STATISTICS INDONESIA

The Agent of Trustworthy Statistical Data For All

Life Expectancy

BPS-Statistics Indonesia

Islamabad, Pakistan

18-20 September, 2017

INTRODUCTION

- Life table is an analytical tool for estimating demographic indicators.
- Strength : ready to use with the absence of standardized population
- Life table is a table consist of a life history of a population by age in *a single statistical model*

- Life table is a way to analyze Age Specific Death Rate (ASDR) and survival analysis
- Life table explains the history of a group of population (hypothetical group) or a cohort with gradually death history.

Benefits of *Life Table*

- To compare mortality rates among population (different region, different cohort etc)
- To measure the improvement of health development, especially for the children (from the e0 number)
- As a Base for life insurance calculation : Premium insurance

- The World Health Organization (WHO) began producing annual life tables for all Member States in 1999.
- These life tables are a basic input to all WHO estimates of global, regional and country-level patterns and trends in all-cause and cause-specific mortality.

Types of Life Table

1. Complete life table
2. Abridged life table

Complete *Life Table*

- Create in a complete table,
- Disaggregate by a single age,
- Note for q_x : interval x to x+1

  Example : q_{30} for interval 30 to 31

Example of Complete *Life Table*

Table A1: Complete Life Table for Singapore Resident Population, 2014

Age x (years)	Probability of dying between exact age x and age x+1 q_x	Number of survivors at exact age x l_x	Number of deaths between exact age x and age x+1 d_x	Number of person-years lived between exact age x and age x+1 L_x	Total person-years lived after exact age x T_x	Expectation of life at exact age x e_x
0	0.00209	100,000	209	99,827	8,264,975	82.6
1	0.00013	99,791	13	99,785	8,165,148	81.8
2	0.00012	99,778	12	99,772	8,065,364	80.8
3	0.00011	99,766	11	99,761	7,965,592	79.8
4	0.00009	99,755	9	99,751	7,865,831	78.9
5	0.00007	99,746	7	99,743	7,766,081	77.9
6	0.00005	99,739	5	99,737	7,666,338	76.9
7	0.00004	99,734	4	99,732	7,566,602	75.9
8	0.00004	99,730	4	99,728	7,466,870	74.9
9	0.00005	99,726	5	99,724	7,367,142	73.9
10	0.00006	99,721	6	99,718	7,267,418	72.9
11	0.00007	99,715	7	99,712	7,167,700	71.9
12	0.00009	99,708	9	99,704	7,067,989	70.9
13	0.00011	99,699	11	99,694	6,968,285	69.9
14	0.00013	99,688	13	99,682	6,868,592	68.9
90	0.12053	31,007	3,737	29,139	161,409	5.2
91	0.13254	27,270	3,614	25,463	132,271	4.9
92	0.14556	23,656	3,443	21,935	106,808	4.5
93	0.15963	20,213	3,227	18,600	84,873	4.2
94	0.17483	16,986	2,970	15,501	66,274	3.9
95	0.19119	14,016	2,680	12,676	50,773	3.6
96	0.20877	11,336	2,367	10,153	38,097	3.4
97	0.22762	8,969	2,042	7,948	27,944	3.1
98	0.24779	6,927	1,716	6,069	19,996	2.9
99	0.26929	5,211	1,403	4,510	13,927	2.7
100+	1.00000	3,808	3,808	9,418	9,418	2.5

Single year

Sumber: Depertment Statistics of Singapore

Abridged *Life Table*

- *Abridged Life Table* is a more compact and simple life table, the accuracy is almost the same as *Complete Life Table*,
- Disagregated by 5 year age group,
- For country with unequal distribution of population , *Abridged Life Table* is more precise
- Notation : n= age interval and x= exact age x, such as : ${}_nq_x$, ${}_nd_x$, ${}_np_x$, and ${}_nL_x$, while for l_x, T_x, and e_x just the same and related with population at age x
- Example : ${}_5q_{30}$ for interval 30 to 35

