1B4M17113 (Pages : 3) Reg. No:..............................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fourth Semester B.Sc Statistics Degree Examination, March 2017

AS4C04 – Probability Models & Risk Theory

(2015 Admission onwards)

Max. Time: 3 hours Max. Marks: 80

Section-A

[Answer *all* Questions. Each question carries *one* mark]

1. Which of the following is not casualty insurance?
   a)Automobile b) Home c) Health d) Life insurance.
2. If security loading, θ=0.4. The premium income per annum is 40% ....the expected rate of claims outgo.
   a)Less than b) Greater than c) Equal to d) None of these
3. Which of the following is not true for random variable I with range{0,1} ?
   a)Binomial R.V b) Bernoulli R.V c)Uniform R.V d) Indicator.
4. What is $\lim_{u\to\infty} \Psi(u,t)$?
   a)∞ b) 1 c)0 d) none of these
5. Obtain the variance of the claim random variable X, where q=0.04 and the claim amount is fixed at 50.
   a) 0.12 b) 96 c) 0.25 d) 0.2
6. If the insurer is certain to be ruined at some point, then:
   a) Premium income is less than the rate at which claims are paid out
   b) Premium income is greater than the rate at which claims are paid out
   c) Premium income is equal to the rate at which claims are paid out
   d) None of the above.
7. Aggregate claims amounts may be modeled using .... distribution.
   a)Discrete b) Compound c)Conditional d) Continuous
8. If X has a Pareto distribution with parameters λ=400 and α=3, and N has a Poisson (50) distribution. Find the expected value of S.

   a)50 b) 100 c)10000 d) 2000

Fill in the blanks

9. The collective risk model views total claims as a .... distribution.
10. The number of claims that will occur over a certain period is called ....
11. Probability of ultimate ruin is denoted by..........
12. When disability insurance is issued to a group, then it is known as ....

(12x1=12 Marks)

Section-B

[Answer any seven questions. Each question carries *two* marks]

13. Define individual risk model.
14. Define compound Poisson distribution.
15. Define adjustment coefficient.
16. Define Inverse Gaussian distribution.
17. Obtain third order central moment of compound Poisson distribution.
18. Define the probability of ruin in finite time (discrete case).
19. Define time of ruin.
20. Let the individual claim amount distribution be Gamma (2,2) and let the premium security loading factor be 10%. Calculate R.
21. Suppose N~ Poisson(2) and X~Exp(3). Find $M_s(1)$.

(7 x 2 =14 Marks)

Section-C

[Answer *any six* Questions. Each question carries *five* marks]

22. Distinguish between life insurance and casualty insurance.
23. Suppose that N~Negbin (2, 0.8) and X~Gamma (4, 3). Find E[S] and V[S].
24. The number of claims from a portfolio of policies has a Poisson distribution with parameter 30 per year. The individual claim amount distribution is lognormal with parameters $\mu = 3$ and $\sigma^2 = 1.1$. The rate of premium income from the portfolio is 1,200 per year. If the insurer has an initial surplus of 1000, estimate the probability that the insurer's surplus at time 2 will be negative, by assuming that the aggregate claims distribution is approximately normal.
25. Does the compound binomial distribution have an additive property? If so, state the property carefully.
26. Show that if N has a Poisson distribution with parameter λ, the distribution of $Z = \frac{N-\lambda}{\sqrt{\lambda}}$ approaches a N (0, 1) distribution as λ tends to ∞.
27. The number of claims arising from a particular group of policies has a negative binomial distribution wit parameters k=4 and p= 0.8. Individual claim amounts have the following distribution P(X=500)=0.5, P(X=1000)=0.25 and P(X=2000)=0.25. The aggregate claim is denoted by S. calculate P(S ≤ 20000) using normal approximations.
28. Explain the procedure of modeling sums of independent random variables using convolutions.
29. If S has a gamma distribution , show that $E[I_d] = \frac{\alpha}{\beta}[1 - G(d: \alpha + 1, \beta) - d[1 - G(d: \alpha, \beta)]$.

