

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034**B.Sc. DEGREE EXAMINATION – STATISTICS**FOURTH SEMESTER – **APRIL 2023****UST 4601 – ACTUARIAL STATISTICS**

Date: 06-05-2023

Dept. No.

Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

SECTION A - K1 (CO1)**Answer ALL the Questions****(10 x 1 = 10)****1. Answer the following:**

- a) Effective rate of interest
- b) Immediate Annuity
- c) Deferment period
- d) What is office premium?
- e) Calculate the mean and variance if the annual rates of return are assumed to conform to the varying interest rate model and follow a *Gamma* (16, 200) distribution.

2. Fill in the blanks

- a) The amount of money today which is equal to series of payments in future is -----
- b) A sum of money is invested at 4% p.a. effective, the time to double itself is -----
- c) The borrower deposits an amount periodically into a ----- so as to accumulate to the principal.
- d) The insurance premium generally depends on -----
- e) The variance of S_n is -----

SECTION A - K2 (CO1)**Answer ALL the Questions
10)****(10 x 1 =****3. Match the following**

- a) $(1+i)^m \times (1+i')^n \times (1+i'')^p$ - Effective Discount Rate
- b) $i + \frac{1}{S_n} = \frac{1}{a_n}$ - Accumulated value
- c) $\frac{1-v^n}{d}$ - Sinking Fund
- d) $C(1+i)^n$ - Annuity due
- e) $d^{(m)} = m(1 - v^{\frac{1}{m}})$ - Varying Rates of interest

4. True or False

- a) Financial transactions are reckoned at Compound interest.
- b) Nominal rates are paid *more frequently* than once per measurement period.
- c) The life insurance premium is paid either by level payments or one lump sum.
- d) The payments made during life of a person are called life annuity.
- e) Repayment of loan by level payments comprise only the principal.

SECTION B - K3 (CO2)**Answer any TWO of the following
20)****(2 x 10 =**

5. Calculate office annual premium for a Whole Life Assurance for Rs. 20000/- to a person aged 40. Provide for first year expenses at 55% of premium and 17% sum assured; and renewal expense of 5% of premium and 6% sum assured use LIC (1970 -73) ultimate Table and 6% interest.
6. Find the present value and accumulated value of an immediate annuity of 1p.a. for term n years under which payments are made p times a year, the rate of interest being i p.a.

7. A loan of Rs. 10,000/- is to be repaid with interest at 8% p.a. by means of an immediate annuity for 5 years. Find the level payment. Prepare repayment schedule
8. A life office issues capital redemption policies on the following basis:
 (i) Interest : 10%
 (ii) Expense : First year 2 ½ % of S.A. and 6% of premium
 (iii) Renewal 1% of S.A. and 1 ½ % of premium
 Calculate office annual premium for policy of ₹ 20000 for term of 15 years.

SECTION C – K4 (CO3)

Answer any TWO of the following **(2 x 10 = 20)**

9. a) Under a settlement of property Mr. Raj is entitled to receive Rs. 2400 p.a. adindefinitum, the first payment being due at the end of 12 years. Find the present value of Mr.Raj's right @ 8% p.a.
 b) Explain in detail the classification of annuities.
10. Derive the expressions for present value of immediate increasing annuity.
11. A fund is to be set up out of which a payment of ₹100 will be made to each person who in any year qualifies for membership of a certain profession. Assuming that 10 persons will qualify at the end of one year from now, 15 at the end of 2 years, 20 at the end of 3 years, and so on till the number of qualifiers is 50 p.a., when it will remain constant. Find at 5% per annum effective what sum must be paid into the fund now so that it may be sufficient to meet the outgo?
12. A man now aged exactly 50 has built up a savings fund of £400,000. In order to retire at age 60, he will require a fund of at least £600,000 at that time. Calculate the probability that, if he makes no further contributions to the fund, he will be able to retire at age 60. Assume that annual growth rates vary independently from year to year and have the log-normal distribution.

SECTION D – K5 (CO4)

Answer any ONE of the following **(1 x 20 = 20)**

13. Find the value of a 25-year annuity under which the annual payment is Rs. 200 for the first 5 years, Rs. 240 for the next 5, Rs. 280 for the next 5 and so on. The annuity is to be paid annually for the first 5 years, half-yearly for the next 10 and quarterly thereafter. Interest is 9% p.a. convertible half-yearly. for the first 12 years and 8 P.a convertible half-yearly thereafter.
14. Find the expression for the present value at time of 1 unit at time t for force of interest given by
- $$\delta(t) = \begin{cases} 0.04 + 0.002t & 0 \leq t < 10 \\ 0.015t - 0.08 & 10 \leq t < 12 \\ 0.07 & 12 \leq t \end{cases}$$

SECTION E – K6 (CO5)

Answer any ONE of the following **(1 x 20 = 20)**

15. Explain S_n (accumulation of a single investment) and A_n (accumulation of a series of annual investments) in the context of stochastic interest rates and derive its mean and variance.
16. a) Derive the present value of increasing annuity wherein the successive instalment form a arithmetic progression. (10)
 b) (a) A loan of Rs. 3000 is to be repaid by level annual instalment of principal and interest over a period of 10 years, the rate of interest being 10% p.a.
 Find (i) The annual instalment (ii) The interest contained in the 6th payment
 (iii) The principal outstanding after the 6th payment. (10)

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