Example of Abridged *Life Table: Life Table* Indonesia, *2000, Male*

Indonesian Life Table for Male, 2000

Age	interval (h)	mx (1)	qx (2)	Px (3)	lx (4)	dx (5)	Lx (6)	Tx (7)	ex (8)
[0,1)	1	0.037916	0.036936	0.963064	100000	3694	97415	6116997	61.17
[1,5)	4	0.002552	0.010946	0.989054	96306	1054	413019	6019582	62.50
[5,10)	5	0.001801	0.008963	0.991037	95252	854	474127	5606563	58.86
[10,15)	5	0.001330	0.006629	0.993371	94398	626	470428	5132437	54.37
[15,20)	5	0.002739	0.013599	0.986401	93773	1275	465675	4662009	49.72
[20,25)	5	0.002086	0.010376	0.989624	92497	960	460088	4196333	45.37
[25,30)	5	0.003806	0.018850	0.981150	91538	1725	453375	3736246	40.82
[30,35)	5	0.003774	0.018695	0.981305	89812	1679	444864	3282871	36.55
[35,40)	5	0.004183	0.020698	0.979302	88133	1824	436106	2838007	32.20
[40,45)	5	0.005828	0.028720	0.971280	86309	2479	425348	2401901	27.83
[45,50)	5	0.011749	0.057070	0.942930	83830	4784	407190	1976553	23.58
[50,55)	5	0.016448	0.078990	0.921010	79046	6244	379620	1569363	19.85
[55,60)	5	0.020638	0.098128	0.901872	72802	7144	346151	1189742	16.34
[60,65)	5	0.043596	0.196558	0.803442	65658	12906	296027	843592	12.85
[65,70)	5	0.056771	0.248575	0.751425	52753	13113	230980	547565	10.38
[70,75)	5	0.093707	0.379606	0.620394	39640	15047	160579	316585	7.99
[75+)		0.157637	1.000000	0.000000	24592	24592	156005	156005	6.34

5 year interval (breakdown)

5 year interval

Sumber: Ministry of Health Republic of Indonesia, 2002

Example Abridged *Life Table:* *Life Table* Indonesia, *2000, Female*

Indonesian Life Table for Female, 2000

Age	interval (h)	mx (1)	qx (2)	px (3)	Lx (4)	dx (5)	Lx (6)	Tx (7)	ex (8)
[0,1)	1	0.033261	0.032504	0.967496	100000	3250	97725	6484527	64.85
[1,5)	4	0.002406	0.010318	0.989682	96750	998	414932	6386802	66.01
[5,10)	5	0.001499	0.007468	0.992532	95751	715	476969	5971871	62.37
[10,15)	5	0.001548	0.007709	0.992291	95036	733	473349	5494902	57.82
[15,20)	5	0.001358	0.006769	0.993231	94304	638	469922	5021552	53.25
[20,25)	5	0.002434	0.012097	0.987903	93665	1133	465494	4551630	48.59
[25,30)	5	0.002815	0.013975	0.986025	92532	1293	459428	4086137	44.16
[30,35)	5	0.003513	0.017412	0.982588	91239	1589	452224	3626708	39.75
[35,40)	5	0.003679	0.018229	0.981771	89650	1634	444167	3174485	35.41
[40,45)	5	0.005983	0.029472	0.970528	88016	2594	433596	2730318	31.02
[45,50)	5	0.006540	0.032174	0.967826	85422	2748	420240	2296722	26.89
[50,55)	5	0.012601	0.061080	0.938920	82674	5050	400745	1876482	22.70
[55,60)	5	0.016728	0.080282	0.919718	77624	6232	372541	1475738	19.01
[60,65)	5	0.029630	0.137933	0.862067	71392	9847	332343	1103197	15.45
[65,70)	5	0.035338	0.162348	0.837652	61545	9992	282745	770854	12.53
[70,75)	5	0.060610	0.263174	0.736826	51553	13567	223847	488109	9.47
[75+)		0.143743	1.000000	0.000000	37986	37986	264261	264261	6.96

