RET/14/Test B

896	Statistics

Question Booklet No. .....

*(To be filled up by the candidate by **blue/black ball-point pen**)*

Roll No. | | | | | | | | | |

Roll No. (Write the digits in words) .....

Serial No. of OMR Answer Sheet .....

Day and Date ....

(Signature of Invigilator)

INSTRUCTIONS TO CANDIDATES

(Use only ***blue/black ball-point pen*** in the space above and on both sides of the ***Answer Sheet***)

1. Within 10 minutes of the issue of the Question Booklet, Please ensure that you have got the correct booklet and it contains all the pages in correct sequence and no page/question is missing. In case of faulty Question Booklet, bring it to the notice of the Superintendent/Invigilators immediately to obtain a fresh Question Booklet.
2. Do not bring any loose paper, written or blank, inside the Examination Hall *except the Admit Card without its envelope.*
3. *A separate Answer Sheet is given. It should not be folded or mutilated. A second Answer Sheet shall not be provided.*
4. Write your Roll Number and Serial Number of the Answer Sheet by pen in the space provided above.
5. *On the front page of the Answer Sheet, write by pen your Roll Number in the space provided at the top, and by darkening the circles at the bottom. Also, wherever applicable, write the Question Booklet Number and the Set Number in appropriate places.*
6. *No overwriting is allowed in the entries of Roll No., Question Booklet No. and Set No. (if any) on OMR sheet and Roll No. and OMR sheet No. on the Question Booklet.*
7. *Any changes in the aforesaid-entries is to be verified by the invigilator, otherwise it will be taken as unfair means.*
8. *This Booklet contains 40 multiple choice questions followed by 10 short answer questions. For each MCQ, you are to record the correct option on the Answer Sheet by darkening the appropriate circle in the corresponding row of the Answer Sheet, by pen as mentioned in the guidelines given on the first page of the Answer Sheet. For answering any five short Answer Questions use five Blank pages attached at the end of this Question Booklet.*
9. For each question, darken only one circle on the Answer Sheet. If you darken more than one circle or darken a circle partially, the answer will be treated as incorrect.
10. *Note that the answer once filled in ink cannot be changed.* If you *do not wish to attempt* a question, leave all the circles in the corresponding row blank (such question will be awarded zero marks).
11. For rough work, use the inner back page of the title cover and the blank page at the end of this Booklet.
12. Deposit *both OMR Answer Sheet and Question Booklet* at the end of the Test.
13. You are not permitted to leave the Examination Hall until the end of the Test.
14. If a candidate attempts to use any form of unfair means, he/she shall be liable to such punishment as the University may determine and impose on him/her.

Total No. of Printed Pages : 15

FOR ROUGH WORK

Research Entrance Test – 2014

No. of Questions : 50

Time : 2 Hours ***Full Marks : 200***

Note : (i) This Question Booklet contains **40** Multiple Choice Questions followed by **10** Short Answer Questions.

(ii) Attempt as many MCQs as you can. Each MCQ carries **3 (Three)** marks. **1 (One)** mark will be deducted for each incorrect answer. Zero mark will be awarded for each unattempted question. If more than **one** alternative answers of MCQs seem to be approximate to the correct answer, choose the closest one.

(iii) Answer only **5** Short Answer Questions. Each question carries **16 (Sixteen)** marks and should be answered in **150-200** words. Blank **5 (Five)** pages attached with this booklet shall only be used for the purpose. Answer each question on separate page, after writing Question No.

