Manual for SOA Exam MLC.

Chapter 3. Life tables.

Actuarial problems.

Extract from:
"Arcones' Manual for SOA Exam MLC. Fall 2009 Edition",
available at http://www.actexmadriver.com/

(#28, Exam M, Spring 2005) For a life table with a one-year select period, you are given: (i)

x	$\ell_{[x]}$	$d_{[x]}$	ℓ_{x+1}	$\overset{\circ}{e}_{[x]}$
80	1000	90	–	8.5
81	920	90	–	–

(ii) Deaths are uniformly distributed over each year of age.

Calculate $\overset{\circ}{e}_{[81]}$.

(A) 8.0 (B) 8.1 (C) 8.2 (D) 8.3 (E) 8.4

(#26, Exam MLC, Spring 2006) Oil wells produce until they run dry. The survival function for a well is given by:

$S(t)$	1.00	0.90	0.80	0.60	0.30	0.10	0.05	0.00
t (years)	0	1	2	3	4	5	6	7

An oil company owns 10 wells age 3. It insures them for 1 million each against failure for two years where the loss is payable at the end of the year of failure.
You are given:
(i) R is the present-value random variable for the insurers aggregate losses on the 10 wells.
(ii) The insurer actually experiences 3 failures in the first year and 5 in the second year.
(iii) $i = 0.10$
Calculate the ratio of the actual value of R to the expected value of R.
(A) 0.94 (B) 0.96 (C) 0.98 (D) 1.00 (E) 1.02

(#18, Exam MLC, Spring 2007) You are given the following extract from a 2–year select–and–ultimate mortality table:

$[x]$	$\ell_{[x]}$	$\ell_{[x]+1}$	ℓ_{x+2}	$x+2$
65	–	–	8200	67
66	–	–	8000	68
67	–	–	7700	69

The following relationships hold for all x:
(i) $3q_{[x]+1} = 4q_{[x+1]}$.
(ii) $4q_{x+2} = 5q_{[x+1]+1}$.
Calculate $\ell_{[67]}$.
(A) 7940 (B) 8000 (C) 8060 (D) 8130 (E) 8200

(#21, Exam MLC, Spring 2007) You are given the following information about a new model for buildings with limiting age ω.
(i) The expected number of buildings surviving at age x will be $l_x = (\omega - x)^{\alpha}$, $x < \omega$. (ii) The new model predicts a $33\frac{1}{3}\%$ higher complete life expectancy (over the previous De Moivre model with the same ω) for buildings aged 30.
(iii) The complete life expectancy for buildings aged 60 under the new model is 20 years.
Calculate the complete life expectancy under the previous De Moivre model for buildings aged 70.
(A) 8 (B) 10 (C) 12 (D) 14 (E) 16

(#12, MLC–09–08) T, the future lifetime of (0), has the following distribution.
(i) $f_1(t)$ follows the Illustrative Life Table, using UDD in each year.
(ii) $f_2(t)$ follows DeMoivre's law with $\omega = 100$.
(iii)

$$f_T(t) = \begin{cases} kf_1(t) & \text{if } 0 \le t \le 50 \\ (1.2)f_2(t) & \text{if } 50 < t \end{cases}$$

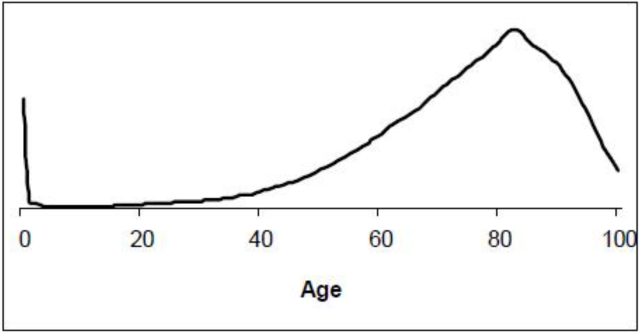
Calculate ${}_{10}p_{40}$.
(A) 0.81 (B) 0.85 (C) 0.88 (D) 0.92 (E) 0.96

(#66, MLC–09–08) For a select-and-ultimate mortality table with a 3-year select period: (i)

x	$q_{[x]}$	$q_{[x]+1}$	$q_{[x]+2}$	q_{x+3}	$x+3$
60	0.09	0.11	0.13	0.15	63
61	0.10	0.12	0.14	0.16	64
62	0.11	0.13	0.15	0.17	65
63	0.12	0.14	0.16	0.18	66
64	0.13	0.15	0.17	0.19	67

(ii) White was a newly selected life on 01/01/2000.
(iii) White's age on 01/01/2001 is 61.
(iv) P is the probability on 01/01/2001 that White will be alive on 01/01/2006.
Calculate P.
(A) $0 \le P < 0.43$
(B) $0.43 \le P < 0.45$
(C) $0.45 \le P < 0.47$
(D) $0.47 \le P < 0.49$
(E) $0.49 \le P < 1.00$

(#106, MLC–09–08) The following graph is related to current human mortality:



Which of the following functions of age does the graph most likely show?

(A) $\mu(x)$ (B) $l_x\mu(x)$ (C) $l_x p_x$ (D) l_x (E) l_x^2

(#136, MLC–09–08) You are given the following extract from a select-and-ultimate mortality table with a 2-year select period:

x	$l_{[x]}$	$l_{[x]+1}$	l_{x+2}	$x+2$
60	80,625	79,954	78,839	62
61	79,137	78,402	77,252	63
62	77,575	76,770	75,578	64

Assume that deaths are uniformly distributed between integral ages.
Calculate ${}_{0.9}q_{[60]+0.6}$.
(A) 0.0102 (B) 0.0103 (C) 0.0104 (D) 0.0105 (E) 0.0106

(#264, MLC–09–08) You are given the following extract from a select–an–ultimate mortality table:

$[x]$	$l_{[x]}$	$l_{[x]+1}$	l_{x+2}	$x+2$
60	80,625	79,954	78,839	62
61	79,137	78,402	77,252	63
62	77,575	76,770	75,578	64

Calculate $1000\,{}_{0.7}q_{[60]+0.8}$, using the hyperbolic assumption for mortality at fractional ages.

(A) 8.6 (B) 8.7 (C) 8.8 (D) 8.9 (E) 9.0

(#267, MLC–09–08) You are given:
(i) $\mu_x = \sqrt{\frac{1}{80-x}}$, $0 \leq x \leq 80$
(ii) F is the exact value of $s(10.5)$
(iii) G is the value of $s(10.5)$ using the Balducci assumption
Calculate $F - G$.
(A) -0.0183 (B) -0.0005 (C) 0 (D) 0.0006 (E) 0.0172