Sumber: Ministry of Health Republic of Indonesia, 2002

Example of Abridged *Life Table*: *Life Table* Indonesia, *2000, Male + Female*

Indonesian Life Table for Male & Female, 2000

Age	interval (h)	mx (1)	qx (2)	px (3)	lx (4)	dx (5)	Lx (6)	Tx (7)	ex (8)
[0,1)	1	0.035662	0.034793	0.965207	100000	3479	97564	6296836	62.97
[1,5)	4	0.002481	0.010641	0.989359	96521	1027	413944	6199272	64.23
[5,10)	5	0.001655	0.008240	0.991760	95494	787	475501	5785328	60.58
[10,15)	5	0.001435	0.007151	0.992849	94707	677	471840	5309827	56.07
[15,20)	5	0.002064	0.010269	0.989731	94029	966	467733	4837987	51.45
[20,25)	5	0.002264	0.011258	0.988742	93064	1048	462700	4370253	46.96
[25,30)	5	0.003291	0.016323	0.983677	92016	1502	456326	3907553	42.47
[30,35)	5	0.003641	0.018038	0.981962	90514	1633	448489	3451228	38.13
[35,40)	5	0.003524	0.017468	0.982532	88881	1553	440526	3002738	33.78
[40,45)	5	0.005903	0.029086	0.970914	87329	2540	430294	2562213	29.34
[45,50)	5	0.009239	0.045152	0.954848	84789	3828	414373	2131918	25.14
[50,55)	5	0.014462	0.069789	0.930211	80960	5650	390677	1717545	21.21
[55,60)	5	0.018686	0.089261	0.910739	75310	6722	359746	1326868	17.62
[60,65)	5	0.036210	0.166021	0.833979	68588	11387	314473	967122	14.10
[65,70)	5	0.045565	0.204528	0.795472	57201	11699	256757	652649	11.41
[70,75)	5	0.077155	0.323395	0.676605	45502	14715	190722	395892	8.70
[75+)		0.150055	1.000000	0.000000	30787	30787	205171	205171	6.66

Sumber: Ministry of Health Republic of Indonesia, 2002

Abridged *Life Table: Life Table* Indonesia, *2010*

Life Table Indonesia menurut Metode Log-quadratic dengan k=0.

Laki-laki

Age (x)	$_nm_x$	l_x	d_x	q_x	p_x	L_x	T_x	e_x
0	0.02891	100,000	2,820	0.02820	0.97180	98,026	6,718,163	67.2
1	0.00156	97,180	606	0.00623	0.99377	387,511	6,620,136	68.1
5	0.00070	96,575	337	0.00349	0.99651	482,031	6,232,626	64.5
10	0.00061	96,238	291	0.00302	0.99698	480,461	5,750,594	59.8
15	0.00136	95,947	650	0.00677	0.99323	478,109	5,270,133	54.9
20	0.00189	95,297	896	0.00940	0.99060	474,244	4,792,024	50.3
25	0.00192	94,401	903	0.00957	0.99044	469,746	4,317,780	45.7
30	0.00220	93,498	1,021	0.01092	0.98908	464,936	3,848,033	41.2
35	0.00287	92,477	1,319	0.01427	0.98573	459,085	3,383,098	36.6
40	0.00408	91,157	1,841	0.02019	0.97981	451,185	2,924,013	32.1
45	0.00628	89,317	2,763	0.03093	0.96907	439,676	2,472,828	27.7
50	0.00991	86,554	4,192	0.04843	0.95157	422,290	2,033,152	23.5
55	0.01570	82,362	6,241	0.07578	0.92422	396,208	1,610,863	19.6
60	0.02480	76,121	8,909	0.11704	0.88296	358,332	1,214,655	16.0
65	0.03870	67,212	11,901	0.17706	0.82294	306,307	856,323	12.7
70	0.06021	55,311	14,550	0.26306	0.73694	240,181	550,016	9.9
75	0.09448	40,761	15,577	0.38214	0.61786	164,864	309,836	7.6
80	0.14575	25,185	13,310	0.52848	0.47152	92,649	144,972	5.8
85	0.22138	11,875	8,115	0.68333	0.31667	39,089	52,323	4.4
90	0.31972	3,760	3,068	0.81596	0.18404	11,131	13,234	3.5
95	0.43821	692	620	0.89574	0.10426	1,911	2,103	3.0
100	0.56385	72	70	0.96646	0.03354	186	192	2.7
105	0.68263	2	2	1.00000	0.00000	6	6	2.5

