

Code No: X0521

R07**SET - 1**

II B. Tech I Semester, Supplementary Examinations, Nov – 2012
PROBABILITY AND STATISTICS
(Com. to CSE, IT)

Time: 3 hours

Max. Marks: 80

Answer any FIVE Questions
All Questions carry Equal Marks
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1. a) If A and B are any two events then prove that  
i)  $P(\bar{A} \cap B) = P(B) - P(A \cap B)$       (ii)  $P(A \cap \bar{B}) = P(A) - P(A \cap B)$ .  
b) Among 150 students 80 are studying Mathematics, 40 are studying physics and 30 are studying Mathematics and physics. If a student is chosen at random, find the probability that the student. i) Studying Mathematics or Physics ii) studying neither Mathematics nor Physics
2. a) Two dice are thrown. Let X assign to each point (a,b) in S the maximum of its numbers i.e.  $X(a,b) = \max(a,b)$ . Find the probability distribution of the random variable X.  
b) The probability density function of a random variable is given by  $f(x) = y_0 e^{-|x|}$ ,  $-\infty < x < \infty$ . Find  $y_0$ , mean and variance of the distribution.
3. a) 20% of items produced from a factory are defective. Find the probability that in a sample of 5 chosen at random i) None is defective ii) one is defective iii)  $p(1 < x < 4)$ .  
b) The average rate of phone calls received is 0.6 calls per minute at an office Determine the probability that i) There will be one or more calls in a minute, ii) There will be at least three calls during 4 minutes.
4. A population consists of four numbers 3,7,11,15 consider all possible samples of size two which can be drawn with replacement from their population. Find  
i) The population mean      ii) The population standard deviation  
iii) The mean of the sampling distribution of means  
iv) The standard deviation of the sampling distribution of means.
5. a) What is the maximum error one can expect to make with probability 0.90 when using the mean of random sample of size 64 to estimate the mean of a population with variance is 2.56?  
b) A sample of 10 cam shafts intended for use in gasoline engines has an average eccentricity of 1.02 and a standard deviation of 0.044 inch. Assuming the data may be treated a random sample from a normal population, determine a 95% confidence interval for the actual mean eccentricity of the cam shaft.

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6. a) An oceanographer wants to check whether the average depth of the ocean in a certain region is 57.4 fathoms, as had previously recorded. What can he conclude at the level of significance 0.05 if surroundings take at 40 random locations in the given region yielded a mean of 59.1 fathoms with a standard deviation of 5.2 fathoms?
- b) A sample of heights of 6400 English men has mean of 67.85 inches and standard deviation of 2.56 inches. While a sample of heights of 1600 Australians has a mean of 68.55 inches and standard deviation of 2.52 inches. Do the data indicate that Australians are on the average, taller than English men?

7. a) The daily wages in rupees of skilled workers in two cities are as follows.

| City   | Size of sample | S.D. of wages in the sample |
|--------|----------------|-----------------------------|
| City A | 16             | 25                          |
| City B | 13             | 32                          |

Test at 5% level the equality of variances of the wage distribution in the two cities.

- b) The following data represents a person's ability in Mathematics and his interest in statistics.

| Ability in Mathematics |         | Low | Average | High |
|------------------------|---------|-----|---------|------|
| Interest in Statistics | Low     | 63  | 42      | 15   |
|                        | Average | 58  | 61      | 31   |
|                        | High    | 14  | 47      | 29   |

Use the 0.01 level of significance and test for independence between person's ability in Mathematics and interest in statistics.

8. A toll gate is operated on a free way where cars arrive according to a poisson distribution with mean frequency of 1.2 cars per minute. The time of completing payment follows an exponential distribution with mean of 20 seconds. Find
- The idle time of the counter
  - Average number of cars in the system
  - Average number of cars in the queue
  - Average time that a car spends in the system
  - Average time that a car spends in the queue.

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1. a) If A and B independent events then prove that
 - i) \bar{A} and \bar{B} are independent
 - ii) A and \bar{B} are independent.
 b) A problem in statistics is given to the three students A, B, C whose chance of solving it are $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{1}{4}$ respectively. What is the probability that the problem is solved.

2. a) Let X denote the number of heads in a single toss of 3 fair coins. Determine
 - i) $P(X < 2)$
 - ii) $P(1 < X \leq 3)$.
 b) A continuous random variable X has the distribution function

$$F(x) = 0, \text{ if } x \leq 1$$

$$= k(x - 1)^4; \text{ if } 1 < x \leq 3$$

$$= 1 \text{ if } x > 3.$$
 Find i) the probability density function of X, ii) Find k, iii) Mean

3. a) Prove that Poisson distribution is a limiting case of Binominal Distribution as $n \rightarrow \infty$ and $p \rightarrow 0$.
 b) If the masses of 300 students are normally distributed with mean 68 kgs and standard deviation 3 kgs. How many students have masses i) greater than 72 kg? ii) Less than or equal to 64 kg? iii) Between 65 and 71 kg inclusive?

