BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: BE | **SEMESTER: V**
BRANCH: PROD. | **SESSION : MO/2019**

SUBJECT : PE5005 STATISTICAL QUALITY CONTROL

TIME: 1.5 HOURS | **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) What is Quality? List various dimensions of quality. [2]

(b) The ages of the signers of the Declaration of Independence of the US are shown below. [3]

41	54	47	40	39	35	50	37	49	42	70	32
44	52	39	50	40	30	34	69	39	45	33	42
44	63	60	27	42	34	50	42	52	38	36	45
35	43	48	46	31	27	55	63	46	33	60	62
35	46	45	34	53	50	50					

i. Construct a histogram,
ii. Construct frequency poly-gone
iii. Develop a stem-and-leaf plot for the data.

Q2 (a) What are various components of cost of quality? [2]

(b) What is standard deviation? Why the formula of SD of a sample is different from formula of SD of a population? [3]

Q3 (a) Define and explain type I and type II errors in the context of control charts. How does the choice of control limits influence these two errors? [2]

b) A control chart is to be constructed for the average breaking strength of nylon fibers. