

III B.Tech. I Semester Supplementary Examinations, May -2005
PROBABILITY AND STATISTICS
(Metallurgy & Material Technology)

Time: 3 hours**Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

1. (a) A Band C in order toss a coin. The first one to toss a head wins the game. What are their probabilities of winning, assuming that the game may continue indefinitely?
- (b) State and prove Baye's theorem.

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
3. (a) Show that the mean and variance of a Poisson distribution are equal.
- (b) Determine the minimum mark a student should get in order to receive an A grade if the top 10% of the students are awarded A grades in an examination where the mean mark is 72 and standard deviation is 9.
4. (a) A random sample of 6 steel beams has a mean compressive strength of 58,392 p.s.i. (pounds per square inch) with a standard deviation of 648 p.s.i. Use this information at the level of significance $\alpha = 0.025$ to test whether the true average compressive strength of steel from which this sample came is 58,000 p.s.i. Assume normality?
- (b) Measuring specimens of nylon yarn taken from two machines, it was found that 8 specimens from 1st machine had a mean denier of 9.67 with a standard deviation of 1.81 while 10 specimens from a 2nd machine had a mean denier of 7.43 with a standard deviation 1.48. Assuming the population are normal test the hypothesis $H_0 : \mu_1 - \mu_2 = 1.5$ against $H_1 : \mu_1 - \mu_2 > 1.5$ at 0.05 level of significance?
5. (a) Experiences had shown that 20% of a manufactured product is of the top quality. In one days production of 400 articles only 50 are of top quality. Test the hypothesis at .05 level.

- (b) Ten bearings made by a certain process have a mean diameter of 0.5060 cm with a standard deviation of 0.0040 cm. Assuming that the data may be looked upon as a random sample from a normal distribution, construct a 95% confidence interval for the actual average diameter of the bearings?

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?
7. (a) In the following table tensile applied to a steel specimen in thousands of pounds, and y is the resulting elongation in thousand this of an inch:

x	1	2	3	4	5	6
y	14	33	40	63	76	85

Fit a st. line $y = ax + b$, and use it to predict the elongation when the tensile force is 3.5 thousand pounds.

- (b) Fit a curve of the form $y = ab^x$ for the following data.

x	1	2	3	4	5	6
y	6	18	35	160	485	1460

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.

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1. (a) Two aero planes bomb a target in succession. The probability of each correctly scoring a hit is 0.3 and 0.2 respectively. The second will bomb only if the first misses the target. Find the probability that
 - i. one target is hit
 - ii. both fails to score hits
- (b) There are three boxes. Box I contains 10 light bulbs of which 4 are defective. Box II contains 6 light bulbs of which one is defective. Box III contains 8 light bulbs of which 3 are defective. A box is chosen and a bulb is drawn. Find the probability that the bulb is non defective.
2. (a) If X is a continuous random variable and K is a constant then prove that
 - i. $\text{Var}(X+K) = \text{Var}(X)$
 - ii. $\text{Var}(kX) = k^2 \text{Var}(X)$
- (b) The probability of a man hitting a target is $1/3$.
 - i. If he fires 5 times, what is the probability of his hitting the target at least twice
 - ii. How many times must he fire so that the probability of his hitting the target at least once is more than 90%.
3. (a) If the variance of a Poisson variate is 3. Find the probability that
 - i. $x=0$
 - ii. $1 \leq x < 4$
 - iii. $0 < x \leq 3$
- (b) Write the importance of normal distribution
- (c) If x is a normal variate with mean 30 and the standard deviation 5. Find the probability that
 - i. $26 \leq x \leq 40$
 - ii. $x \leq 45$
4. If the population is 3,6,9,15,27.
 - (a) List all possible samples of size 3 that can be taken without replacement from the finite population.
 - (b) Calculate the mean of each of the sampling distribution of means.

- (c) Find the standard deviation of sampling distribution of means.
5. (a) In a random sample of 400 industrial accidents, it was found that 231 were due atleast partially to unsafe working conditions. Construct a 99% percent confidence interval for the corresponding true proportion?
- (b) Two horses A and B were tested according to the time (in seconds) to run a particular track with the following results.

<i>HorseA</i>	28	30	32	33	33	29	34
<i>HorseB</i>	29	30	30	24	27	29	

Test whether the two horses have the same running capacity.

6. Measurements of the fat content of two kinds of ice creams Brand A and brand B yielded the following sample data.

Brand A	13.5	14.0	13.6	12.9	13.0
Brand B	12.9	13.0	12.4	13.5	12.7

Test the significant between the means at 0.05 level.

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

$$y = a_0 + a_1x + a_2x^2 + \dots\dots\dots a_nx_n.$$

8. A chemical company wishing to study the effect of extraction time on the efficiency of an extraction operation obtained in the data shown in the following table.