4. A population consists of five numbers 2,3,6,8 and 11 consider all possible samples of size 3 that can be drawn without replacement from this population. Find
 - i) the mean of the population
 - ii) the standard deviation of the population
 - iii) the mean of the sampling distribution of means and
 - iv) the standard deviation of the sampling distribution of means (i.e., the standard error of means)

5. a) It is desired to estimate the mean number of hours of continuous use until a certain computer will first require repairs. If it can be assumed that $\sigma = 48$ hours how large a sample be needed so that one will be able to assert with 90% confidence that the sample mean is off by at most 10 hours.
 b) To estimate the average time it takes to assemble a certain computer component, the industrial engineer at an electronics firm timed 40 technicians in the performance of the task, getting a mean of 12.73 minutes and a standard deviation of 2.06 minutes. Use the given data to construct a 99% confidence interval for mean

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6. a) A lady stenographer claims that she can take dictation at the rate of 118 words per minute. Can we reject her claim on the basis of 100 trials in which she demonstrates a mean of 116 words and a standard deviation of 15 words?
- b) A random sample of 1000 men from Northern India gives their mean wage to be Rs.30 per day with a standard deviation of Rs.1.50. A sample of 1500 men from southern India gives a mean wage of Rs.32. Discuss whether the mean rate of wages varies between the two regions.
7. a) A process for making certain bearing is under control if the diameters of the bearing have the mean of 0.5000 cm. What can we say about this process if a sample of 10 of these bearings has a mean diameter of 0.5060 cm and a standard deviation of 0.0040 cm.?
- b) Four methods are under development for making discs of a superconducting material. Fifty discs are made by each method and they are checked for superconductivity when cooled with liquid.

	1 st method	2 nd method	3 rd method	4 th method
Super conductors	31	42	22	25
Failures	19	8	28	25

Test the significant difference between the proportion of superconductors at 0.05 levels.

8. Customers arrive at a one window drive in bank according to a Poisson distribution with mean 10 per hour. Service time per customer is exponential with mean 5 minutes. The car space in front of the window including that for the serviced can accommodate a maximum of 3 cars. Other cars can wait outside the space.
- a) What is the probability that an arriving customer can drive directly to the space in front of the window?
- b) What is the probability that an arriving customer will have to wait outside the indicated space?
- c) How long is an arriving customer expected to wait before starting service.

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1. a) If A, B and C are any three events of a sample space 'S' and are not disjoint then prove that $P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(B \cap C) - P(C \cap A) + P(A \cap B \cap C)$
- b) In a certain town 40% have brown hair, 25% have brown eyes and 15% have both brown hair and brown eyes. A person is selected at random from the town.
- i) If he has brown hair, what is the probability that has brown eyes also.
- ii) If he has brown eyes, determine the probability that he does not have brown hair
2. a) For the discrete probability distribution
- | | | | | | | | | |
|---|---|---|----|----|----|----------------|-----------------|--------------------|
| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| f | 0 | k | 2k | 2k | 3k | k ² | 2k ² | 7k ² +k |
- Determine i) k ii) mean iii) variance iv) smallest value of x such that $P(X \leq x) > \frac{1}{2}$.
- b) If X is a continuous random variable with distribution $f(x) = x/6+k$. if $0 \leq x \leq 3 = 0$ elsewhere Determine i) the value of k ii) the mean iii) $P(1 \leq x \leq 2)$.
3. a) Prove that mean $\mu = np$ and variance $\sigma^2 = npq$ for a Binomial distribution.
- b) The average number of phone calls / minute coming into a switch board between 2 p.m. and 4 p.m. is 2.5. Determine the probability that during one particular day there will be i) 4 or fewer ii) more than 6 calls.
4. A population consists of six number 4,8,12,16,20,24. Consider all samples of size two which can be drawn without replacement from this population, find
- i) population mean
- ii) population standard deviation
- iii) mean of the sampling distribution of means
- iv) standard deviation of the sampling distribution of means.
5. a) A random sample of 100 teaches in a large metropolitan area revealed a mean weekly salary of Rs.487 with standard deviation Rs.48/- with what degree of confidence can we assert that the average weekly salary of all teachers in the metropolitan area is between 472 to 502?
- b) A random sample of 400 items is found to have mean of 82 and standard deviation of 18. Find 95% confidence limits for the mean of the population from which the sample is drawn.