1. Which of the following is ***not*** a greenhouse gas ?
   (1) Carbon dioxide (2) Methane (3) Sulphur dioxide (4) Nitrogen
2. The saliva of mammals contains starch splitting enzyme. The name of that enzyme is :
   (1) Amylase (Ptyalin) (2) Secretin (3) Lysozyme (4) Mucin
3. Cytosine in DNA combines with :
   (1) Adinosine (2) Uracil (3) Guanine (4) Thiamine
4. If Vectors $2i - j + k$, $i + 2j - 3k$, $3i + \lambda j + 5k$ are coplanar, then the value of λ is :
   (1) -2 (2) -3 (3) -4 (4) -5
5. The value of $\left(-1 + i\sqrt{3}\right)^{3/2}$ is :
   (1) $\sqrt{2}$ (2) $2\sqrt{2}$ (3) $2 + \sqrt{2}$ (4) $2 - \sqrt{2}$
6. The number of electrons contained in 1 Coulomb of charge equals to :
   (1) 6.25×10^{17} (2) 6.25×10^{18} (3) 6.25×10^{19} (4) 1.6×10^{19}
7. A unit mass of solid is converted to liquid at its melting ; the heat required for this process is the :
   (1) Specific heat (2) Latent heat of vaporization
   (3) Latent heat of fusion (4) External latent heat
8. Granite is :
   (1) a sedimentary rock (2) a metamorphic rock
   (3) a volcanic rock (4) a plutonic igneous rock
9. Coal is a :
   (1) Sedimentary rock (2) Hydrothermal deposit
   (3) Low-grade metamorphic rock (4) High-grade metamorphic rock
10. Which one of the following gases is present in the stratosphere that filters out some of the sun's ultraviolet light and provides an effective shield against radiation damage to living things ?
    (1) Oxygen (2) Methane (3) Ozone (4) Helium
11. Let $X_1, X_2, \ldots\ldots X_n$ be a random sample from a Poisson distribution with parameter μ. What is the maximum likelihood estimate of $e^{-n\mu}$?
    (1) $e^{-\bar{x}}$ (2) $e^{-\sum_{i=1}^{n} x_i}$ (3) $e^{-\sum_{i=1}^{n} \log x_i}$ (4) $\dfrac{\sum_{i=1}^{n} \log x_i}{n}$
12. Let L denote the likelihood function and T be an unbiased estimater of $g(\theta)$. Then for $K(\theta) > 0$, T attains the minimum variance bound if :
    (1) $L = K(\theta)\,(T - g(\theta))$ (2) $\log L = K(\theta)\,(T - g(\theta))$
    (3) $\dfrac{d}{d\theta} \log L = K(\theta)\,(T - g(\theta))$ (4) $\dfrac{d^2}{d\theta^2} \log L = K(\theta)\,(T - g(\theta))$

13. Let $x_1, x_2, \ldots\ldots, x_n$ be a random sample from the following pdf $f(x, \theta) = e^{-(x-\theta)}; x > \theta$. Then, consider the following statements :

Statement I : $(\bar{x} - 1)$ is an unbiased estimate of θ.

Statement II : $x_{(1)}$ is a consistent estimator of θ.

Which of the above statement is/are correct ?

(1) Only statement I is correct (2) Only statement II is correct

(3) Both statements I and II are correct (4) Both statements I and II are not correct

14. If $x \geq 1$ is the critical region for testing $H_0 : \theta = 2$ against $H_1 : \theta = 1$, on the basis of a single observation from the population $f(x, \theta) = \theta e^{-\theta x}; x > 0, \theta > 0$. The value of type - I error is :

(1) $\frac{1}{e^2}$ (2) $\frac{(e-1)}{e^2}$ (3) $\frac{(e^2-1)}{2}$ (4) e^2

15. The 95% asynptotic confidence interval for θ of the Poisson distribution is :

(1) $\bar{x} \pm 2.58\sqrt{\frac{\bar{x}}{n}}$ (2) $\bar{x} \pm 1.96\sqrt{\frac{\bar{x}}{n}}$ (3) $\bar{x} \pm 1.96\sqrt{\frac{n}{\bar{x}}}$ (4) None of these

16. In the linear death process, the number of persons at time t given that initially there are k_0 individuals, will follow a :

(1) Binomial Distribution (2) Geometric Distribution

(3) Hypergeometric Distribution (4) Negative Binomial Distribution

17. In a Galton-Watson branching process, if number of individuals produced by an individual has mean 0.5, then probability of ultimate extinction is :

(1) 0.5 (2) 1.0 (3) 0.25 (4) zero

18. Let $x_{(1)}, \ldots\ldots x_{(n)}$ be a random sample from $P(\lambda)$ and $T = \sum_{i=1}^{n} x_i$ is the complete sufficient statistics. Then the UMVUE of $P[x_1 = 0]$ is :

(1) $\frac{n}{n-1}T$ (2) $\left(1 - \frac{1}{n}\right)^T$ (3) $\frac{n-1}{n}(T-1)$ (4) $\left(1 - \frac{1}{n}\right)^T + \left(\frac{1}{n}\right)^{T-1}$

19. Let $x_1, x_2, \ldots\ldots, x_n$ be a random sample from Cauchy (π, θ). Then the CRLB for the variance of the unbiased estimate is :

(1) It does not exist (2) $\frac{2\theta^2}{n}$

(3) $\frac{\theta^2}{n}$ (4) exists only for $\theta > 0$

20. Let $x_1, x_2, \ldots\ldots, x_n$ be a random sample from the distribution with pdf $f(x,\theta) = 2(\theta - x)/\theta^2$, for $0 < x < \theta$ and 0 otherwise. Then the sufficient statistic for θ is :

