# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

**M.Sc.** DEGREE EXAMINATION – **STATISTICS**

SECOND SEMESTER – NOVEMBER 2016

**ST 2961 - ACTUARIAL STATISTICS**

Date: 14-11-2016
Time: 01:00-04:00

Dept. No.

Max. : 100 Marks

## Section A

**Answer all questions.** (10x2=20)

1. Define accumulated value.

2. Define discount.

3. Differentiate between nominal and effective rate of interest.

4. What is a contingent annuity?

5. What is a deferred annuity?

6. What is the principle of insurance?

7. What is meant by premium for an insured benefit?

8. What is the use of a mortality table?

9. Differentiate between temporary assurance and pure endowment assurance.

10. What are the probabilities of survival and death?

## Section B

**Answer any FIVE questions.** (5x8=40)

11. Differentiate between effective and nominal rate of interest and derive the expressions for effective rate corresponding to nominal rate and vice-versa.

12. Derive the present value and accumulated value of an increasing annuity.

13. A loan of Rs. 1000 is to be repaid by payments of Rs 200 at the end of one year, Rs. 300 at the end of 2 years and the outstanding balance at the end of 4 years. What should the final payment be in interest is reckoned at 9% p.a. convertible half yearly.

14. Explain in detail the classification of annuities.

15. Using commutation functions based on LIC Ultimate mortality table at 6% interest calculate for a person aged 40.

   **(i)** The present value of whole life assurance of Rs. 100000.

   **(ii)** The present value of double endowment assurance of Rs. 100000 for 15 years term.

16. Calculate the present value of a deferred annuity payable for 10 years certain, the first payment falling due at the end of 6 years from the present time. The annuity is payable at the rate of Rs.1000 p.a. for the first five years and Rs. 2000 p.a. thereafter at 5% interest.

17. Derive expressions of present value of immediate perpetuity, perpetuity due, deferred immediate perpetuity and deferred perpetuity due.

18. Fill up the blanks in the following portion of a life table:

| Age x | $I_x$ | $d_x$ | $q_x$ | $p_x$ |
|-------|-------|-------|---------|---------|
| 10 | 1000000 | | 0.00409 | |
| 11 | | | 0.00370 | |
| 12 | | | | 0.99653 |
| 13 | | | | 0.99658 |
| 14 | | | 0.00342 | |

## Section C

**Answer any TWO questions.** (2x20=40)

19. **(a)** In lieu of a single payment of Rs. 1000 at the present moment a person agrees to receive three equal payments at the end of 3 years, 6 years and 10 years respectively. Assuming a rate of interest of 6% p.a., what should be the value of each of the three payments?

 **(b)** Show that $(1+i)^t\, a_n = v^{n-t}\, s_n = s_t + a_{n-t}$. (10 + 10)

20. **(a)** Explain deferred annuities and derive expressions for present value and accumulated value of deferred annuities.

 **(b)** An employee of an institution has to retire at age 55. A gratuity benefit of one month's salary for each year of service subject to a maximum benefit of 15 months' salary is payable to an employee on retirement or death. Find the probability that

   **(i)** Full gratuity benefit will be payable to a person aged 30, who has just now completed 5 years of service.

   **(ii)** The gratuity benefit payable will not exceed 10 months' salary

   **(iii)** The gratuity benefit payable will be atleast 12 months' salary

   **(iv)** The employee earns atleast 12 months' salary as a gratuity benefit payable at death.

(10 + 10)

21. **(a)** 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 a table showing the loan schedule. What will be the principal and interest contained in each of the 5 installments?

 **(b)** The following particulars are given:

| X | 25 | 26 | 27 | 28 | 29 | 30 |
|------|-------|-------|-------|-------|-------|-------|
| $I_x$ | 97380 | 97088 | 96794 | 96496 | 96194 | 95887 |
| $d_x$ | 292 | 294 | 298 | 302 | 307 | 313 |

Calculate allowing a rate of interest of interest of 6% p.a.

   **(i)** The value of temporary assurance of Rs. 10,000 for 2 years for a person aged 25.

   **(ii)** The value of endowment assurance benefit of Rs. 10,000 for 4 years for a person aged 25.

22. Derive expressions for the present value for the following, using commutation functions,

   **(i)** Temporary assurance

   **(ii)** Whole life assurance

   **(iii)** Endowment assurance

   **(iv)** Pure endowment assurance

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