

Department of Statistics

Part II B. Sc. (Honours) First Tutorial Examination, 2021

Course Title: Actuarial Statistics

Course No. STAT 308

Total marks: 10 Total Time: 50 Minutes

Q1. a) Under usual notations, prove that $i = \left[1 + \frac{(m-1)r}{m}\right]^{1/m} - 1$

b) Find the nominal rate of discount convertible monthly which is equivalent to a nominal rate of interest 12% per year convertible monthly?

Q2. a) Sandra inherits \$10,000. She deposits it in a five-year certificate of deposit (CD) paying 6%

nominal rate of interest compounded monthly and the interest remains on deposit. At the end of the five years, Sandra decides to renew her CD for another five years at nominal interest rate of 7.5% compounded quarterly. At the time of second CD matures, what is her investment worth?

b) Mention some real life applications of force of interest.

Q3. a) Smith Bank promises 3.5% interest compounded continuously. If Ken deposits \$3,000 in the bank, what will his balance be four years later?

Good Luck

1.24

Department of Statistics
Part III B. Sc. (Honors) First Tutorial Examination, 2021

Course Title: Actuarial Statistics

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Total marks: 10 Total Time: 50 Minutes

Q1. a) Under usual notations, prove that $i = \left[1 + \frac{i^{(m)}}{m}\right]^m - 1$

b) Find the nominal rate of discount convertible monthly which is equivalent to a nominal rate of interest 12% per year convertible monthly?

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c) Sandra inherits \$10,000. She deposits it in a five-year certificate of deposit (CD) paying 6% nominal rate of interest compounded monthly, and the interest remains on deposit. At the end of the five years, Sandra decides to renew her CD for another five years at nominal interest rate of 7.5% compounded quarterly. At the time of second CD matures, what is her investment worth?

2. Mention some real life applications of force of interest.

e) Swift Bank promise 3.5% interest compounded continuously. If Ken deposits \$3,000 in the bank, what will his balance be four years later?

***** Good luck *****

1.2A

Q1. a) Explain both mathematically and verbally why each of the following is true:

$$\begin{aligned}
 \text{(i)} \quad d_x + d_{x+1} + \dots + d_{x+n-1} &= l_x - l_{x+n} \\
 \text{(ii)} \quad n|mQ_x &= n p_x - n+m p_x
 \end{aligned}$$

b) What do you mean by benefit premium, office premium and loading?

c) An annuity on (x) provides 1 annually beginning at age $(x+n)$. Nothing is paid before n years. Annual premiums are payable for n years beginning at x . Draw a cash flow diagram and obtain an expression for annual premium, assuming limiting age w .

d) For a special 3-year temporary annuity-immediate on (35) , you are given:

i)

| t | Annual payment | p_{35+t} |
|-----|----------------|------------|
| 0 | 15 | 0.95 |
| 1 | 20 | 0.90 |
| 2 | 25 | 0.85 |

ii) $i = 0.06$

Find net single premium for this contract.

Department of Statistics
Part III B. Sc. (Honors) 2nd Tutorial Examination, 2021
Course Title: Actuarial Statistics
Course No. STAT 308
Total marks: 10 **Total Time: 45 Minutes**

Answer following questions

Q10) ~~Mention~~ some practical applications of increasing annuities.

b) Under usual notations, show algebraically that

$$\text{i) } c_{\alpha} = \frac{1}{i}$$

$$P a_{\overline{w}} + Q \frac{[a_{\overline{w}} - nv^n]}{i}$$

where first payment = P , second payment = $P + Q$, ...

$$\text{iii) } a_{m+n} = a_m + v^n a_n$$

$$\text{iv) } s_{\overline{m+n}} = s_{\overline{m}} + (1+i)^m s_{\overline{n}}$$

Q2. a) What is a loan amortization schedule? Consider a loan which is being repaid by equal annual payments of 1 for n years. Construct an amortization schedule

b) What is a sinking fund? A loan of L is to be repaid by sinking fund method over n years. Find the (equal) periodic payment of the sinking fund

c) John takes out a 50,000 mortgage on a home at $12\frac{1}{2}\%$ convertible semiannually. He pays off the mortgage with monthly payments for 20 years; the first one due one month after the mortgage is taken out. Immediately after his 60th payment, John renegotiates the loan. He agrees to repay the remainder of the mortgage by making an immediate cash payment of 10,000 and repaying the balance by means of monthly payments for ten years at 11% convertible semiannually. Find the amount of his new payment

Good luck!!

