

II B.Tech II Semester Supplementary Examinations, November/December 2005

PROBABILITY AND STATISTICS

(Common to Civil Engineering, Mechanical Engineering, Computer Science & Engineering, Chemical Engineering, Information Technology, Mechatronics, Computer Science & Systems Engineering, Electronics & Computer Engineering, Production Engineering and Bio-Technology)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) If A and B are any two arbitrary events of the sample space then Prove that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
 (b) Determine the probability for each of the following events:
 - i. a non defective bolt will be found if out of 600 bolts already examined 12 were defective.
 - (c) Two digits are selected at random from the digits 1 through 9.
 - i. If the sum is odd, what is the probability that 2 is one of the numbers selected.
 - ii. If 2 is one of the digits selected, what is the probability that the sum is odd [5+5+6]
2. (a) If X and Y are discrete random variables and K is a constant then prove that.
 - i. $E(X + K) = E(X) + K$
 - ii. $E(X+Y) = E(X) + E(Y)$
 (b) Out of 800 families with 5 childrens each, how many would you expect to have
 - i. 3 boys
 - ii. either 2 or 3 boys [8+8]
3. (a) Average number of accidents on any day on a national highway is 1.8. Determine the probability that the number of accidents are
 - i. at least one
 - ii. at most one
 (b) If X is a normal variate, Find:
 - i. to the left of $z = -1.78$
 - ii. to the right of $z = -1.45$
 - iii. corresponding to $-0.80 \leq z \leq 1.53$
 - iv. to the left of $z = -2.52$ and to the right of $z = 1.83$. [8+8]
4. (a) The following are the number of sales which a sample of 9 sales people in city A and 6 sales people in city B made over a fixed period of time:

City A:	59	68	44	71	63	46	69	54	48
City B:	50	36	62	52	70	41			

- (b) In a random sample of 60 workers the average time taken by them to get to work is 33.8 minutes with a standard deviation of 6.1 minutes, can we reject the null hypothesis $\mu = 32.6$ minutes in favour of alternative hypothesis $\mu > 32.6$ at $\alpha = 0.025$ level of significance? [10+6]
5. (a) A sample of 400 items is taken from a population whose standard deviation is 10. The mean of the sample is 40. Test whether the sample has come from a population with mean 38. Also calculate 95% confidence interval for the proportion.
- (b) A social worker believes that fewer than 25% of the couples in a certain area are ever used any form of birth control. A random sample of 120 couples was contacted. Twenty of them said that they have used. Test the belief if social worker at .05 level. [8+8]
6. (a) To examine the hypothesis that the husbands are more intelligent than the wives, an investigator took a sample of 10 couples and administered them a test which measures the IQ as follows:
- Husbands: 117 105 97 105 123 109 86 78 103 107
 Wives: 106 98 87 104 116 95 90 69 108 85
- Test the hypothesis with a reasonable test at the level of significance of 0.05?
- (b) In an investigation on the machine performance the following results were obtained:

	No.of Units inspected	No. of defectives
Machine 1	375	17
Machine 2	450	22

Test whether there is any significant performance of two machines at $\alpha=0.05$ [8+8]

7. .

- (a) Fit the parabola of the form $y = a + bx + cx^2$ for the following data by the method of least squares

x	-3	-2	-1	0	1	2	3
Y	4.63	2.11	.67	.09	.63	2.15	4.58

- (b) Derive normal equations by the method of least squares for the polynomial
 $y = a_0 + a_1x + a_2x^2 + \dots\dots\dots a_nx_n$. [10+6]

8. Two independent variables x and y have means 5 and 10 and variances 4 and 9 respectively. Find the coefficient of correlation between u and v where

- (a) $u = 3x+4y$, $v = 3x-y$
- (b) If x and y are not independent and $r=.5$, $u = x+y$, $v = x-y$ [8+8]

