth fifth of G3	0.0060	-0.0400	0.2200	0.0160	-0.0020	
Last fifth of G3	0.0027	-0.0284	0.1570	0.0804	-0.0117	
First fifth of G4	-0.0015	-0.0084	0.0822	0.1468	-0.0191	
Second fifth of G4	-0.0038	0.0072	0.0172	0.1992	-0.0198	
Third fifth of G4	-0.0028	0.0112	-0.0248	0.2272	-0.0108	Next to last panel
Fourth fifth of G4	0.0013	0.0028	-0.0402	0.2268	0.0093	
Last fifth of G4	0.0068	-0.0128	-0.0344	0.2000	0.0404	
First fifth of G5	0.0115	-0.0284	-0.0158	0.1508	0.0819	
Second fifth of G5	0.0129	-0.0356	0.0054	0.0844	0.1329	
Third fifth of G5	0.0084	-0.0256	0.0184	0.0064	0.1924	Last Panel
Fourth fifth of G5	-0.0045	0.01	0.0130	-0.0780	0.2595	
Last fifth of G5	-0.0283	0.0796	-0.0210	-0.1636	0.3333	

From Table 8 we can conclude that actuarial present value (APV) for life insurance (determine APV for aged 30, 40, and 50) and life annuity (determine APV for aged 50, 60, and 70). Additionally, we consider determine the ratio (on percentage) of APV life insurance to facilitate the comparison. Based on this calculation, Indonesia has highest APV life insurance followed Malaysia then Singapore either for male or female. It means that, for the country which has higher mortality rate gives higher APV life insurance. Vice versa, if the country has lower mortality rate, it gives lower APV life insurance. For gender side, APV for female is lower than male for these three countries. For age side, the older the policyholder, the higher the APV of life insurance. On the other hand, the older the policyholder, the lower the APV of life annuities.

Table 7. Beer's Graduation Modified Coefficient

Interpolated Subgroup	Coefficient to be applied to					Panel
	G1	G2	G3	G4	G5	
First fifth of G1	0.3332	-0.1938	0.0702	-0.0118	0.0022	
Second fifth of G1	0.2569	-0.0753	0.0205	-0.0027	0.0006	
Third fifth of G1	0.1903	0.0216	-0.0146	0.0032	-0.0005	First panel
Fourth fifth of G1	0.1334	0.0969	-0.0351	0.0059	-0.0011	
Last fifth of G1	0.0862	0.1506	-0.0410	0.0054	-0.0012	
First fifth of G2	0.0486	0.1831	-0.0329	0.0021	-0.0009	
Second fifth of G2	0.0203	0.1955	-0.0123	-0.0031	-0.0004	
Third fifth of G2	0.0008	0.1893	0.0193	-0.0097	0.0003	Next to first panel
Fourth fifth of G2	-0.0108	0.1677	0.0577	-0.0153	0.0007	
Last fifth of G2	-0.0159	0.1354	0.0972	-0.0170	0.0003	
First fifth of G3	-0.0160	0.0973	0.1321	-0.0121	-0.0013	
Second fifth of G3	-0.0129	0.0590	0.1564	0.0018	-0.0043	
Third fifth of G3	-0.0085	0.0260	0.1650	0.0260	-0.0085	Middle panel
Fourth fifth of G3	-0.0043	0.0018	0.1564	0.0590	-0.0129	
Last fifth of G3	-0.0013	-0.0121	0.1321	0.0973	-0.0160	
First fifth of G4	0.0003	-0.0170	0.0972	0.1354	-0.0159	
Second fifth of G4	0.0007	-0.0153	0.0577	0.1677	-0.0108	
Third fifth of G4	0.0003	-0.0097	0.0193	0.1893	0.0008	Next to last panel
Fourth fifth of G4	-0.0004	-0.0031	-0.0123	0.1955	0.0203	
Last fifth of G4	-0.0009	0.0021	-0.0329	0.1831	0.0486	
First fifth of G5	-0.0012	0.0054	-0.0410	0.1506	0.0862	
Second fifth of G5	-0.0011	0.0059	-0.0351	0.0969	0.1334	
Third fifth of G5	-0.0005	0.0032	-0.0146	0.0216	0.1903	Last panel
Fourth fifth of G5	0.0006	-0.0027	0.0205	-0.0753	0.2569	
Last fifth of G5	0.0022	-0.0118	0.0702	-0.1938	0.3332	