(1) $\sum_{i=1}^{n} x_i$ (2) $x_{(n)}$

(3) $[x_{(1)} + x_{(n)}]/2$ (4) $[x_{(1)} \ldots\ldots x_{(n)}]$ the entire set of observations

21. Consider a single observation x_1 from $N(\theta, 1)$ and let the prior for θ be $N(0, 1)$. Bayes estimator assuming a squared error loss function and absolute loss function is :

(1) Under SEL it is $\frac{x_1}{2}$ and under AEL it does not exist

(2) Under AEL it is $\frac{x_1}{2}$ and under SEL it does not exist

(3) It is $\frac{x_1}{2}$ under both AEL and SEL

(4) It is $\frac{3x_1}{2}$ under both AEL and SEL

22. Which statement is ***correct*** with respect to subjective probability ?

(1) It can be evaluated using classical definition of probability

(2) It can evaluated using frequentist approach

(3) It can be evaluated using observed data values

(4) It can be evaluated using personal judgement and introspection

23. Consider the distribution $\theta^x(1-\theta)^x$ obtained from Binomial sampling scheme. What will be the Jeffrey's prior ?

(1) Beta (0.5, 0.5) (2) Beta (1, 1) (3) Beta (1, 0.5) (4) Beta (1, 1.5)

24. Suppose that $P(\theta / x_1 \ldots\ldots x_n)$ is the posterior distribution based on $f(x/\theta)$ and an appropriately chosen prior $g(\theta)$. Let x_{n+1} and x_{n+2} are two additional observations added at a later stage. What is the posterior $P(\theta / x_1 \ldots\ldots\ldots x_{n+2})$:

(1) Cannot be determined since prior distribution can not be obtained on the basis of the given information.

(2) Same as $P(\theta / x_1 \ldots\ldots x_n)$ since x_i's are i. i. d.

(3) Proportional to $\prod_{i=n+1}^{n+2} f(x_i)\, P(\theta / x_1 \ldots\ldots x_n)$

(4) Proportional to $P(\theta / x_1 \ldots\ldots x_n).\, g(\theta)$; where $g(\theta)$ is the appropriately chosen prior.

25. Which one of the following is a direct measure of Migration ?
(1) Balancing equation method (2) Place of birth method
(3) Survival ratio method (4) National population growth method

26. Among the following categories providing information on the population which one is ***not*** provided by population census ?
(1) Demographic characteristics (2) Social-cultural characteristics
(3) Economic characteristics (4) Characteristics related to health of the population

27. Some salient features of a census are :
a. Selectivity b. Simultaneity c. Universality d. Periodicity
Find out the ***correct*** combination of answer according to the Code :
(1) a., b. and c. are correct (2) b., c. and d. are correct
(3) a., c. and d. are correct (4) a, b. and d. are correct

28. Myer's blended population index is used to ***correct*** :
(1) Digit preference in age data (2) Sex-ratio
(3) Growth rate (4) Migration rate

29. If death rate of a stationary population is 10 per thousand, then its life expectancy would be :
(1) 10 years (2) 50 years (3) 75 years (4) 100 years

30. Which one of the following is ***not*** true in case of stable population theory ?
(1) NRR = e^{rT} (2) b = d = $1/e_0^0$ (if r = 0)
(3) C(a, t) = C(a) (4) NRR = GRR

31. If joint probability density function of x and y is :

$$f(x,y) = \frac{1}{\pi} e^{-\frac{1}{2}[(x-1)^2+(y-2)^2]}$$

What is the distribution of $x - y$.
(1) Normal N(1, 2) (2) Normal N(1, 1) (3) Normal N(0, 2) (4) Normal N(–1, 2)

32. Distribution of Hotelling T^2 is based on :
(1) Normal distribution (2) t-distribution
(3) F- distribution (4) Chi-square distribution

33. In the process of dividing a finite population into strata, the variability of the total population is distributed over two types of variability, one, between strata variability and, second, with in strata variability. For a population divided into 5 strata, the following values were obtained :
Total sum of squares (TSS) = 125.70
Between strata sum of squares (BSS) = 87.93
Within strata sum of squares (WSS) = 37.77
Then the difference between the variances, $V(\bar{y}s+)$ under proportional allocation and $V(\bar{y}_n)$ under SRSWOR will be :
(1) 87.93 (2) 125.70 (3) 50.16 (4) 37.77

