

Stat 344 — Fall 2023  
Homework Assignment 2  
Due Date: Tuesday, October 10th

**General Notes:**

- Please hand in Part I on paper in class on the due date.
- Upload the Excel spreadsheet you create to answer the questions in Part II to Learning Suite. Your spreadsheet should be neatly organized and labeled; each answer should be highlighted in some manner, and it should be very clear how each of your answers was obtained.

**Part I**

1. Explain the purpose of the underwriting done by insurance companies prior to issuing life insurance policies. Include an explanation of how a life insurance company could potentially lose money if it decided not to perform underwriting prior to issuing its life insurance policies. (Your answer should be roughly one or two paragraphs in length.)
2. Explain why a life insurance company might request each of the following items from a life insurance applicant: (Each of your answers should be roughly one to three sentences in length.)
  - (a) Health records and history of hospitalizations
  - (b) Driving records
  - (c) Credit reports
  - (d) List at least two other types of information that you think it might be helpful for a life insurance company to collect from a life insurance applicant. Briefly explain why each would be useful to the insurer.

3. You are given the following information:

$${}_3p_{51} = 0.9126, \quad {}_2q_{50} = 0.0298, \quad q_{52} = 0.0300, \quad {}_2p_{52} = 0.9312, \quad q_{54} = 1$$

- (a) Using the above information, fill in the blank entries of the following life table:
- (b) Using the UDD assumption, write the pmf of  $K_{52}^{(2)}$ . (The curtate future lifetime random variable, where instead of rounding down to the nearest year, you round down to the nearest 6 months)

$x$	$l_x$	$d_x$
50		
51		
52		
53		
54	9,034.50	—
$\vdots$	$\vdots$	$\vdots$

4. You are given the following life table excerpt (Table 3.1 from Dickson et al.):

$x$	$l_x$	$d_x$
30	10,000.00	34.78
31	9,965.22	38.10
32	9,927.12	41.76
33	9,885.35	45.81
34	9,839.55	50.26
$\vdots$	$\vdots$	$\vdots$

Calculate the following probabilities under (i) the UDD fractional age assumption and (ii) the Constant Force of Mortality fractional age assumption. (Be sure to carry your calculations to at least 5 decimal places for this problem.)

(a)  ${}_{0.7}q_{33}$  [0.00324, 0.00325]

(b)  ${}_{0.4}p_{32.5}$  [0.99831]

(c)  $p_{31.3}$  [0.99606]

(d)  ${}_{1.7}p_{30.8}$  [0.99339, 0.99338]

(e)  ${}_{0.8|2.1}q_{30.8}$  [0.00893]

5. Below is an excerpt of a select and ultimate mortality table with a 3 year select period (Table 3 from Jordan's Life Contingencies).

$[x]$	$\ell_{[x]}$	$\ell_{[x]+1}$	$\ell_{[x]+2}$	$\ell_{x+3}$	$x + 3$
20	946,394	945,145	943,671	942,001	23
21	944,710	943,435	941,916	940,202	24
22	942,944	941,652	940,108	938,359	25
23	941,143	939,835	938,265	936,482	26
24	939,279	937,964	936,379	934,572	27
25	937,373	936,061	934,460	932,628	28
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

- (a) Calculate  ${}_3p_{[22]}$ . [0.99514]
- (b) Calculate  ${}_3p_{[20]+2}$ . [0.99437]
- (c) Explain in one or two sentences what the above two probabilities represent, and how their interpretations differ.
- (d) Calculate  ${}_2|q_{[21]+1}$ . [0.00195]
- (e) Calculate  $e_{[21]+1:\overline{3}}$ . [2.98958]
- (f) Calculate  ${}_{1.6}q_{[23]+2}$  under the UDD fractional age assumption. [0.00312]
- (g) Calculate  ${}_{1.6}q_{[23]+2}$  under the Constant Force of Mortality fractional age assumption. [0.00312]

## Part II

For this part, use the **Standard Select Mortality Tables**; an Excel version can be found on my website under supplemental material. We will consider the mortality of  $[y]$ , where  $y$  is the last two digits of your BYU ID number. If the last two digits of your BYU ID are between 00 and 19, then add 20 to the last two digits to get  $y$ . For example, if your BYU ID number is 01-234-4456, then  $y = 56$ ; if your BYU ID number is 02-400-3403, then  $y = 03 + 20 = 23$ .

1. In a new tab, create a column of  $\ell_{[y]+k}$ , for  $k = 0, 1, \dots$ .
2. Calculate the value of  ${}_{10}p_{[y]}$  and write a sentence that interprets this value.
3. Calculate the value of  ${}_{15}|_5q_{[y]}$  and write a sentence that interprets this value.
- 4 - 6. For the random variable  $K_{[y]}$ , calculate its median,<sup>1</sup> mean, and standard deviation.
7. Give the age at which  $[y]$  is most likely to die and the probability that  $[y]$  will die at this age.

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<sup>1</sup>The median will likely not be an exact integer, in which case there is not a universal agreement on the definition of the median. For this problem, if the median comes out between two integers, you can use either of these two integers, or any number in between them.