Table 8. APV of Life Insurace

Country 2015	Gender		Life Insurance Discrete			Ratio Life Insurance (%) Discrete		
			30	*40*	*50*	*30*	*40*	*50*
Indonesia	Female	Mean	0.1014	0.1592	0.2457	38.29	24.39	15.81
		Std	0.1218	0.1489	0.1775	48.91	40.01	33.55
	Male	Mean	0.1211	0.1898	0.2911	32.08	20.47	13.34
		Std	0.1316	0.1612	0.1942	45.27	36.95	30.68
Malaysia	Female	Mean	0.0747	0.1257	0.2054	52.01	30.90	18.91
		Std	0.0850	0.1175	0.1535	70.04	50.71	38.80
	Male	Mean	0.1044	0.1639	0.2525	37.20	23.70	15.38
		Std	0.1246	0.159	0.1916	47.79	38.44	31.09
Singapore	Female	Mean	0.0388	0.0646	0.1055	100.00	60.11	36.81
		Std	0.0596	0.0711	0.0666	100.00	83.80	89.50
	Male	Mean	0.0508	0.0811	0.1274	76.47	47.87	30.49
		Std	0.0803	0.0915	0.0796	74.14	65.07	74.83

CONCLUSIONS

This chapter is to summarize all the contents in this paper. To start with, data for analysis are based on Indonesia, Malaysia, and Singapore mortality rate in year 2000-2015 with 5-year aged group. Then I did the interpolation to determine single year value by using Beer graduation ordinary and modified method. The mortality projection is estimated by using decreasing annual mortality rate.

Firstly, we try to calculate actuarial present value (APV) for life insurance (determine APV for aged 30, 40, and 50) and life annuity (determine APV for aged 50, 60, and 70). Based on this calculation, Indonesia has highest APV life insurance followed Malaysia then Singapore either for female or male. It means that, for the country which has higher mortality rate gives higher APV life insurance and lower. Vice versa, if the country has lower mortality rate, it gives lower APV life insurance. For gender side, APV for female is lower than male for these three countries. For age side, the older the policyholder, the higher the APV of life insurance. On the other hand, the older the policyholder, the lower the APV of life annuities.

According to this paper analyzes, we can conclude that it would be better to open annuity market in Indonesia, Malaysia, and Singapore. Indonesia has lower mortality rate and give the best profit for longevity bond either female or male. Malaysia is the second place after Indonesia to make profit from annuity product and followed Singapore. But for Singaporean female, we must be careful about the annuity product for early age 50 years old.

REFERENCES

[1] A. Benfield, "Global Insurance Market Opportunities," *Risk. Reinsurance. Human Resources*, vol. 1, p. 63, 2015.

[2] World Health Organization (2015), *World health statistics 2015*. World Health Organization.

[3] S. Levantesi, M. Menzietti, T. Torri, "Longevity bond pricing models: an application to the Italian annuity market and pension schemes," G. Dell'Istituto Ital. Degli Attuari, vol. 72, pp. 125–147, 2009.

[4] G. J. Thomsen, J. V. Andersen, F. Markets, "Longevity Bonds – a Financial Market Instrument to Manage Longevity Risk," *Denmark National Bank Monetary Review*, vol. 4, pp. 29-44, 2007.

[5] R. L. Brown, J. McDaid, "Factors Affecting Retirement Mortality," North Am. Actuar. J., vol. 7, no. 2, pp. 24–43, 2003, doi: 10.1080/10920277.2003.10596083.

[6] S. Horiuchi, J. R. Wilmoth, "Deceleration in the age pattern of mortality at olderages," Demography, vol. 35, no. 4, pp. 391–412, 1998, doi: 10.2307/3004009.

