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F.Y. B.Sc. (Computer Science) EXAMINATION, 2018

STATISTICS

(Statistical Methods-II)

Paper II

(2013 PATTERN)

Time : Three Hours **Maximum Marks : 80**

N.B. :— (*i*) *All* questions are compulsory.

(*ii*) Figures to the right indicate full marks.

(*iii*) Use of non-programmable, scientific calculators and statistical tables is allowed.

(*iv*) Symbols have their usual meanings unless otherwise stated.

1. (A) Fill in the blanks : [1 mark each]

(*i*) An event A which contains only one element of sample space is called as ....

(*ii*) If two events A and B are mutually exclusive, then $P(A \cup B)$ = ...

(*iii*) If random variable X follows uniform distribution in (–2, 2), then its mean is ....

(*iv*) The standard deviation of a statistic is called as ....

(B) Select most appropriate option for each of the following : [1 mark each]

(*i*) Var(5X–2) =

(*a*) 5*Var(X)

(*b*) 25*Var(X)

(*c*) 5*Var(X–2)

(*d*) 25*Var(X)–2

(*ii*) Let A and B be any *two* events defined on Ω, then $P(A \cap B) =$

(*a*) $P(A) + P(B)$

(*b*) $P(A)*P(A/B), P(A)>0$

(*c*) $P(A)*P(B/A), P(A) > 0$

(*d*) $P(A) * P(A/B), P(B) > 0$

(*iii*) Given three aribitrary events A, B and C defined on Ω, then the expression for the event "occurrence of at least one of the events" is :

(*a*) $A \cup B \cup C$

(*b*) $B \cap A \cup C$

(*c*) $B \cup (A \cap C)$

(*d*) $A \cap B \cap C$

(*iv*) Probability of Rejecting H_0 when H_0 is true is called as :

(*a*) Statistic

(*b*) Parameter

(*c*) Sample

(*d*) Level of significance

(C) Attempt each of the following : [2 marks each]

(*i*) A continuous random variable X has the probability density function (p.d.f.)

$$f(x) = \begin{cases} k, & 2 \le x \le 5 \\ 0, & otherwise \end{cases}$$

Find the value of k.

(*ii*) If X has Pareto distribution with $\alpha = 4$, find the mean of X.

(*iii*) State normal approximation to Poisson distribution.

(*iv*) State Box-Muller transformations.

2. Attempt any *four* of the following : [4 marks each]

(*a*) Find the total number of three digit numbers that can be formed from six digits 2, 3, 5, 6, 7 and 9. How many of these are less than 500 ?

(*b*) Three coins are tossed together. The events are defined as below :

A : Exactly 2 coins show heads

B : At least 2 coins show heads

List the elements of A and B. Verify whether A and B are mutually exclusive ?

(*c*) Define each of the following with an illustration :

(*i*) Discrete sample space

(*ii*) Non-deterministic experiment.

(*d*) In a random arrangement of the letters of the word "SIGNAL", find the probability that :

(*i*) All the vowels come together.

(*ii*) The vowels occupy odd places.

(*e*) State axioms of probability. Also, prove that "If A and B are two events defined on Ω, such that A is subset of B, then $P(A) \leq P(B)$."

(*f*) An event A is such that it is three times as probable as the event A^c. Find P(A).

3. Attempt any *four* of the following : [4 marks each]

(*a*) Define independence of two events A and B defined on a sample space Ω. Can they be independent and mutually exclusive simultaneously ? Justify your answer.

(*b*) The events A_1, A_2 and A_3 form a partition of sample space. If $P(A_1) = P(A_2) = P(A_3) = 1/3$, $P(B/A_1) = 2/7$, $P(B/A_2) = 4/9$, $P(B/A_3) = 1/5$, find $P(A_1/B)$.

(*c*) Define each of the following :

(*i*) Exhaustive events

(*ii*) Sure event

(*iii*) Intersection of two events

(*iv*) Permutation.

(*d*) If $X \rightarrow U[a, 10]$ and $P(3<X<7) = 1/2$, find the value of a.

(*e*) Define each of the following :

(*i*) Continuous random variable

(*ii*) Expectation of a continuous random variable.

(*f*) If X $\rightarrow$ N(5, 16), find :

(*i*) $P(5 \leq X \leq 7)$

(*ii*) $P(3X + 7 > 24)$.

4. Attempt any *two* of the following : [8 marks each]

(*a*) (*i*) Define normal distribution. State *two* properties of normal distribution.

(*ii*) The failure time of a component X is assumed to have an exponential distribution with mean of 100 hours. Find the probability that any particular component will :

(1) last at least for 200 hours and

(2) last between 250 and 300 hours.

(*b*) (*i*) Define distribution function of a continuous random variable. State any *two* properties of the distribution function.

(*ii*) In a laboratory experiment, 18 determinations of the coefficient of friction between leather and metal yielded the following results :

0.49, 0.56, 0.49, 0.55, 0.45, 0.55, 0.51, 0.4, 0.56, 0.47, 0.58, 0.41, 0.54, 0.48, 0.51, 0.57, 0.43, 0.56.

Test using sign whether population median is 0.5 at 5% level of significance (l.o.s.).

(*c*) (*i*) Explain the method of drawing a model sample from a uniform (a, b) distribution.

(*ii*) In a sample of 500 parts manufactured by a company, the number of defective parts was found to be 42. The company, however, claimed that 6% of their product is defective. Test the claim at 5% level of significance.

(*d*) (*i*) Describe procedure of run test.

(*ii*) Define probability density function of a continuous random variable. Also, verify whether the following function can be considered as a valid probability density function :

$$f(x) = \begin{cases} \dfrac{3x(2-x)}{4}, & 0 \le x \le 2 \\ 0, & \text{otherwise} \end{cases}$$

5. Attempt any *one* of the following :

(*a*) (*i*) Define each of the following : [4]

SRSWOR

Null hypothesis

Statistic

Critical region

(*ii*) The table below gives the number of customers visiting a certain Post office on various days of the week :

Days	**Number of Customers**
Monday	130
Tuesday	120
Wednesday	110
Thursday	115
Friday	110
Saturday	135

Test whether the customers visiting the post office are uniformly distributed. Use 5% l.o.s. [4]

(*iii*) Memory capacity of 10 students was tested before and after training and are as follows : [8]

Roll No.	Before Training	After Training
1	12	15
2	14	16
3	11	10
4	8	7
5	7	5
6	10	12
7	3	10
8	0	2
9	5	3
10	6	8

Test whether the training was effective or not. Use 5% l.o.s.

(*b*) (*i*) Explain the large sample test for testing $H_0 : P_1 = P_2$ against $H_1 : P_1 \neq P_2$. [4]

(*ii*) A random sample of 90 adults is classified according to gender and the number of hours they watch television during a week :

Time spent watching television during a week	Gender: Male	Gender: Female
Over 25 hours	15	29
Under 25 hours	27	19

Test whether the time spent in watching television is independent of gender at 5% level of significance. [4]

(*iii*) Given the following information about two variables X and Y : [8]

$$n = 10, \sum_{i=1}^{10} x_i = 55, \sum_{i=1}^{10} y_i = 40, \sum_{i=1}^{10} x_i^2 = 385,$$

$$\sum_{i=1}^{10} y_i^2 = 192, \sum_{i=1}^{10} x_i y_i = 185$$

(1) Compute the value of correlation coefficient between X and Y.

(2) Test the significance of correlation coefficient between X and Y at 1% l.o.s.