This question paper contains 5 *printed pages.*

2001 *Your Roll No.* .....

MHROD / I Sem. **A**

Course 616 – BUSINESS STATISTICS AND RESEARCH METHODOLOGY

(Admissions of 2004 and onwards)

Time : 3 hours *Maximum Marks* : 70

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt all questions.

1. Attempt any *four* of the following:

(a) Suppose that 5,000 sales invoices are separated into four strata. Stratum 1 contains 50 invoices, Stratum 2 contains 500 invoices, Stratum 3 contains 1,000 invoices, and Stratum 4 contains 3,450 invoices. A sample of 500 invoices is needed.

(i) What type of sampling should be done? Why? Explain how the sampling would be carried out.

(ii) Why or why not is the sampling in (i) simple random sampling?

(b) Distinguish between positive and negative skewness. Give rough sketches to show each of these and also indicate the relative location of mean, median and mode. Calculate Pearson's co-efficient of skewness if median = 43, co-efficient of variation = 30%, and standard deviation = 12.

(c) Distinguish between Type I and Type II errors. Do you agree that reducing the probability of Type I error also reduces the probability of Type II error? Explain.

(d) The profits of a large company showed following changes in the last four years.

Year	*Percent Change*
2007	12% increase
2008	8% decrease
2009	10% increase
2010	18% increase

It is concluded that the average change in profits has been an 8% increase. Do you agree? Calculate average change if you do not agree.

(e) An analysis of monthly wages gives the following results:

	Firm A	*Firm B*
No. of workers	450	550
Average monthly wages	Rs 2,560	Rs 2,240
Standard Deviation	Rs 112	Rs 105

(i) Which firm has a larger wage bill?

(ii) In which firm is there more uniformity in wages?

(iii) What is the combined standard deviation of the wages in the two firms?

(f) For a population of size 50, the mean and standard deviation are known to be equal to 60 and 8 respectively If samples of size 10 are selected from this without replacement, obtain the mean and standard deviation of the sampling distribution of means.

5×4 = 20

2. Attempt any *two* parts:

(a) The following information is available before and after an industrial dispute settlement between the management and the trade union of Bajaj Enterprises:

	Before	*After*
No. of employees	950	900
Mean salary (Rs)	10,500	11,000
Median salary (Rs)	10,000	9,700
Standard deviation (Rs)	4,500	4,800

You are required to comment on the results from the perspective of management and trade union.

(b) The probability that a customer entering a shopping mall during a discount sale will buy a refrigerator or a TV set is 0.32. If the probability of a customer to buy a refrigerator is 0.21 and that of buying a TV set is 0.16, what is the probability that the customer will buy both, refrigerator and a TV set? Are the events of buying a refrigerator and buying a TV set independent?

(c) In a company, it is found that the probability for a worker who attended a training program to meet his production quota is 0.92 while for a worker who did not attend the program, this probability is 0.42. If 72 percent of the workers have had training program, what is the probability that a randomly selected worker would meet the production quota? If a randomly selected worker is one who met the production quota, what is the probability that he did not attend the training program?

5×2 = 10

3. Attempt any *two* parts:

(a) A survey is planned to determine the mean annual family medical expenses of employees of a large company. The management of the company wishes to be 95% confident that the sample mean is correct to within ±Rs 50 of the true population mean annual family medical expenses. A pilot study indicates that the standard deviation can be estimated as Rs 400.
How large a sample size is necessary?
If management wants to be correct to within ±Rs 25, what sample size is necessary?

(b) Tool-workers are subject to work-related injuries. One disorder, caused by strains to the hands and wrists, is called carpal tunnel syndrome. Assume that it strikes a large number of workers every year. It is estimated that the average cost of this disorder to the employers and insurers is Rs 30,000 per injured worker. Suppose that these costs are normally distributed, with a standard deviation of Rs 9,000.

(i) What proportion of the costs is between Rs 5,000 and Rs 20,000?

(ii) What proportion of the costs is greater than Rs 50,000?

(iii) Suppose the standard deviation is unknown, but 90.82% of the costs are more than Rs 7,000. What would be the value of the standard deviation?

(c) A manufacturer of LCD TV claims that it is becoming quite popular and that 5% of the homes are having LCD TV. However, a dealer of conventional TVs claims that the percentage of homes with LCD TV is less than 5%. A sample of 400 household is surveyed and it is found that only 18 households have LCD TV. Test at a 1% level of significance whether claim of the manufacturer is tenable.

5×2 = 10

4. Attempt any *two* parts:

(a) The HR department of a company has been investigating two educational programmes for increasing the sensitivity of the managers: called 'formal' and 'informal'. Data relating to a sample of managers trained in both programme are given below:

Programme Sampled	*Mean Sensitivity Score after this programme*	*Standard Deviation*	*Number of managers observed*
Formal	92	15	12
Informal	84	19	15

The company wishes to test whether the sensitivity achieved by the formal programme is higher than the sensitivity achieved under the informal programme. Test at 5 percent level of significance.

(b) In order to study the effect of season on fire-related accidents, a researcher collected data on such accidents and observed the month/season in which they took place. The collected data were recorded as follows:

Season/Months	*No. of Accidents*
Spring (March – May)	33
Summer (June – August)	57
Fall (Sep – Nov)	41
Winter (Dec – Feb)	71

The researcher believes that the probability of an accident is the same for Spring and Fall. Similarly, the probability of an accident is the same for Summer and Winter, and it is twice

as likely as the Spring or Fall season. State the null and alternative hypotheses in orde to verify the researcher's belief. Using a 5% level of significance, perform this test

(c) Three training methods are compared to see whether they led to greater productivity after training. The following are productivity measures for individuals trained by each method

Method 1:	45	40	50	39	53	44
Method 2:	59	43	47	51	39	49
Method 3:	41	37	43	40	52	37

At the 0.05 level of significance, do the three training methods lead to different level of productivity?

7½ ×2 = 15

5. Attempt any two parts:

(a) A sample of eight employees is taken from the production department of a light engineering factory. The data that follow relate to the number of weeks experience in the wiring of components, and the number of components which were rejected as unsatisfactory last week:

Employee	A	B	C	D	E	F	G	H
Weeks of experience	4	5	7	9	10	11	12	14
Number of rejects	21	22	15	18	14	14	11	13

Calculate the co-efficient of correlation for these data and interpret its value.
Find the least squares regression equation of rejects on experience. Predict the number of rejects you would expect from an employee with one week of experience

(b) For a binomial distribution with n = 8, and having $P(x = 0) = P(x = 8)$. Calculate $P(x = 3)$. Also, calculate the mean and standard deviation of this distribution.

(c) An enquiry into the budgets of the middle class families of a certain city revealed that on an average the percentage expenses on the different groups were: Food 45, Rent 15, Clothing 12, Fuel & Light 8, and Miscellaneous 20. The percentage increases in the current year as compared with a fixed base period were, respectively, 310, 150, 243, 148 and 185. Calculate the consumer price index number for the current year.
A person was getting Rs 5,800 per month in the base year and Rs 10,300 per month in the current year. State how much he ought to have received as extra allowance to maintain his former standard of living.

(d) Discuss various scales of measurement used for collection of data.

(e) The distribution of income for 400 families is given below:

Income (000 Rs)	*No. of Families*
5 – 10	28
10 – 15	44
15 – 20	56
20 – 30	72
30 – 50	65
50 – 70	100
70 – 90	22
90 – 120	13

Calculate median income, lower quartile income and upper quartile income. Hence, calculate Bowley's co-efficient of skewness.

$7_{1/2} \times 2 = 15$