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1. (a) If A_1, A_2, \dots, A_n are n events then prove that $P(\bigcap_{i=1}^n A_i) \geq \sum_{i=1}^n P(A_i) - (n-1)$
- (b) Companies B_1, B_2, B_3 produce 30%, 45%, 25% of the cars respectively. It is known that 2%, 3%, 2% of these cars produced from B_1, B_2, B_3 are defective.
 - i. What is the probability that a car purchased is defective.
 - ii. If a car purchased is found to be defective what is the probability that this car is produced by the company B . [6+10]
2. (a) For the continuous probability function $f(x) = kx^2e^{-x}$ when $x \geq 0$, find
 - i. k
 - ii. mean
 - iii. variance
- (b) 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. $p(1 < x < 4)$ [8+8]
3. (a) A distributor of bean seeds determines from extensive tests that 5% of large batch of seeds will not germinate. He sells the seeds in packets of 200 and guarantees 90% germination. Determine the probability that a particular packet will violate the guarantee.
- (b) Show that the mean deviation from the mean equals (approximately) to $4/3$ of standard deviation for normal distribution. [8+8]
4. (a) Write about
 - i. Null hypothesis
 - ii. Alternate Hypothesis.
- (b) An ambulance service claims that it takes on the average less than 10 minutes to reach its destination in emergency calls. A sample of 36 calls has a mean of 11 minutes and the variance of 16 minutes.

Test the significance at .05 level. [8+8]

5. (a) A random sample of size 81 was taken whose variance is 20.25 and mean 32 construct 98% confidence interval
- (b) A manufacturer claims that only 4% of his products are defective. A random sample of 500 were taken among which 100 defective Test the hypothesis at .05 level [8+8]
6. The following is the distribution of the hourly number of trucks arriving at a company's warehouse.

Tracks arriving per hour	0	1	2	3	4	5	6	7	8
Frequency	52	151	130	102	45	12	5	1	2

Fit a Poisson distribution and test for goodness of fit at the level of significance .05. [16]

7. (a) The following are the measurements of the air velocity and evaporation coefficient of burning fuel droplets in air impulse engine

Air velocity x	20	60	100	140	180	220	260	300	340	380
Evaporation Coefficient y	.18	.37	.35	.78	.56	.75	1.18	1.36	1.17	1.65

- (b) Fit a straight line to the above data. Fit a curve of the form $y = a.(b)^x$ by the method of least squares for the following data.

x	0	1	2	3	4	5	6	7
y	10	21	35	59	92	200	400	610

[8+8]

8. 10 observations on price x and supply y the following data was obtained.

$$\sum x = 130, \sum y = 220, \sum x^2 = 2288, \sum y^2 = 5506 \text{ and } \sum xy = 3467$$

Find

- (a) coefficient of correlation
- (b) The line of regression of y or x
- (c) The standard error of estimate. [6+5+6]

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1. (a) Two marbles are drawn in succession from a box containing 10 red, 30 white, 20 blue and 15 orange marbles, with replacement being made after each drawing.. Find the probability that
 - i. both are white
 - ii. first is red and second is white
- (b) A businessman 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. What is the probability that business mans room having faulty plumbing is assigned to hotel Z. [8+8]

2. (a) If $F(x)$ is the distribution function of X given by

$$\begin{aligned}
 F(x) &= 0 && \text{if } x \leq 1 \\
 &= k(x-1)^4 && \text{if } 1 < x \leq 3 \\
 &= 1 && \text{if } x > 3
 \end{aligned}$$

determine

- i. $f(x)$
 - ii. k
- (b) Find the maximum n such that the probability of getting no head in tossing a coin n times is greater than .1 [8+8]
3. (a) Suppose 2% of the people on the average are left handed. Find
 - i. the probability of finding 3 or more left handed
 - ii. the probability of finding ≤ 1 left handed.
- (b) The mean and standard deviation of a normal variate are 8 and 4 respectively find
 - i. $P(5 \leq x \leq 10)$
 - ii. $P(x \geq 5)$ [8+8]

4. (a) A random sample of size 144 is taken from an infinite population having the mean 75 and variance 225. What is the probability that \bar{x} will lie between 72 and 77?
- (b) It is claimed that a random sample of 49 tyres is a mean life of 15200km. This sample was drawn from a population whose mean is 15150kms and a standard deviation of 1200km. Test the significance at 0.5 level. [8+8]
5. (a) Write about one tailed and two tailed tests.
- (b) Samples of students were drawn from two universities and from their weights in kilograms and standard deviation are calculated. Make a large sample test to test the significance of the difference between the means.