Perempuan

Age (x)	$_nm_x$	l_x	d_x	q_x	p_x	L_x	T_x	e_x
0	0.02338	100,000	2,291	0.02290	0.97710	98,397	7,258,935	72.6
1	0.00136	97,710	531	0.00544	0.99456	389,775	7,160,538	73.3
5	0.00051	97,178	247	0.00254	0.99746	485,274	6,770,763	69.7
10	0.00041	96,931	198	0.00205	0.99795	484,160	6,285,489	64.8
15	0.00069	96,733	331	0.00342	0.99658	482,837	5,801,329	60.0
20	0.00086	96,402	412	0.00427	0.99573	480,980	5,318,492	55.2
25	0.00103	95,990	493	0.00513	0.99487	478,718	4,837,513	50.4
30	0.00133	95,497	632	0.00662	0.99338	475,907	4,358,795	45.6
35	0.00186	94,866	878	0.00925	0.99075	472,133	3,882,888	40.9
40	0.00268	93,988	1,251	0.01331	0.98669	466,810	3,410,755	36.3
45	0.00400	92,737	1,837	0.01981	0.98019	459,091	2,943,945	31.7
50	0.00595	90,900	2,666	0.02933	0.97067	447,835	2,484,854	27.3
55	0.00890	88,234	3,848	0.04361	0.95639	431,551	2,037,019	23.1
60	0.01412	84,386	5,763	0.06829	0.93171	407,525	1,605,468	19.0
65	0.02335	78,624	8,693	0.11056	0.88944	371,385	1,197,943	15.2
70	0.04020	69,931	12,818	0.18330	0.81670	317,607	826,558	11.8
75	0.06970	57,112	16,949	0.29677	0.70323	243,189	508,950	8.9
80	0.11652	40,163	17,959	0.44715	0.55285	155,919	265,761	6.6
85	0.18748	22,204	13,649	0.61471	0.38529	76,899	109,842	4.9
90	0.28146	8,555	6,528	0.76303	0.23697	26,457	32,943	3.9
95	0.40487	2,027	1,757	0.86656	0.13344	5,745	6,486	3.2
100	0.53959	271	257	0.95179	0.04821	709	742	2.7
105	0.66898	13	13	1.00000	0.00000	33	33	2.5

Sumber: Kajian Lif e Table Indonesia Berdasarkan Hasil SP2010, BPS, 2005

Model of Standard *Life Table*

- UN Models:
  - ✓ Far Eastern
  - ✓ Latin American
  - ✓ South Asian
  - ✓ Chilean
  - ✓ General

- Princeton Model (Coale Demeny):
  - ✓ West (reference for Indonesia)
  - ✓ South
  - ✓ East
  - ✓ North

x	n	$_nq_x$	$_np_x$	l_x	$_nd_x$	$_nL_x$	T_x	e_x
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*

x	=	Exact age (in year)
n	=	Aged Interval
$_nq_x$	=	probability of dying between exact age x and x+n
$_np_x$	=	probability of surviving between age x and x+n
l_x	=	Number of survivors at exact age x
$_nd_x$	=	Number of people dying between age x and x+n
L_x	=	years lived between age x and x+n
T_x	=	total years lived after exact age x
e_x	=	expectation of life , average number of life after exact age x

Note : for *complete life table*, n=1

Calculation of *Complete Life Table*

Mortality table for woman, Indonesia year 1959-1969

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0 1 2 3 4 : 105 : 109						

Mortality table for woman, Indonesia year 1959-1969

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0			2,256			
1						
2						
3						
4						
:						
105						
:						
109						

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0			2,256			
1			155			
2						
3						
4						
:						
105						
:						
109						

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0			2,256			
1			155			
2			91			
3						
4						
:						
105						
:						
109						

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e^0_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0			2,256			
1			155			
2			91			
3			69			
4			58			
:			:			
105			7			
:			:			
109			1			

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e^0_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0		100,000	2,256			
1			155			
2			91			
3			69			
4			58			
:			:			
105			7			
:			:			
109			1			

Radix

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0		100,000	2,256			
1		97,744	155			
2			91			
3			69			
4			58			
:			:			
105			7			
:			:			
109			1			

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0		100,000	2,256			
1		97,744	155			
2		97,589	91			
3		97,498	69			
4		97,429	58			
:		:	:			
105		16	7			
:		:	:			
109		1	1			

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256			
1		97,744	155			
2		97,589	91			
3		97,498	69			
4		97,429	58			
:		:	:			
105		16	7			
:		:	:			
109		1	1			