(6 x 5=30 Marks)

Section-D

[Answer *any three* Questions. Each question carries eight marks]

30. a) Show that sums of independent compound Poisson random variables is itself a Compound Poisson random variable.

    b) If N has a Poisson distribution with mean λ, show that

$$M_S(t) = \exp(\lambda\,(M_X(t) - 1)).$$

31. Derive the formula for the expectation and variance of aggregate claims.

32. Explain the probability of ruin in continuous time.

33. The aggregate claims arising during each year from a particular type of annual insurance policy are assumed to follow a normal distribution with mean $0.7\,P$ and standard deviation $2.0\,P$, where P is the annual premium. Claims are assumed to arise independently. Insurers are required to assess their solvency position at the end of each year. A small insurer with an initial surplus of £0.1m for this type of insurance expects to sell 100 policies at the beginning of the coming year in respect of identical risks for an annual premium of £5,000. The insurer will incur expenses of $0.\,2\,P$ at the time of writing each policy. Calculate the probability that the insurer will prove to be insolvent for this portfolio at the end of the coming year. Ignore interest.

34. (i) Explain collective risk models.

    (ii) Let X denote the amount of claim takes values 1,2 and 3 with respective probabilities 0.3, 0.4 and 0.3 and N denote the frequency of claims with possible values 0, 1 and 2 with probabilities 0.4,0.5 and 0.1 respectively. Find the probability distribution of total claims over the period.

(3 x 8=24 marks)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fourth Semester B.Sc Statistics Degree Examination, March 2017

ST4C04 – Applied Statistics

(2015 Admission onwards)

Max. Time: 3 hours Max. Marks: 80

Part A

(Answer **all** questions)

1. The totality of items or things under consideration is______________
2. A list of questions properly selected and arranged pertaining to the investigation is known as ______________
3. The individual items in a population are called ______________
4. The basic purpose of analysis of variance is to test the homogeneity of ______________
5. For the validity of the F-test in ANOVA, the distribution of the parent population from which observations are taken should be______________
6. The component of time series which is attached to a lock-outin a factory for a month is ______
7. Simple average method is used to determine ______________variation in a time series.
8. The G.M. of Laspeyres' and Parche's index no. is______________
9. In the construction of Laspeyres' index no, the weights assigned is______________
10. The theoretical basis for the c-chart is derived from__________distribution.
11. The natural tolerance limits are given by______________
12. Statistical quality control takes care of variation due to ________________causes.

(12 x1=12 Marks)

Part B

(Answer any **seven** questions)

13. Distinguish between census and sampling.
14. Define simple random sampling.
15. Give a practical situation where ANOVA can be applied.
16. Write down the mathematical model in one-way classification.
17. What are the points to be considered while choosing the base year for the construction of an index number?
18. Define time series. Give an example.
19. What do you mean by weighted index number?
20. Explain the terms 'chance causes' and 'assignable causes' of variation as used in quality control.
21. What you mean by process control?

(7x2=14 Marks)

Part C

(Answer any **six** questions)

22. Discuss the advantages of sampling over census method.
23. What are the essential points to be remembered while planning the survey?
24. Give the ANOVA table for two-way classification model.
25. What is difference between 'variability within classes' and 'variability between classes'? Explain with suitable example.
26. Explain how trend is obtained by the method of moving averages in the analysis of time series. What are the merits and demerits of the method?
27. What is Fisher's ideal index number? Why is it called ideal? Show that it satisfies both the time reversal test and the factor reversal test.
28. The average number of defectives in 22 sampled lots of 2000 rubber belts each was found to be 16%. Indicate how to construct the relevant control chart.
29. Explain the objectives and uses of Statistical Quality Control.

(6 x 5=30 Marks)

Part D

(Answer any **three** questions)

30. What are the essentials of a good questionnaire?
31. Describe the various steps in ANOVA testing for one-way classification model. Also give the model ANOVA table.
32. Below are given the figures of production (in thousand tons) of a sugar factory.

Year :	2009	2010	2011	2012	2013	2014	2015
Production:	77	88	94	85	91	98	90

Fit a straight line trend by the 'method of least squares' and show the trend values.

33. What is an index number? Explain the various problems involved in the construction of index numbers.
34. The following data gives the measurements of the axles of a bicycle wheel. 12 samples were taken so that each sample contains the measurements of four axles. Draw the $\bar{X}$ and R charts and comment whether the process is under control or not.

