

GUJARAT TECHNOLOGICAL UNIVERSITY
B E Sem-VI Examination May 2011

Subject code: 162501

Subject Name: Statistical Methods & Quality Control

Date: 16/05/2011

Time: 10.30 am – 01.00 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of Statical tables is permitted.

- Q.1 (a)** A consumer forum wants to check the average weight of a new product on the market. A random sample of 25 items of the product was taken and the weights (in grams) of these items were classified as follows: **07**

Class Limits	74-77	77-80	80-83	83-86	86-89
Frequencies	3	6	9	3	4

Find the mean, median, mode and standard deviation of the weight in this sample. What is the Coefficient of skewness?

- (b)** An inspector working for a manufacturing company has a 99% chance of correctly identifying defective items and a 0.5% chance of incorrectly classifying a good item as defective. The company has evidence that its line produces 0.9% of nonconforming items. **07**
- a. What is the probability that an item selected for inspection is classified as defective?
 - b. If an item selected at random is classified as non-defective, what is the probability that it is indeed good?

- Q.2 (a)** A fair die is tossed. Let X denote twice the number appearing on the face of die (i.e. $X=2, 4, 6$ etc.) and Y denote 1 or 3 depending on whether an odd or an even number appears on the face of this die. **07**
- a. Find the distribution of : i) X, ii) Y and iii) $X + Y$
 - b. What is the mean and variance of i) X and ii) Y?

- (b)** Government regulations indicate that the total weight of cargo in a certain kind of airplane cannot exceed 330 kg. On a particular day a plane is loaded with 100 boxes of goods. If the weight distribution for individual boxes is normal with mean 3.2 kg and standard deviation 0.4 kg, what is the probability that the regulations will NOT be met? **07**

OR

- (b) The rate at which a particular defect occurs in lengths of plastic film being produced by a stable manufacturing process is 4.2 defects per 75 meter length. A random sample of the film is selected and it was found that the length of the film in the sample was 25 meters. What is the probability that there will be at most 2 defects found in the sample? **07**

- Q.3 (a)** A manufacturer of strapping tape claims that the tape has a mean breaking strength of 500 psi. Experience has shown that breaking strengths are approximately normally distributed, with a standard deviation of 48 psi. A random sample of 16 specimens is drawn from a large shipment of tape, and a mean of 480 psi is computed. Can we conclude from these data that the mean breaking strength for this shipment is less than that claimed by the manufacturer? **07**

- (b) A coin is to be tested for fairness. It is tossed 25 times and only 8 heads are observed. Test if the coin is fair at $\alpha = 5\%$. **07**

OR

- Q.3 (a)** The sodium content of thirty 300-gram boxes of organic corn flakes was determined. The data (in milligrams) are as follows: 131.15, 130.69, 130.91, 129.54, 129.64, 128.77, 130.72, 128.33, 128.24, 129.65, 130.14, 129.29, 128.71, 129.00, 129.39, 130.42, 129.53, 130.12, 129.78, 130.92, 131.15, 130.69, 130.91, 129.54, 129.64, 128.77, 130.72, 128.33, 128.24, and 129.65. Can you support a claim that mean sodium content of this brand of cornflakes is 130 milligrams? Use $\alpha = 0.05$. Set appropriate hypothesis to answer the question. **07**

- (b) A product developer is interested in reducing the drying time of a primer paint. Two formulations of the paint are tested; formulation 1 is the standard chemistry, and formulation 2 has a new drying ingredient that should reduce the drying time. From experience, it is known that the standard deviation of drying time is 8 minutes, and this inherent variability should be unaffected by the addition of the new ingredient. Ten specimens are painted with formulation 1, and another 10 specimens are painted with formulation 2; the 20 specimens are painted in random order. The two sample average drying times are $\bar{X}_1 = 121$ minutes and $\bar{X}_2 = 112$ minutes, respectively. What conclusions can the product developer draw about the effectiveness of the new ingredient, using $\alpha = 0.05$? **07**

- Q.4 (a)** Three suppliers (alpha to Gamma) provide the following data on defective parts. **07**

Supplier	Part Quality		
	Good	Minor Defect	Major Defect
Alpha	90	3	7
Beta	170	18	7
Gamma	135	6	9

Test for independence between supplier and part quality. What is the implication of your result to the purchasing department?

- (b) The compressive strength of concrete is being studied, and four different mixing techniques are being investigated. The following data have been collected. 07

Mixing Technique	Compressive Strength			
1	3129	3000	2865	2890
2	3200	3300	2975	3150
3	2800	2900	2985	3050
4	2600	2700	2600	2765

1. Test the hypothesis that mixing techniques affect the strength of the concrete. Use $\alpha = 0.05$.
2. Find the P-value for the F-statistic computed in part 1.

OR

- Q.4 (a)** Consider the seven data points in the table 07

x	-5	-3	-1	0	1	3	5
y	0.8	1.1	2.5	3.1	5.0	4.7	6.2

Construct a scatter diagram for the data. After examining the scattergram, do you think that x and y are correlated? If correlation is present, is it positive or negative?

- Find the correlation coefficient r and interpret its value.
 - Find the least squares prediction equation.
- (b) Vadhodara Furniture is a manufacturer of executive tables for corporate institutions. In order to control the quality of its tables, its QC manager selects 15 tables at random and inspects the number of scratches on each one of them. The following results are obtained: 07

Sample No.	No. of Defects	Sample No.	No. of Defects	Sample No.	No. of Defects
1	13	6	10	11	7
2	9	7	12	12	11
3	19	8	0	13	9
4	7	9	2	14	13
5	8	10	5	15	1

Prepare a suitable control chart for the above data and plot it on graph paper.

- Q.5 (a)** A component part for a jet aircraft engine is manufactured by an investment casting process. The vane opening on this casting is an important functional parameter of the part. Company is using $\bar{X}$ -bar and R control charts to assess the statistical stability of this process. Table below presents 20 samples of five parts each. The values given in the table have been coded by using the last three digits of the dimension; that is, 31.6 should be 0.50316 inch. Prepare and plot the control chart for the process engineer. Interpret your result.

The value of other parameters are given as follows:

n	A1	A2	d2	D3	D4
5	1.596	0.577	2.326	0	2.115

Sample No.	X ₁	X ₂	X ₃	X ₄	X ₅
1	33	29	31	32	33
2	33	31	35	37	31
3	35	37	33	34	36
4	30	31	33	34	33
5	33	34	35	33	34
6	38	37	39	40	38
7	30	31	32	34	31
8	29	39	38	39	39
9	28	33	35	36	43
10	38	33	32	35	32
11	28	30	28	32	31
12	31	35	35	35	34
13	27	32	34	35	37
14	33	33	35	37	36
15	35	37	32	35	39
16	33	33	27	31	30
17	35	34	34	30	32
18	32	33	30	30	32
19	25	27	34	27	28
20	35	35	36	33	30

- (b) What is Acceptance Sampling? What is an Ideal OC curve? Explain consumer's and producer's risk 07

OR

- Q.5** (a) Compare variable and attribute control charts 07
(b) Explain double sampling plan in detail. 07