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256			
1	0,00158	97,744	155			
2		97,589	91			
3		97,498	69			
4		97,429	58			
:		:	:			
105		16	7			
:		:	:			
109		1	1			

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256			
1	0,00158	97,744	155			
2	0,00093	97,589	91			
3	0,00071	97,498	69			
4	0,00060	97,429	58			
:	:	:	:			
105	0,47662	16	7			
:	:	:	:			
109	1	1	1			

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109		
1	0,00158	97,744	155			
2	0,00093	97,589	91			
3	0,00071	97,498	69			
4	0,00060	97,429	58			
:	:	:	:			
105	0,47662	16	7			
:	:	:	:			
109	1	1	1			

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109		
1	0,00158	97,744	155	97,666		
2	0,00093	97,589	91			
3	0,00071	97,498	69			
4	0,00060	97,429	58			
:	:	:	:			
105	0,47662	16	7			
:	:	:	:			
109	1	1	1			

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109		
1	0,00158	97,744	155	97,666		
2	0,00093	97,589	91	97,544		
3	0,00071	97,498	69			
4	0,00060	97,429	58			
:	:	:	:			
105	0,47662	16	7			
:	:	:	:			
109	1	1	1			

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e^0_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109		
1	0,00158	97,744	155	97,666		
2	0,00093	97,589	91	97,544		
3	0,00071	97,498	69	97,463		
4	0,00060	97,429	58	97,400		
:	:	:	:	:		
105	0,47662	16	7	12		
:	:	:	:	:		
109	1	1	1	0		

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e^0_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109		
1	0,00158	97,744	155	97,666		
2	0,00093	97,589	91	97,544		
3	0,00071	97,498	69	97,463		
4	0,00060	97,429	58	97,400		
:	:	:	:	:		
105	0,47662	16	7	12		
:	:	:	:	:		
109	1	1	1	0		
				7,324,402		

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109	7,324,402	
1	0,00158	97,744	155	97,666		
2	0,00093	97,589	91	97,544		
3	0,00071	97,498	69	97,463		
4	0,00060	97,429	58	97,400		
:	:	:	:	:		
105	0,47662	16	7	12		
:	:	:	:	:		
109	1	1	1	0		
				7,324,402		

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109	7,324,402	
1	0,00158	97,744	155	97,666	7,226,293	
2	0,00093	97,589	91	97,544		
3	0,00071	97,498	69	97,463		
4	0,00060	97,429	58	97,400		
:	:	:	:	:		
105	0,47662	16	7	12		
:	:	:	:	:		
109	1	1	1	0		
				7,324,402		

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109	7,324,402	
1	0,00158	97,744	155	97,666	7,226,293	
2	0,00093	97,589	91	97,544	7,128,627	
3	0,00071	97,498	69	97,463	7,031,083	
4	0,00060	97,429	58	97,400	6,933,620	
:	:	:	:	:	:	
105	0,47662	16	7	12	25	
:	:	:	:	:	:	
109	1	1	1	0	1	
				7,324,402		

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109	7,324,402	73,24
1	0,00158	97,744	155	97,666	7,226,293	
2	0,00093	97,589	91	97,544	7,128,627	
3	0,00071	97,498	69	97,463	7,031,083	
4	0,00060	97,429	58	97,400	6,933,620	
:	:	:	:	:	:	
105	0,47662	16	7	12	25	
:	:	:	:	:	:	
109	1	1	1	0	1	
				7,324,402		

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109	7,324,402	73,24
1	0,00158	97,744	155	97,666	7,226,293	73,93
2	0,00093	97,589	91	97,544	7,128,627	
3	0,00071	97,498	69	97,463	7,031,083	
4	0,00060	97,429	58	97,400	6,933,620	
:	:	:	:	:	:	
105	0,47662	16	7	12	25	
:	:	:	:	:	:	
109	1	1	1	0	1	
				7,324,402		

x	q_x [(4)/(3)]	l_x	d_x	L_x	T_x [Σ(5)]	e_x [(6)/(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0,02256	100,000	2,256	98,109	7,324,402	73,24
1	0,00158	97,744	155	97,666	7,226,293	73,93
2	0,00093	97,589	91	97,544	7,128,627	73,05
3	0,00071	97,498	69	97,463	7,031,083	72,12
4	0,00060	97,429	58	97,400	6,933,620	72,17
:	:	:	:	:	:	:
105	0,47662	16	7	12	25	1,53
:	:	:	:	:	:	:
109	1	1	1	0	1	1,29
				7,324,402		