Department of Statistics
Part III B. Sc. (Honors) Second Tutorial Examination, 2020
Course Title: Actuarial Statistics
Course No. STAT 308

Total marks: 10

Total Time: 45 Minutes

Q1. a) Explain, in brief, the concept of nominal rate of interest

b) Under usual notations, prove that

i) $1 - d = v$

ii) $i = \left[1 + \frac{i^{(m)}}{m} \right]^m - 1$

c) If $i^{(6)} = 0.15$, find the equivalent nominal rate of interest convertible semiannually?

Q2. a) Mention some practical applications of annuities

b) Under usual notations, show algebraically that

i) $a_{\overline{n}|} = \frac{1-v^n}{i}$

ii) $s_{\overline{k+n}|} = s_{\overline{k}|} + (1 + i)^n s_{\overline{n}|}$

c) An annuity provides for 10 annual payments. The first of these payments is 100, and each subsequent payment is 2% greater than the one preceding it. Find the present value of this annuity if $i = 0.05$

***** Good luck *****

$$1 + y = \left[1 + \frac{i^{(m)}}{2} \right]^6$$

Department of Statistics
 Jahangirnagar University
 Part III B. Sc (Hons.) Examination-2021
 Course Code: Stat-308
 Course Title: Actuarial Statistics

Time: 2.5 Hours

Full Marks: 35

Answer Any **Three** of the Following Questions. All Questions Carry Equal Marks.

1. a) Explain with suitable examples principal, amount function and accumulated value.
 b) Define simple and compound interest with suitable examples. Which one do you think better for developing countries like Bangladesh?
 c) The Albert family buys a new apartment for 89500 on June 1, 1987. How much was this house worth on June 1, 1981 if real estate prices have risen at a compound interest rate of 7% per year during that period?

2. a) Explain the following terms with suitable examples:

i) Nominal and effective rate of interest
 ii) Force of interest
 b) What is the present value and discount? 1500 is to be accumulated by November 1, 1988, at a compound rate of discount of 8% per year.
 i) Find the present value on November 1, 1982.
 ii) Find the value of i corresponding to d , where i is the rate of interest and d is the rate of discount.

c) Consider the function $b(p) = \sqrt{1 + (i^2 + 2i)p^2}$, $i > 0, p > 0$. Show that $b(p) < 1 + ip$ for $0 < p < 1$, but $b(p) > 1 + ip$ for $p > 1$.

3. a) What is a loan amortization schedule?
 b) Consider a loan which is being repaid by equal annual payments of 1 for n years. Construct an amortization schedule.
 c) What is sinking fund schedule? A loan of L is to be repaid by sinking fund method over n years. Construct the sinking fund schedule for repaying of loan.
 d) What is yield rate or internal rate of return for an investment? Explain.

4. a) Explain mathematically, why each of the following is true?

i) ${}_n|_m q_x = {}_n p_x - {}_{n+m} p_x$
 ii) ${}_{n+m} p_x = {}_m p_x \cdot {}_n p_{x+m}$
 b) An annuity on (x) provides k annually beginning at age $(x+n)$. Nothing is paid before n years. Annual premiums are payable for n years beginning at x . Draw a cash flow diagram and obtain an expression for annual premium, assuming limiting age ω .
 c) For a special 3-year temporary annuity-due on (55), you are given the following table

| t | Annual payment | p_{55+t} |
|-----|----------------|------------|
| 0 | 150 | 0.90 |
| 1 | 200 | 0.92 |
| 2 | 250 | 0.88 |

and $i = 0.03$. Find net single premium for this contract.

5. a) Give some examples of gross premiums
 b) Draw a cash flow diagram of an n -year endowment insurance of face value 1 on (x) .
 Derive an expression to find net single premium
 c) You are given

Mortality: Illustrative life table

| x | l_x | d_x |
|-----|-----------|--------|
| 25 | 8,640,861 | 77,426 |
| 26 | 8,563,435 | 83,527 |
| 27 | 8,479,908 | 90,082 |
| 28 | 8,389,826 | |

and $i = 0.05$. Calculate the net single premium of 3-year endowment insurance on (25) of 10,000.