Extraction time x	27	45	41	19	35	39	19	49	15	31
Extraction efficiency y	57	64	80	46	62	72	52	77	57	68

Calculate the coefficient of correlation between x and y and the two lines of regression.

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1. (a) If $P(A) = a$, $P(B) = b$, $P(A \cap B) = c$, express the following in terms of a , b , and c
 - i. $P(A^c \cap B^c)$
 - ii. $P(A \cap B)$
 - iii. $P(A^c \cap (A \cap B))$
 - iv. $P[(A \cup (A^c \cap B))]$
- (b) Box A contains nine cards numbered 1 to 9 and box B contains five cards numbered 1 to 5. A box is chosen at random and a card is drawn, if the card shows an even number another card is drawn from the same box, if the card shows an odd number a card is drawn from the other box.
 - i. What is the probability that both cards show even numbers?
 - ii. If both cards show even numbers, what is the probability that they come from box A.
 - iii. What is the probability that both cards show an odd number?
2. (a) Find the variance of the binomial distribution .
- (b) Determine the probability distribution of the number of bad eggs in a basket containing 6 eggs given that 10% of eggs are bad in a large consignment
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. $P(x \geq 5)$
4. (a) A random sample of size 100 is taken from an infinite population having the mean $\mu=76$ and the variance $\sigma^2 = 256$. Find the probability that \bar{x} will be between 75 and 78.
- (b) Write about
 - i. Critical region
 - ii. Two tailed test.

5. (a) In a random sample of 160 workers exposed to a certain amount of radiation, 24 experienced some ill effects. Construct a 99% confidence interval for the corresponding true percentage.
- (b) What is the size of the smallest sample required to estimate an unknown proportion to within a maximum error of 0.06 with at least 5% confidence?
- (c) The performance of a computer is observed over a period of 2 years to check the claim that the probability is 0.20 that its downtime will exceed 5 hours in any given week. Testing the null hypothesis $P = 0.20$ against the alternate hypothesis $P \neq 0.20$, what can we conclude at the level of significance $\alpha = 0.05$, if there were only 11 weeks in which the downtime of the computer exceeded 5 hours?
6. (a) A firm manufacturing rivets wants to limit variation in their length as much as possible. The lengths (in cms.) of 10 rivets manufactured by a new process are

2.15	1.99	2.05	2.12	2.17
2.01	1.98	2.03	2.25	1.93

Examine whether the new process can be considered superior to the old if the old population has standard deviation 0.145 cm.?

- (b) The following are the average weekly losses of worker hours due to accidents in 10 industrial plants before and after a certain safety programme was put into operation:

Before:	45	73	46	124	33	57	83	34	26	17
After :	36	60	44	119	35	51	77	29	24	11

Test whether the safety programme is effective in reducing the number of accidents at the level of significance of 0.05?

7. Fit an equation of the form $Y = a + bx$ to the following data:

x:	2	3	4	5	6
y:	144	172.8	248.8	298.5	298.5

8. (a) If there are no ties in the ranks then show that the rank correlation is given by $\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$ where $d_i = \text{rank of } x_i - \text{rank of } y_i$
- (b) For 20 army personnel, the regression of weight of kidneys (y) on weight of heart (x), both measured in oz, is $y = 0.399x + 6.394$ and the regression of weight of heart on weight of kidneys is $x = 1.212y - 2.461$. Find the correlation coefficient between the two variables and also their means.

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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

2. (a) Let $F(x)$ be the distribution function of a random variable X given by

$$F(x) = cx^3 \quad \text{when } 0 \leq x < 3$$

$$= 1 \quad \text{when } x \geq 3$$

$$= 0 \quad \text{when } x < 0.$$

If $P(X=3) = 0$ Determine

- i. c
 - ii. mean
 - iii. $P(x > 1)$
 - (b) A student takes a true false examination consisting of 8 questions. He guesses each answer. The guesses are made at random. Find the smallest value of n that the probability of guessing at least n correct answers is less than $\frac{1}{2}$
3. (a) Determine the probability that out of 2000 persons
 - i. exactly 5
 - ii. more than 3 persons will suffer a bad reaction if it is known that the probability of bad reaction due to an injection is 0.001.
 - (b) Find the
 - i. mean and
 - ii. standard deviation of an examination grades if grades 70 and 88 correspond to standard scores of - 0.6 and 1.4 respectively

4. To compare two kinds of bumper guards, 6 of each kind were mounted on a car and then the car has ran into a concrete wall. The following are the costs of repairs:

<i>Guard1</i>	107	148	123	165	102	119
<i>Guard2</i>	134	115	112	151	133	129

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

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
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

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 $y = a_0 + a_1x + a_2x^2 + \dots + a_nx_n$.

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
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