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6. a) According to the norms established for a mechanical aptitude test, persons who are 18 years old have an average height of 73.2 with standard deviation of 8.6. If 45 randomly selected persons of that age average 76.7, test the null hypothesis $\mu = 73.2$ against the alternative hypothesis $\mu > 73.2$ at 0.01 level of significance.
- b) Test whether the means of the samples are significantly different, given the following data.

Samples	Size	Mean	Standard deviation
Sample I	100	110	12
Sample II	100	112	16

7. a) The mean weekly sales of soap bars in departmental stores was 146.3 bars per store. After an advertising campaign the mean weekly sales in 22 stores for a typical week increased to 153.7 and showed a standard deviation of 17.2 was the advertising campaign successful?
- b) The following data gives the fields of interest and attitude to religion.

	Arts and commerce	Science and Engineering	Total
Conformist	109	51	160
Non conformist	23	17	40
Total	132	68	200

Examine whether the field of interest and attitude to religion are associated.

8. The mean rate of arrival of planes at an airport during the peak period is 20 hours. The number of arrivals in any hour follows a Poisson distribution. When there is congestion the planes are forced to fly over the field in the stack awaiting the landing of other planes that arrived earlier, 60 planes per hour can land in good weather and 30 planes per hour can land in bad weather.
- i) How many planes would be flying over the field in the stack on an average in good weather and in bad weather?
- ii) How long a plane would be in the stack in the process of landing in good and bad weather?

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1. a) State and prove the Baye's theorem of probability
 b) A business man goes to hotels X, Y, Z 20%, 50%, 30% of the time respectively. It is known that 5%, 4%, 8% of the rooms in X, Y, Z hotels have faulty plumbing. (i) Find the probability that the business man goes to the hotel with faulty plumbing?
2. a) A random variable X has the following probability function.
- | | | | | | | | | |
|------|---|---|----|----|----|----------------|-----------------|--------------------|
| X | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| P(X) | 0 | k | 2k | 2k | 3k | k ² | 2k ² | 7k ² +k |
- i) Find the value of k
 ii) Evaluate $P(X < 6)$, $P(X \geq 6)$
 iii) $P(0 < X < 5)$
 b) A random process gives measurements X between 0 and 1 with a probability density function
 $f(x) = k(1 - x^2)$, $0 < x < 1$.
 $= 0$, elsewhere
 Find the value of K and (i) $P(0.1 < X < 0.2)$ (ii) $P(X > 0.5)$.
3. a) The mean and variance of a Binomial variable X with parameters n and p are 16 and 8. Find $P(X \geq 1)$ and $P(X > 2)$.
 b) Suppose the weights of 80 male students are normally distributed with mean $\mu=140$ pounds and standard deviation 10 pounds. Find the number of students whose weights are
 i) between 138 and 148 pounds ii) more than 152 pounds.
4. If the population is 3,6,9,15,27.
 i) List all possible samples of size 3 that can be taken without replacement from the finite population.
 ii) Calculate the mean of the sampling distribution of mean
 iii) Find the standard deviation of sampling distribution of means.
5. a) A random sample of size 16 values from a normal population showed a mean of 41.5 inches and the sum of the squares of deviations from means is 135 sq. inches. Find the maximum error with 95% confidence.
 b) Measurements of the weights of a random sample of 200 ball bearings made by a certain machine during one week showed a mean of 0.824 and a standard deviation of 0.042. Find 95% confidence limits for the mean weight of all the ball bearings.

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6. a) The mean breaking strength of cubes supplied by a manufacturer is 2000 with a standard deviation of 200. A sample of 100 has a mean of 1950. Test the significance at 0.05 level?
- b) A sample of 100 electric bulbs produced by manufacturer A showed a mean life time of 1190 hours and a standard deviation of 90 hours. A sample of 75 bulbs produced by manufacturer B showed a mean life time of 1210 hours with a standard deviation of 120 hours. Is there any significant difference between the mean life times of the two brands at 0.05 level?
7. a) There are two firms A and B which produce rivets. Both the firms produce rivets whose mean diameters are same but their standard deviations many differ. A sample of 22 rivets produced by the firm A showed a standard deviation of 2.9 mm while a sample of size 16 rivets from the firm B showed a standard deviation of 3.8 mm. Test whether both the firms have the same variability.
- b) In an experiment on immunization of cattle from tuberculosis the following results were obtained.

	Affected	Not effected
Inoculated	12	26
Not inoculated	16	6

8. Analyze and discuss the effect of vaccine in controlling susceptibility to tuberculosis.
- In a railway marshalling yard goods trains arrive at a rate of 30 trains per day. Assuming that the inter – arrival time follows an exponential distribution and the service time distribution is also exponential with an average 36 minutes. Calculate the following:
- i) The average number of trains in the queue.
- ii) The probability that the queue size exceeds 10.
- If the input of trains increases to an average 33 per day, what will be change in (i) and (ii) ?