	Mean	S.D	Size of the sample
University A	55	10	400
University B	57	15	100
[8+8]			

6. (a) 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	
Total	132	68	200

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

- (b) Assuming tht $\sigma = 20.0$, how large a random sample be taken to assert with probability 0.95 that the sample mean will not differ from the true mean by more than 3.0 points? [16]
7. (a) The following data pertain to the number of computer jobs per day and the required CPU time required:
- Number of Jobs
- | | | | | | |
|---|---|---|---|---|---|
| X | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
- CPU time
- | | | | | | |
|---|---|---|---|---|----|
| Y | 2 | 5 | 4 | 9 | 10 |
|---|---|---|---|---|----|
- Fit a least square line to estimate the mean CPU time and using it estimate the CPU time at $x = 3.5$.
- (b) Fit a parabola of the form $y = a_0 + a_1x + a_2x^2$ to the following data: by the method of least squares and estimate y at $x=7.5$.
- | | | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|------|
| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| y | 1.28 | 1.53 | 1.03 | 0.81 | 0.74 | 0.65 | 0.87 | 0.81 | 1.10 | 1.03 |
- The method of least squares and estimate Y at $X = 7.5$ [8+8]

8. (a) The equations of two regression lines obtained in a correlation analysis are $3x+12y = 19$ and $3y + 9x = 46$ - obtain.

- i. Mean values of x and y
- ii. correlation coefficient between x and y

- (b) Find the coefficient of correlation between the variable A and B.

A	2	3	6	8	5	7	10	9	4	1
B	9	6	10	4	3	7	5	8	1	2 [8+8]

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- (b) A businessman 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. What is the probability that business mans room having faulty plumbing is assigned to hotel Z. [8+8]
2. (a) If 3 cars drawn from a lot of 6 cars containing 2 defective cars, find the probability distribution of the number of defective cars.
- (b) 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 [8+8]
3. (a) Find the probability that at most 5 defective components will be found in a lot of 200 it experience. Shows that 2% of such components are defective. Also find the probability of more than five defective components.
 - (b) Write the importance of normal distribution.
 - (c) If the mean and S.D of normal distribution are 70 and 16, find $p(38) < x < 46$ [8+8]
 4. To compare two kinds of bumper guards, 6 od each kind were monted on a car and then the car has ran into a concrete wall. The following are the costs of repairs:

Guard1	107	148	123	165	102	119
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Guard2 134 115 112 151 133 129

Use the 0.01 level of significance to test whether the difference between two sample means is significant? [16]

5. (a) A die is thrown 256 times an even digit turns up 150 times. Can we say that the die is unbiased.
- (b) If we can assert with 95% that the maximum error is .05 and $p=.2$, find the sample size.
- (c) Write about null hypothesis and testing of null hypothesis . [5+5+6]

6. (a) To examine the hypothesis that the husbands are more intelligent than the wives, an investigator took a sample of 10 couples and administered them a test which measures the IQ as follows:

Husbands: 117 105 97 105 123 109 86 78 103 107
 Wives: 106 98 87 104 116 95 90 69 108 85

Test the hypothesis with a reasonable test at the level of significance of 0.05?

- (b) In an investigation on the machine performance the following results were obtained:

	No.of Units inspected	No. of defectives
Machine 1	375	17
Machine 2	450	22

Test whether there is any significant performance of two machines at $\alpha=0.05$ [8+8]

7. (a) The following data pertain to the cosmic ray doses measured at various altitudes:

Altitude

(Feet x) 50 450 780 1200 4400 4800 5300

Dose Rate

(year y) 28 30 32 36 51 58 69

Fit a straight lines $y = a + bx$

- (b) Derive normal equations to fit the parabola $y = a + b x + cx^2$ [10+6]

8. (a) The following table gives experimental values of the three variates X,Y and Z. Fit a multiple regression of the type $Z = \alpha X + \beta Y$.

X	1	2	3	5
Y	1	3	4	2
Z	7	18	25	23

- (b) The following are the marks obtained by 12 students in Economics and Statistics:

Economics(x) 78 56 36 66 25 75 82 62

Statistics(y) 84 44 51 58 60 68 62 58

Compute the Spearman rank correlation coefficient between x and y [8+8]