Probability of a person age 0 dying before the first birthday, col (2) :

Probability of dying (q_0) = d_0/l_0 = 2,256/100,000 = 0,02256

Probability of a person age 0 survived and reached his 1st year :

Probability of survived (p_0) = l_1 = 97,744/100,000 = 0,97744 atau (1-q_0)

General formula:

$$q_x = \frac{d_x}{l_x}$$

and

$$p_x = \frac{l_{x+1}}{l_x}$$

Col (5): L_x

$$L_0 = 0{,}3\ l_0 + 0{,}7\ l_1$$
$$L_1 = 0{,}4\ l_1 + 0{,}6\ l_2$$
$$L_2 = \tfrac{1}{2}\ (\ l_x + l_{x+1}\ ) = \tfrac{1}{2}\ (\ l_2 + l_3)$$

col (6): T_x

$$T_0 = L_0 + L_1 + L_2 + L_3 + \ldots + L_n$$
$$T_1 = L_1 + L_2 + L_3 + L_4 + \ldots + L_n$$

formula:

$$T_x = \sum_{i=x}^{i=w} L_i$$

Kolom (7): e_x

formula:

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

Life Expectancy at birth:

$$e_0 = \frac{T_0}{l_0}$$

- ✓ The life table is called longitudinal life table.
- ✓ Weakness : difficult to have mortality data by single age
- ✓ cross section Life Table is more practical and simple .
- ✓ This table describe mortality for synthetic cohort dying follow the mortality trend by age that exist for a group of population in the particular time period.

Calculation of *Abridged Life Table*

Formula for *Abridged Life Table* :

$l_0 = 100{,}000$

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

${}_nd_x = {}_nq_x \times l_x$ or $(l_x - l_{x+n})$
(number of dying between x and x+n)

${}_nq_x = {}_nd_x / l_x$
(*probability of dying* between x and x+n)

${}_np_x = 1 - {}_nq_x$

$L_0 = 0{,}3\, l_0 + 0{,}7\, l_1$

${}_4L_1 = 1{,}9\, l_1 + 2{,}1\, l_5$

${}_5L_x = 5/2\,(l_x + l_{x+5})$ or ${}_nL_x = n/2\,(l_x + l_{x+n})$

$T_x = \sum_{i=x} L_i$

${}_nL_x = T_x - T_{x+n}$

$e_x = T_x / l_x$

$e_0 = T_0 / l_0$

(life expectancy at birth)

Abridged Life Table for Australian Males 1980-1982

Age (x)	n	l_x	$_nd_x$	$_nq_x$	$_np_x$	$_nL_x$	T_x	e_x
0	1	100000	1147	0,01147	0,98853	99197,1	7110236,5	71,1
1	4	98853	264	0,00267	0,99733	394884,1	7011039,4	70,9
5	5	98589	164	0,00166	0,99834	492536,2	6616155,2	67,1
10	5	98425	160	0,00163	0,99837	491725,9	6123619,1	62,2
15	5	98265	604	0,00615	0,99385	489814,0	5631893,1	57,3
20	5	97661	789	0,00808	0,99192	486330,5	5142079,1	52,7
25	5	96872	665	0,00686	0,99314	482696,4	4655748,6	48,1
30	5	96207	609	0,00633	0,99367	479512,5	4173052,3	43,4
35	5	95598	778	0,00814	0,99186	476044,7	3693539,7	38,6
40	5	94820	1269	0,01338	0,98662	470927,5	3217495,1	33,9
45	5	93551	2154	0,02302	0,97698	462371,9	2746567,6	29,4
50	5	91398	3528	0,03860	0,96140	448168,2	2284195,6	25,0
55	5	87870	5434	0,06184	0,93816	425763,7	1836027,5	20,9
60	5	82436	8030	0,09741	0,90259	392103,8	1410263,8	17,1
65	5	74406	11342	0,15244	0,84756	343672,6	1018160,0	13,7
70	5	63063	14656	0,23240	0,76760	278676,8	674487,3	10,7
75	5	48407	16383	0,33844	0,66156	201079,5	395810,5	8,2
80	5	32024	14989	0,46806	0,53194	122649,1	194731,0	6,1
85	∞	17035	17035	1,00000	0,00000	72081,9	72081,9	4,2

