1. INTRODUCTION

1.1 *A life table is a useful tool for presenting the mortality situation of a population. A life table is prepared from age-specific mortality rates or probability of deaths (q_x) and the results used to measure mortality, survival ratio and life expectancy.*

1.2 *Life expectancy is the average number of years a person is expected to live at the beginning of a certain age, assuming the mortality rate of a certain age is the same throughout his or her lifetime. Life expectancy at birth reflects mortality. It is independent of the population's age structure and is not influenced by extraneous factors such as the selection of a standard population, changes in birth rates and other demographic phenomena.*

1.3 *Life tables are used by demographers, public health workers and actuaries in the studies of fertility, mortality, migration, longevity, population growth, population projections, length of working life and length of married life*[1]*.*

1.4 *This report also provides life tables by major ethnic group at Malaysia level based on the classification used during Population and Housing Census of Malaysia 2020 (MyCensus 2020). The classifications used are:*

Citizens

a. *Bumiputera consists of Malay and Other Bumiputera;*
b. *Chinese;*
c. *Indians; and*
d. *Others.*

Non-citizens

1.5 *The statistics of life expectancy for 2020 to 2025 have been revised based on the MyCensus 2020 meanwhile the statistics of life expectancy for 2010 to 2019 are based on the Population and Housing Census of Malaysia 2010 (Census 2010) and will be revised later.*

[1] *H.S Shryock and J.S. Siegel (1976)*

2. CONCEPTS

2.1 *Abridged life table is a table that shows the probability that a person at a certain age (5-year age interval) will die before reaching his or her next birthday. A life table is prepared from age-specific mortality rates or probability of deaths (q_x) and the results used to measure mortality, survival ratio and life expectancy.*

2.2 *Life expectancy is the average remaining age (years) for a person is expected to live at the beginning of a certain age if the age-specific death rates of the given period continued throughout his or her lifetime.*

2.3 *Survivors are the number of survivors at the beginning of a certain age.*

3. METHODOLOGY

3.1 *The life tables are generated from Coale-Demeny (West) model based on the average final number of mid-year for three year. This approach was adopted to minimise random annual fluctuations in the number of deaths. The use of triennial deaths implies that there will always be a time lag of one or two years for life tables of a year to be made available. For the calculation of life expectancy in the latest year, the same model was also applied but it takes into account the number of deaths in the current year only. However, the life expectancy will be updated the following year when the mid-year death numbers for the three-year period are available. Since 1991, the calculation of life expectancy for the current year has used the Brass Logit model. However, starting 2024, the Coale-Demeny (West) model will be used instead of the Brass Logit model because the assessment of this model showed that the estimates is more accurate as compared to the Brass Logit model.*

3.2 *The abridged life tables 2023 (final) are generated using the Coale-Demeny (West) model based on the average final number of mid-year deaths by single age, ethnic group, sex, state and administrative districts for 2022, 2023 and 2024.*

3.2.1 *Mid-year data on deaths for 2022 refers to the deaths recorded in the second half-yearly of 2021 from July to December 2021 and the first half-yearly of 2022 deaths from January to June 2022 by single age, ethnic group, sex, state and administrative districts.*

3.2.2 *Mid-year data on deaths for 2023 refers to the deaths recorded in the second half-yearly of 2022 from July to December 2022 and the first half-yearly of 2023 deaths from January to June 2023 by single age, ethnic group, sex, state and administrative districts.*

3.2.3 Mid-year data on deaths for 2024 refers to the deaths recorded in the second half-yearly of 2023 from July to December 2023 and the first half-yearly of 2024 deaths from January to June 2024 by single age, ethnic group, sex, state and administrative districts.

3.2.4 The input of the population used to generate the abridged life tables is the mid-year population estimates for 2023 based on the MyCensus 2020 by single age, ethnic group, sex, state and administrative districts.

3.3 The abridged life tables 2024 (preliminary) are generated using the Coale-Demeny (West) model based on the average final number of mid-year deaths by single age, ethnic group, sex, state and administrative districts for 2023, 2024 and 2025 (estimates).

3.3.1 Mid-year data on deaths for 2023 refers to the deaths recorded in the second half-yearly of 2022 from July to December 2022 and the first half-yearly of 2023 deaths from January to June 2023 by single age, ethnic group, sex, state and administrative districts.

3.3.2 Mid-year data on deaths for 2024 refers to the deaths recorded in the second half-yearly of 2023 from July to December 2023 and the first half-yearly of 2024 deaths from January to June 2024 by single age, ethnic group, sex, state and administrative districts.

3.3.3 Mid-year death estimates for 2025 refer to the deaths recorded in the second half-yearly of 2024 from July to December 2024 and the first half-yearly of 2025 deaths from January to June 2025 by single age, ethnic group, sex, state and administrative districts. The 2025 estimate deaths based on 10-year death time series data using the time series modeler-exponential smoothing models.

