



# **MAASAI MARA UNIVERSITY**

**REGULAR UNIVERSITY EXAMINATIONS  
2023/2024 ACADEMIC YEAR (RESITS)  
SECOND YEAR SECOND SEMESTER**

**SCHOOL OF PURE, APPLIED AND HEALTH  
SCIENCES  
BACHELOR OF SCIENCE APPLIED STATISTICS  
WITH COMPUTING**

**COURSE CODE: STA 2218  
COURSE TITLE: PRINCIPALS OF ACTUARIAL  
SCIENCE**

**DATE: 23/4/24**

**TIME: 1100-1300HRS**

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## **INSTRUCTIONS TO CANDIDATES**

1. Answer **Question ONE** and any other **Two** questions.
2. Show all the workings clearly
3. Do not write on the question paper
4. All Examination Rules Apply.

**Question One (30 marks)**

(a) You are given that  $S_0(t) = 1 - t/100$   $0 \leq t \leq 100$

- (i) Calculate the probability that an individual age 10 now can survive to age 25
- (ii) Calculate the probability that an individual age 10 now will die within 15 years

(6 marks)

(b) You are given  $P_x = 0.99$ ,  $P_{x+1} = 0.985$ ,  ${}_3P_{x+1} = 0.95$ ,  $q_{x+3} = 0.02$   
Calculate

- (i)  ${}_3P_x$
- (ii)  ${}_1|_2q_x$

(6 marks)

(c) For a given age  $x$ , now you are given

$$S_x(t) = \frac{(10-t)^2}{100} \text{ for } 0 \leq t \leq 10$$

Find

- (i)  $\mu_{x+t}$
- (ii)  $f_x(t)$

(6 marks)

(d) The present value of a series of payments of 2 at the end of every eight years, forever is equal to 5. Calculate the effective rate of interest.

(4 marks)

(e) A certain interest rate the present value of the following two payments patterns are equal

- (i) 200 invested at the end of 5 years plus 500 at the end of 10 years and
- (ii) 400.94 invested at the end of 5 years

At the same interest rate, 100 invested at the end of 5 years will accumulate to P at the end of 10 years, Calculate P

(4 marks)

(f) A deposit of X is made into a fund which pays an annual effective interest rate of 6% for 10 years. At the same time  $\frac{X}{2}$  is deposited into another fund which pays an annual effective rate of discount of d for 10 years. The amount of interest earned over 10 years are equal for the both funds. Calculate d.

**Question Two (20 marks)**

(a) You are given

$$S_0(t) = \frac{(121 - t)^{0.5}}{k}$$

- (i) Show that  $k$  must be 11 for the function to be a valued survival function.
- (ii) Show that the limiting age for this survival function is 121
- (iii) Calculate  $e_0$  for the survival model
- (iv) Calculate the probability using the survival model, that (57) dies between the ages of 84 and 100

(12 marks)

(b) You are given  $l_x = 10,000e^{-0.05x}$

Find  ${}_5|_{15}q_{10}$

(8 marks)

### Question Three(20 marks)

(a) You are given the following excerpt of a life-table

$x$	$l_x$	$d_x$
20	96138.01	99.0569
21	96078.95	102.0149
22	95976.93	105.2582
23	95871.68	108.8135
24	95762.86	112.7102
25	95650.15	116.9802

Calculate

- (i)  ${}_5P_{20}$
- (ii)  $q_{24}$
- (iii)  ${}_4|_1q_{20}$

(10 marks)

(b) A loan of 1000 is to be repaid by annual payments of 100 to commence at the end of the fifth year and continue thereafter for as long as necessary, the effective rate of discount is 5%. Find the amount of final payment if it is to be larger than regular payment.

(10 marks)

### Question Four (20 marks)

(a) If  $\bar{a}_n = 3$  and  $\bar{s}_n = 12$  find  $\delta$ .

(10 marks)

(b) A savings fund requires the investor to pay an equal amount of installment each year for

3 years, with the first installment to be paid immediately. At the end of the 3 years, a lump sum will be paid back to the investor. If the effective interest rate is 5, what is the amount of the installment so that the investor can get back 10,000.

(10 marks)

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