34. It the cost function is of the form $C = C_\circ + \sum ti\sqrt{n_i}$, where $C_\circ$ and t_i are known, then the variance of the estimator $\bar{y}$ s+ in stratified random sampling for fined total cost is minimum if :

(1) $n_i \propto (p_i^2 S_i^2 / t_i)^{2/3}$ (2) $n_i \propto N_i S_i$ (3) $n_i \propto N_i$ (4) $n_i \propto p_i S_i^2$

35. In a survey of 32,000 people in a city, the proportion of people with heart disease is estimated to be 5 in a thousand. For a fresh survey, approximately how many persons may you need to find the proportion in your sample within a 5% margin of error :

(1) 14,070 (2) 20,000 (3) 5,000 (4) 29,090

36. In a population, there are 600 males and 400 females. If one wishes to estimate the proportion of the females in the population on the basis of a sample of size 100 taken from the population with SRSWOR, then the variance of the estimator will be equal to :

(1) $\frac{(1000-100)\times 0.6\times 0.4}{999\times 100}$ (2) $\frac{999\times 0.6\times 0.4}{900\times 100}$

(3) $\frac{900\times 600\times 400}{100}$ (4) $\frac{600\times 400\times 100}{999}$

37. If V_1 is the variance of sample mean in SRSWR and V_2 is the variance of sample mean in SRSWOR, sample size n is equal to 20 and $\frac{V_1}{V_2} = 2$, then the population size N is :

(1) 30 (2) 40 (3) 29 (4) 39

38. Let S be the convex set of all the feasible solutions of a linear programming problem. Let $X_1, X_2 \in S$. Then for constants λ_1 and λ_2, the condition for $X \in S$, which one of the following conditions must be satisfied ?

(1) $X = \lambda_1 X_1 + \lambda_2 X_2$ such that $\lambda_1 - \lambda_2 = 1, \lambda_1, \lambda_2 \geq 0$

(2) $X = \lambda_1 X_1 + \lambda_2 X_2$ such that $\lambda_1 = 1 - \lambda_2, \lambda_1, \lambda_2 \geq 0$

(3) $X = \lambda_1^2 X_1 + (1 - \lambda_2^2) X_2$ for all $\lambda_1, \lambda_2 \geq 0$

(4) None of the above

39. An all integer programming problem, when solved through Branch and Bound technique, yielded the following solutions for different nodes :

Problem A : $x_1 = 15, x_2 = 2.5$, Minimum Z = 51.25

Problem B : $x_1 = 16, x_2 = 2$, Minimum Z = 53

Problem C : $x_1 = 14.66, x_2 = 3$, Minimum Z = 51.5

Problem D : $x_1 = 14, x_2 = 4$, Minimum Z = 52

Problem E : $x_1 = 15, x_2 = 3$, Minimum Z = 52.5

Which of the following nodes give the solution of the problem ?

(1) Problem B
(2) Problem B and E both
(3) Problem D
(4) Problem E and D both

40. In an (M/M/1) : $(\infty / FIFO)$ queueing model, if λ and μ are respectively the mean arrival rate and mean service rate, then $\lambda/\mu(\mu-\lambda)$ is :

(1) Average number of customers in the queue
(2) Average number of customers in the system
(3) Average time of a customer in the queue
(4) None of the above

Attempt any five questions. Write answer in 150-200 words. Each question carries 16 marks. Answer each question on separate page, after writing Question Number.

1. Discuss in brief the different methods of removing multicollinearity.
2. Let $x_1, x_2 \ldots\ldots x_n$ be a random sample from exponential distribution with parameter θ then find the minimum variance bound estimator for θ.
3. By an example show that maximum likelihood estimators are not unique.
4. Explain difference between time dependent Poisson process and weighted Poisson process.
5. Comment on admissibility of Bayes estimator.
6. If A follows a Wishart distribution Wp $(n, \bar{z})$ and L is any non-null p × 1 vector, prove that $L'AL / L'\bar{z}L$ follows chi-square χ^2_n.
7. The joint distribution of x and y is $f(x, y) = xe^{-y}$ for $0 < x < 2$ and $y > 0$; and zero elsewhere. Derive the distribution by $x + y$.
8. Show that the minimum mean squared error of the estimator $t = \lambda\bar{y}_n$ is given by

$$\min MSE(t) = \frac{V(\bar{y}_n)}{1 + V(\bar{y}_n)/\bar{y}^2}$$

9. Show that the set of all feasible solutions of a linear programming problem constitutes a convex set.
10. Discuss in brief various techniques for computation of infant mortality rate.

Roll No. : .....

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FOR ROUGH WORK