3.3.4 The input of the population used to generate the abridged life tables is the mid-year population estimates for 2024 based on the MyCensus 2020 by single age, ethnic group, sex, state and administrative districts.

3.4 The abridged life tables 2025 (estimates) are generated using the the Coale-Demeny (West) model based on the number of mid-year deaths for current year.and mid-year population estimates for the current year.

3.4.1 Mid-year death estimates for 2025 refer to the deaths recorded in the second half-yearly of 2024 from July to December 2024 and the first half-yearly of 2025 deaths from January to June 2025 by single age, ethnic group, sex, state and administrative districts.

3.4.2 *The input of the population used to generate the abridged life tables is the mid-year population estimates for 2025 based on the MyCensus 2020 by single age, ethnic group, sex, state and administrative districts.*

3.5 *The calculation of life tables requires a set of input values of either the age-specific mortality rates of the population, ${}_nM_x$ or the ${}_nq_x$ values, that is, probabilities of dying between exact ages x and $x+n$, where n equals to 5-year age intervals except for the first two age groups below 1 year and 1-4 years.*

3.6 *For estimating ${}_1q_0$ and ${}_4q_1$ from ${}_1M_0$ and ${}_4M_1$ and ${}_1L_0$ (where ${}_1L_0$ refers to the number of person-years lived between age 0 and 1) and ${}_4L_1$ from ${}_1q_0$ and ${}_4q_1$, death separation factors which are required from the Coale-Demeny model life tables[2].*

3.7 *The data input is in the form of 17 values of ${}_nM_x$ or ${}_nq_x$. If there are more than 17 values, only data up to ${}_5q_{75}$ were taken. If there are less than 17 values, that is data up to an age group below the age of 75 years, extrapolation up to the age of 75 years is done automatically.*

3.8 *The extrapolation is done by assuming that the ${}_5q_x$ values have exponential functions. The ratio of the two highest values of ${}_nq_x$ in the data input is constant for estimation, up to the age of 75 years. For example, the ratio of a from the data given is computed as:*

$$a = \frac{{}_5q_{x+5}}{{}_5q_x}$$

where:

${}_5q_{x+5}$ *The highest value of the given set in which x is less than 70*

a *Constant value*

Therefore, the estimate of ${}_5q_{x+10}$ is:

$${}_5q_{x+10} = a \cdot {}_5q_{x+5}$$

This relationship is used in estimation up to ${}_5q_{75}$.

[2] *A. Coale and P. Demeny* (1966)

3.9 The age-specific mortality rates, ${}_nM_x$ of the population calculated as follows:

$$ {}_nM_x = \frac{{}_nD_x}{{}_nP_x} $$

where:

${}_nD_x$ Number of deaths between ages x and $x+n$

${}_nP_x$ Number of populations between ages x and $x+n$

4. COMPUTATION OF LIFE TABLE FUNCTIONS

4.1 If ${}_nM_x$ values are used as inputs, the ${}_nq_x$ values are computed as:

$$ {}_nq_x = \frac{(n.\ {}_nM_x)}{(1 + (n - {}_nk_x).\ {}_nM_x)} $$

where:

${}_nq_x$ Probability of dying between exact age x and exact age $x+n$

${}_nM_x$ Age-specific mortality rates for ages x and $x+n$

n Age group interval (1, 4 and 5)

${}_nk_x$ Death separation factor for ages x and $x+n$

The death separation factors for ages below 1 year and 1-4 years can be provided as the input or the Coale-Demeny death separation factors can be used.

The separation factor for all higher age groups is assumed to be 2.5.

4.2 Survivors (the number of survivors) at each exact age x, l_x is:

$$ \frac{l_{x+n}}{l_x} = 1 - {}_nq_x $$

with a radix of 100,000 births, that is at exact age 0, l_0

4.3 The number of deaths between exact ages x and $x+n$, ${}_nd_x$ is:

$$ {}_nd_x = l_x - l_{x+n} $$

4.4 *The number of person-years lived (survivors) between exact ages* x *and* $x + n$, ${}_nL_x$ *is calculated as:*

$${}_1L_0 = {}_1k_0 \,.\, l_0 + (1 - ({}_1k_0))l_1$$

$${}_4L_1 = {}_4k_1 \,.\, l_1 + (4 - ({}_4k_1))l_5$$

$${}_5L_x = 2.5(l_x + l_{x+5}) \qquad x = 5, 10, \ldots 75$$

where:

${}_1k_0$ *Death separation factors for ages below 1 year*

Male : ${}_1k_0 = 0.0425 + 2.875\ {}_1q_0$

Female : ${}_1k_0 = 0.05 + 3.0\ {}_1q_0$

${}_4k_1$ *Death separation factors for aged 1-4 years*

Male : ${}_4k_1 = 1.653 - 3.013\ {}_1q_0$

Female : ${}_4k_1 = 1.524 - 1.625\ {}_1q_0$

All the death separation factors used are as suggested in Coale-Demeny model life tables.

