

Thapar Institute of Engineering & Technology, Patiala
School of Mathematics & Computer Applications
End Semester Examination (11/12/2006)
MA-501 Research Methodology

(49)

Max Marks: 45

Time: 3 Hours

Note: Attempt any FIVE questions.

Use of Statistical tables is allowed.

Write your tutorial group on top of first page of answer sheet.

Evaluated answer sheets will be shown on 15 December 2006 (Friday), at 2:30 P.M. in room B-210.

1. (a) Define mean and standard deviation of a data given in the form of frequency distribution. What characteristics of data do these measure? 3

- (b) The table below gives the weighted means of 200 castings.

Weight in Kg.	No of castings
91-100	7
101-110	13
111-120	20
121-130	30
131-140	49
141-150	37
151-160	29
161-170	15

Calculate (i) mode (ii) standard deviation (iii) 70th percentile. 6

2. (a) Give the axiomatic definition of probability and derive $P(A) + P(\bar{A}) = 1$. 2
- (b) There are three machines I, II and III producing 3000, 2500 and 4500 bullets per hour respectively. These machines are known to produce 1%, 1.2% and .2% defective bullets respectively. One bullet is taken at random from an hour's production of the three machines.
- (i) What is the probability that this bullet is defective?
- (ii) The drawn bullet is found to be defective, what is the probability that this was produced by machine II? 4
- (c) A bag contains 50 tickets numbered 1 to 50. Three tickets are drawn at random from the bag. What is the probability that the numbers on the selected tickets are in arithmetic progression? 3

3. (a) Define correlation coefficient r and show that $-1 \leq r \leq 1$. 3
- (b) Given n pairs of observations on (x, y) , derive the line of regression of y on x . Give its significance. 3
- (c) The following data represent the normal stress (x) and shear resistance (y) of seven specimen in a metal test.

Normal stress :	26.8	25.4	23.6	23.9	24.7	27.4	22.6
Shear resistance:	26.5	27.3	27.1	25.9	26.3	23.2	25.8

Find the correlation coefficient between the two variables and interpret the value. 3

4. (a) The distribution function of a random variable X is given below.

$$\begin{aligned}
 F(x) &= 0, & x < 0 \\
 &= \frac{1}{2}, & 0 \leq x < 1 \\
 &= \frac{2}{3}, & 1 \leq x < 2 \\
 &= \frac{11}{12}, & 2 \leq x < 3 \\
 &= 1, & x \geq 3
 \end{aligned}$$

Find the values of (i) $P(X > 1/2)$ (ii) $P(2 < X \leq 4)$ (iii) $P(X=1)$. 3

(b) A random variable X has the following probability distribution

$x :$	0	1	2	3	4	5	6	7
$p(x):$	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2+k$

Find the values of (i) k (ii) $E(X)$. 3

(c) Gauges are used to reject all components where a certain dimension is not within the specifications $1.50 \pm d$. It is known that this measurement is normally distributed with mean 1.50 and standard deviation 0.2. Determine the value d such that the specifications cover 98% of the measurements. 3

5 (a) Define Poisson distribution and derive its mean. 2

(b) A car firm has two cars, which it hires out day by day. The number of demands for a car on each day follows Poisson distribution with mean 1.5. Calculate
(i) the proportions of days on which neither car is used, and
(ii) the proportions of days on which some demand is refused. 3

(c) To investigate the collapse of the roof of a building, a testing laboratory is given all the available bolts that connected the steel structure at 3 different positions on the roof. The process required to shear each of these bolts are as follows:

Position 1:	90	82	79	98	83	91	
Position 2:	105	89	93	104	89	95	86
Position 3:	83	89	80	94			

Perform an analysis of variance to test whether the differences among the sample means at the three positions are significant. 4

6 (a) An industrial safety program was recently instituted in the computer chip industry. The average weekly loss in the man-hours due to accident in 10 similar plants both before and after the program is as follows:

Plant	1	2	3	4	5	6	7	8	9	10
Before	30.5	18.5	24.5	32	16	15	23.5	25.5	28	18
After	23	21	22	28.5	14.5	15.5	24.5	21	23.5	16.5

Determine whether the safety program has been proven to be effective. 4

(b) The following table gives the level of education and marriage adjustment score for a sample of married women. Can you conclude from the above that higher the level of education, greater is the degree of adjustment in marriage? 5

level of education	Marriage - Adjustment score			
	very low	low	high	very high
College	24	97	62	58
High school	22	28	30	41
Middle School	32	10	11	20