Notes:

- Calculation of the last row for age 85 for Abridged Life Table using specific treatment as it is an open interval
- ${}_{\infty}q_{85}$ is always equal to 1,0 and ${}_{\infty}d_{85} = l_{85}$,
- When ASDR of age 85 is known, value for ∞L85 is expected as ∞L85 = l85 /∞M85, when it is unknown then , ∞L85 = l85 x log10 l85,

Exercise 1

1. Fill in and complete this following *Abridged Life Table* :

x	${}_nq_x$	l_x	${}_nd_x$	${}_nL_x$	T_x	e_x
0	0,00612	100.000				
1	0,00108					
5	0,00057					
10	0,00071					
15	0,00246					
20	0,00432					
25	0,00479					
30	0,00550					
35	0,00691					
40	0,00998					
45	0,01604					
50	0,02434					
55	0,03511					
60	0,04985					
65	0,07441					
70	0,11232					
75	0,17478					
80	0,27438					
85	0,43082					
90	0,61528					
95	0,78340					
100+	1,00000					

ASDR 100+ = 0,4329

Exercise 2. Question based on exercise no 1:

a) For someone who has reached age 50 year old, how many years in average he/she could survive?

b) What is the probability of someone aged 60 year old will reach aged 65 year old?

c) What is the life expectancy for a 15 year old individual?

d) From a radix 100.000 person, is there any probability that someone will reach age of 100 year old? If yes, how many are they?

Exercise 3 Fill in *Complete Life Table*

x	qx	lx	dx	Lx	Tx	ex
0	0.00723	100,000				
1	0.00055					
2	0.00036					
3	0.00029					
4	0.00023					
5	0.00021					
6	0.00020					
7	0.00019					
8	0.00017					
9	0.00015					
10	0.00014					
11	0.00014					
12	0.00019					
13	0.00028					
14	0.00041					
15	0.00055					
16	0.00068					
17	0.00078					
18	0.00085					
19	0.00089					
20	0.00093					
21	0.00098					
22	0.00101					
23	0.00101					
24	0.00101					
25	0.00100					
26	0.00099					
27	0.00100					
28	0.00103					
29	0.00108					
30	0.00114					
31	0.00119					
32	0.00126					
33	0.00133					

x	qx	lx	dx	Lx	Tx	ex
34	0.00140					
35	0.00149					
36	0.00157					
37	0.00167					
38	0.00178					
39	0.00192					
40	0.00206					
41	0.00222					
42	0.00239					
43	0.00257					
44	0.00278					
45	0.00300					
46	0.00325					
47	0.00352					
48	0.00380					
49	0.00411					
50	0.00444					
51	0.00482					
52	0.00524					
53	0.00571					
54	0.00623					
55	0.00685					
56	0.00755					
57	0.00833					
58	0.00916					
59	0.01005					
60	0.01101					
61	0.01208					
62	0.01321					
63	0.01439					
64	0.01560					
65	0.01679					
66	0.01802					

x	qx	lx	dx	Lx	Tx	ex
67	0.01948					
68	0.02127					
69	0.02338					
70	0.02565					
71	0.02799					
72	0.03043					
73	0.03297					
74	0.03563					
75	0.03843					
76	0.04147					
77	0.04494					
78	0.04904					
79	0.05385					
80	0.05938					
81	0.06555					
82	0.07241					
83	0.07990					
84	0.08812					
85	0.09653					
86	0.10556					
87	0.11539					
88	0.12616					
89	0.13802					
90	0.15085					
91	0.16429					
92	0.17813					
93	0.19250					
94	0.20764					
95	0.22354					
96	0.23999					
97	0.25653					
98	0.27295					
99	0.28915					
100+	1.00000					

ASDR 100+ = 0,4329

Exercise 4. Question based on Ex 3:

a) What is probability of someone aged 60 year old will reach aged 61?

b) What is the life expectancy for a 1 year old individual?

c) From radix 100.000 person, how many person will survive and reach aged 75 year old?

d) For some one who has reached age 60 year old, how many years in average he/she will get survive?

Thank you

Terima Kasih