Example 1: Statistics and life insurance

Worksheet 1: Standardised Death Rate for Male in 2020

In the following website, please refer to the Feature article "The Mortality Trend in Hong Kong, 1986 to 2020" in Hong Kong Monthly Digest of Statistics November 2021 compiled by the Census and Statistics Department (C&SD) and answer the following questions.

https://www.censtatd.gov.hk/en/EIndexbySubject.html?scode=160&pcode=FA100094

1. According to the data on Table 1 "Number of deaths, crude death rate and standardised death rate, 1986 to 2020" on page 5 of the monthly digest, project the population of Hong Kong in 2020.

2. Refer to the following URL:
    https://www.info.gov.hk/gia/general/202108/12/P2021081200387.htm?fontSize=1
    Try to discuss and explain why the 2020 Hong Kong population and the projection of question 1 are different.

3. Refer to Table 3.2 on page 61 in the 2016 Population By-census Main Results (https://www.bycensus2016.gov.hk/data/16bc-main-results.pdf), taking the population of male in 2016 as the reference population, then applies the 2020 death rates for male by age group to the reference population structure in 2016, the expected number of deaths for male of each age group in 2016 population can be found. Try to complete the table below to find out the total number of expected deaths of male.

Age group	Death rate by age group (per 1,000 males) in 2020	Male population (reference population) in 2016	Expected number of deaths in male population
0	2.1	27691	$27691 \times \dfrac{2.1}{1000} = 58$
1 – 4	0.1		
5 – 9	0.1		
10 – 14	0.1		
15 – 19	0.2		
20 – 24	0.3		
25 – 29	0.4		
30 – 34	0.5		
35 – 39	0.8		
40 – 44	1.2		
45 – 49	2.0		
50 – 54	3.3		
55 – 59	5.1		
60 – 64	7.5		
65 – 69	12.2		
70 – 74	18.8		
75 – 79	34.2		
80 – 84	52.5		
85+	111.6		
Total			

Total number of expected deaths of males =

Standardised death rate for male in 2020 (per 1000 males) =

Worksheet 2: Calculation of insurance premiums

1. Refer to the 2016 Population By-census data and download it from the website:
    https://www.censtatd.gov.hk/en/EIndexbySubject.html?scode=600&pcode=D5212101

    Download Table E2021A: 2021 Population Census - Main Tables (Demographic)

    Select Table A103ae: Population, Population (Excluding Foreign Domestic Helpers) by Sex, Age and Year

    Process the Feature Article "The Mortality Trend in Hong Kong, 1986 to 2020" and 2016 Population By-census data comprehensively and create a spreadsheet integrating the 2016 population by sex and age group, standardised death rate and death population.

Cross-curricular learning: The following are some extended learning contents of "Module 1.3 Financial Education" of the "Citizenship, Economics and Society (Secondary 1-3)" curriculum.

Basic knowledge about insurance

Insurance can be broadly divided into life insurance and general insurance. Life insurance pays the beneficiaries a lump sum upon the insured's death. As for general insurance, it provides coverage for losses other than death, such as personal injury or damage to assets caused by accidents.

Insurance gives you peace of mind and some financial protection against unforeseen incidents and other risks in life. You may need insurance for many reasons, some of which include protecting your dependents in the event of your death, your ability to earn an income, your home, car, or other assets in case of theft or disaster.

Insurance is about managing risks. If you have insurance cover, you transfer part of the financial risk to your insurer. Without insurance, you bear the financial risk by yourself. Incorporating insurance into your financial plan is necessary to protect yourself, your family and your assets, and safeguard against a wide range of risks.

Source: Investor and Financial Education Council website.
https://www.ifec.org.hk/web/en/financial-products/insurance/basics/insurance-basics.page

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1. An insurance company wants to sell a 1-year term life insurance policy with $1,000,000 sum insured for all the males in the age group of 40-44. Please help the insurance company to calculate the premiums that policyholders need to pay.

Extract records of male in the spreadsheet to complete the following table:

Male			
Age group	Standardised death rate	Population	Number of deaths
0	2.1	27691	
1 – 4	0.2	117132	
5 – 9	0.1		
10 – 14	0.1		
15 – 19	0.2		
20 – 24	0.3		
25 – 29	0.5		
30 – 34	0.6		
35 – 39	0.8		
40 – 44	1.3		
45 – 49	2.0		
50 – 54	3.1		
55 – 59	5.3		
60 – 64	8.4		
65 – 69	12.7		
70 – 74	21.6		
75 – 79	34.6		
80 – 84	60.3		
85+	123.0		
All ages	7.7		

According to the data in the table above, the number of deaths of males in the 40-44 age group is

Suppose all males in that age group purchase this life insurance.

The amount of compensation from the insurance company is

Find out the total number of males in the 40-44 age group. If the compensation is shared among them, the minimum insurance premium they should pay in that year is

2. Using a similar approach, if an insurance company switched to selling the same life insurance to all females in the 40-44 age group, how much would each female pay?

Extended Question:

3. If the insurance company changes to a 10-year term life insurance policy with $1,000,000 sum insured for 50,000 males aged 43, what additional data is needed to determine the annual premium that each customer has to pay?

   Hint: If you can find the standardised death rate for each age between the ages of 43 and 53, the calculated insurance amount will be more accurate. In 2016, the standardised death rate for males aged 40 – 44 was 1.3, that for males in the 45 – 49 age group was 2.0, and that for males in the 50 – 54 age group is 3.1.

   (a)   Based on these data, we can calculate the number of deaths of male per year, try to complete the following table:

Male			
Period	**Age**	**Number of deaths**	**Number of survivors**
0	43	0	50000
1	44	$50000 \times \dfrac{1.3}{1000} = 65$	49935
2	45		
3	46		
4	47		
5	48		
6	49		
7	50		
8	51		
9	52		
10	53		

(b)   Calculate the total amount of insurance paid by insurance companies over a 10-year period.

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(c)   Assume that the survivor pays the equivalent insurance premium of HK\$ x each year, try to find out the value of x.

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(d)   Why is the premium of a 10-year term life insurance policy higher than that of a 1-year life term life insurance policy?

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(e)   What other possible considerations are there when calculating insurance companies' actual premiums?

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END