[7] S. Brown, "Excess mortality of schizophrenia: A meta-analysis," Br. J. Psychiatry, vol. 171, no. 6, pp. 502–508, 1997, doi: 10.1192/bjp.171.6.502.

[8] M. J. Thun et al., "Alcohol Consumption and Mortality among Middle-Aged and Elderly U.S. Adults," N. Engl. J. Med., vol. 337, no. 24, pp. 1705–1714, 1997, doi: 10.1056/NEJM199712113372401.

[9] G. E. Vaillant, K. Mukamal, "Successful Aging," Am. J. Psychiatry, vol. 158, no. 6, pp. 839–847, 2001, doi: 10.1176/appi.ajp.158.6.839.

[10] G. Pappas, S. Queen, W. Hadden, G. Fisher, "The Increasing Disparity in Mortality between Socioeconomic Groups in the United States, 1960 and 1986," N. Engl. J. Med., vol. 329, no. 2, pp. 103–109, 1993, doi: 10.1056/NEJM199307083290207.

[11] F. B. Rogers, S. R. Shackford, M. S. Keller, "Early Fixation Reduces Morbidity and Mortality in Elderly Patients with Hip Fractures from Low-Impact Falls," *J. Trauma Inj. Infect. Crit. Care*, vol. 39, no. 2, pp. 261–265, 1995, doi: 10.1097/00005373-199508000-00012.
[12] Central Intelligence Agency (Ed.), *The World Factbook 2011*. Central Intelligence Agency, 2011.
[13] P. M. Lantz, J. S. House, J. M. Lepkowski, D. R. Williams, R. P. Mero, J. Chen, "Socioeconomic Factors, Health Behaviors, and Mortality: Results From a Nationally Representative Prospective Study of US Adults," JAMA, vol. 279, no. 21, p. 1703, 1998, doi: 10.1001/jama.279.21.1703.
[14] J. Kallan, "Effects of sociodemographic variables on adult mortality in the United States: Comparisons by sex, age, and cause of death," *Biodemography Soc. Biol.*, vol. 44, no. 1–2, pp. 136–147, 1997, doi: 10.1080/19485565.1997.9988940.
[15] International Monetary Fund, International Monetary Fund Annual Report 2015: Tackling Challenges Together. Washington, D.C.: International Monetary Fund, 2015. doi: 10.5089/9781513510798.011.
[16] "Malaysia Demographic Statistics Quarter 1 2018," http://ghdx.healthdata.org/record/malaysia-demographic-statistics-quarter-1-2018
[17] S. Indonesia, "Statistical Yearbook of Indonesia 2015," Statistics Indonesia, 2015.
[18] D. B. Allison et al., "Antipsychotic-induced weight gain: a comprehensive research synthesis.," Am. J. Psychiatry, vol. 156, no. 11, pp. 1686–1696, 1999, doi: 10.1176/ajp.156.11.1686.
[19] A. Rodgers, "Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised," BMJ, vol. 321, no. 7275, pp. 1493–1493, 2000, doi: 10.1136/bmj.321.7275.1493.
[20] J. Vallin, F. Meslé, "Convergences and divergences in mortality: A new approach of health transition," Demogr. Res., vol. Special 2, pp. 11–44, 2004, doi: 10.4054/DemRes.2004.S2.2.
[21] Kark, J. D., Shemi, G., Friedlander, Y., Martin, O., Manor, O., & Blondheim, S. H. (1996). Does religious observance promote health? mortality in secular vs religious kibbutzim in Israel. *American Journal of Public Health*, vol. 86, no. 3, pp. 341-346.
[22] "Global Youth Tobacco Survey (GYTS) Indonesia Report, 2014." WHO Regional Office for South-East Asia, 2015.
[23] B. Everitt, A. Skrondal, The Cambridge dictionary of statistics, *Cambridge University Press*, 2010.
[24] L. Gordis, "Epidemiology e-book," *Elsevier Health Sciences,* 2013.