The open-ended age group, L_{80+} *is calculated as:*
$L_{80+} = 3.725\ (l_{80}) + 0.0000625\ (l_{80})^2$

4.5 *The central mortality rate between age* x *and age* $x + n$, ${}_nm_x$ *is:*

$${}_nm_x = \frac{{}_nd_x}{{}_nL_x}$$

4.6 *The total number of person-years lived after exact age* x, T_x *is:*

$$T_x = \sum_{y=x}^{y=w} L_y$$

where:

$\sum_{y=x}^{y=w} L_y$ *Sum of the* L_x *for ages* x *and over to the end of the life table*

w *The oldest age in the life table*

4.7 *The survival ratio,* ${}_nS_x$ *is:*

$$ {}_nS_x = \frac{{}_nL_{x+5}}{{}_nL_x} $$

where:

Proportion of surviving from birth to ages 0-4 years is:

$$ S_0 = \frac{{}_5L_0}{5(l_0)} $$

Proportion of surviving from ages 0-4 years to 5-9 years is:

$$ S_1 = \frac{{}_5L_5}{{}_5L_0} $$

Proportion of surviving from ages x *to* $x + 5$ *is:*

$$ {}_5S_x = \frac{{}_5L_{x+5}}{{}_5L_x} $$

Proportion of surviving from ages 75-80 years and over is:

$$ S_{75+} = \frac{L_{80+}}{L_{75+}} $$

4.8 *Life expectancy at the age* x, e_x *is:*

$$ e_x = \frac{T_x}{l_x} $$

5. LIFE TABLE DEFINITIONS

x *and* $x + n$	*The period of life between two exact ages* x *and* $x + n$.
	For example, age group of the age of '65-70' means the 5-year interval between the 65th and 70th birthdays.
${}_nq_x$	*The probability of dying between age* x *and age* $x + n$, *the proportion of persons in the cohort that alive at the beginning of age interval* x *who will die before reaching the end of that age interval* $x + n$.

For example, refer to the Table 2.1, the probability that a person of exact the age of 65th will die before reaching his 70th birthday, ${}_5q_{65}$ is 0.13690, that is, out of every 100,000 persons alive and exactly 65 years old, 13,891 will die before reaching their 70th birthday.

l_x *Survivors at each exact age x, that is, the number of persons living at the beginning of an age interval x out of a total of births assumed to be 100,000 persons.*

For example, refer to the Table 2.1, out of 100,000 newborn male babies, 73,070 persons would survive to exact the age of 65th years.

${}_nd_x$ *The number of deaths between exact age x and exact age $x+n$, that is, the number of persons who would die within the indicated age interval x to $x+n$ out of the total number of births assumed in the table.*

For example, refer to the Table 2.1 there would be 10,003 deaths for male between exact the ages of 65 years and 70 years to the initial cohort of 100,000 newborn male babies.

${}_nm_x$ *Central mortality rate between exact age x and exact age $x+n$.*

For example, refer to the Table 2.1, the central mortality rate for male between the age of 65 years and the age of 70 years is 10,003 / 340,344 that is, 0.02939.

${}_nL_x$ *The number of person-years lived (survivors) between exact age x and exact age $x+n$ by the cohort 100,000 births assumed.*

For example, refer to the Table 2.1, the 100,000 newborn male babies would live 340,344 person-years between exact the ages of 65 years and 70 years. Out of 73,070 person who reach the age of 65 years, the 62,617 persons who survive to the age of 70 years would live 5 years each, that is 315,335 person-years (63,067 x 5 = 315,335 person-years) and 10,003 persons who die would each live varying periods of time less than 5 years, averaging about 2.5 years, that is 25,252.5 person-years (10,003 x 2.5 = 25,007.5).

$_nS_x$ *The proportion of survivors from age group x to $x+n$ to another age group $x+5$ to $x+5+n$.*

For example, refer to the Table 2.1 the proportion of survivors for male from the age group of 65-69 to the age group of 70-74 is 284,881/ 340,344 that is 0.83704.

T_x *The total number of person-years to be lived after the beginning of exact age x by the cohort of 100,000 births assumed.*

For example, refer to the Table 2.1, the 100,000 of newborn male babies would live,1,055,472 person-years after their 65th birthday.

e_x *Life expectancy is the average remaining age (years) for a person is expected to live (survives) at the beginning of a certain age x if the age-specific death rates of the given period continued throughout his/ her lifetime.*

For example, refer to the Table 2.1, males who reaches his 65th birthday is expected to live 14.4 years more.

6. NOTE AND SYMBOLS

p	*Preliminary*
e	*Estimates*
W.P.	*Wilayah Persekutuan*
-	*Nil/ blank*
N/A	*Not available*
..	*Data not acquired*