139	140	142	136	145	146	148	145	140	140
140	142	136	137	146	148	145	146	139	140
145	142	143	142	146	149	146	147	141	139
144	139	141	142	146	144	146	144	138	139

For n=4, A_2=0.73, D_3=0, D_4=2.28

(3 x 8 =24 Marks)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fourth Semester B.Sc Statistics Degree Examination, March 2017

ST4B04 – Testing of Hypothesis

(2015 Admission onwards)

Max. Time: 3 hours Max. Marks: 80

Part A

(Answer **ALL** questions)

1. The theory of testing of hypothesis was initiated by :
   (a) R.A. Fisher (b) A. Wald (c) C.R. Rao (d) Neyman and Pearson
2. Level of significance is the probability of:
   (a)Type I error (b) Not committing error (c) Type I error (d) None of these.
3. A hypothesis which completely specifies the form of the distribution of the population is called:
   (a) Null (b) Alternative (c) Simple (d) Composite
4. Equality of several normal population means can be tested by:
   (a)Bartlett's test (b) F-test (c) Chi-square test (d) t-test
5. The error degrees of freedom for two way ANOVA with k rows and n columns is:
   (a) k-1 (b) n-1 (c) (k-1)(n-1) (d) nk-1
6. The value of the Chi-square statistics is zero, if and only if:
   (a) $\sum_i O_i = \sum_i E_i$ (b) $O_i = E_i$ for all i (c) $O_i < E_i$ for all i (d) $O_i > E_i$ for all i
7. The value of the statistics that defines the region of acceptance and rejection, is called ....
8. The power of a statistical test is ....
9. The error arising due to drawing inference about the population on the basis of sample is called ....
10. In any testing problem, the type .... error is considered more serious than type .... error.
11. The mean difference between 10 paired observations is 15 and standard deviation of difference is 5. Then the value of the t statistics used in paired t-test is ....
12. The test for independence of attributes is done by ....

(12 × 1=12 Marks)

Part B

(Answer any SEVEN questions)

13. Define Null hypothesis.
14. Define most powerful critical region.
15. If α and β are the probabilities of two types of errors in testing of hypothesis, can $\alpha+\beta=1$? If not why?
16. Write down the test statistics for testing the equality of means of two populations based on large samples, where variances are not known.
17. Mention any two applications of t-distribution.
18. What are the assumptions on F-test?
19. What is a non-parametric test?
20. State the null hypothesis and situations where we use Kruskal-Wallis test.
21. What is sign test?

(7×2=14 Marks)

Part C

(Answer any SIX questions)

22. If $x \geq 0.8$ is the critical region for testing $H_0: \theta = 1.5$ against $H_1: \theta = 2.5$ on the basis of a single observation taken from the population with p.d.f $f(x;\theta) = \frac{1}{\theta}$, $0 \leq x \leq \theta$, what would be the sizes of type I and type II errors?
23. Outline Neyman-Pearson approach to testing of a statistical hypothesis.
24. Derive the most powerful test of the hypothesis, $\theta = \frac{1}{2}$ against the alternative $\theta = \frac{1}{4}$ for the parameter θ in a geometric distribution $P_\theta(x) = \theta(1-\theta)^x$, for x=0,1,2,......... based on a random sample of size 2.
25. Explain the method for testing equality of proportions of two populations based on large samples
26. Explain the method of paired t-test.
27. Explain how the Chi-square distribution is used to test goodness of fit.
28. What are the advantages and drawbacks of non-parametric methods over parametric methods?
29. A random sample of 27 pairs of observations from a normal population gives r=0.6. Is it likely that the variables are correlated.

(6×5=30 Marks)

Part D

(Answer any THREE questions)

30. How do you test whether mean of a given population has a specified value? Discuss the cases where the population is not normally distributed as well as when it is normally distributed and the cases where σ is known and unknown.
31. A sample of size 9 showed the following values: 45, 47, 50, 52, 48, 47, 49, 53, 51. Can the sample be considered to be taken from a normal population with mean 47.5.
32. Two samples of sizes 9 and 8 from two normal populations give the sum of squares of the deviations from their means to be 160 and 91, respectively. Can they be considered as taken from population with the same standard deviations?
33. Develop the Mann-Whitney-Wilcoxon test stating the underlying assumptions and null hypothesis.
34. The following data give the life time of bulbs of two different brands:

Brand I :	8	10	9	11	12	13	70	
BrandII :	1	12	8	14	13	16	11	12

Using Kolmogorov-Smirnov test, examine whether the brands differ with respect to average life.

(3 × 8=24 Marks)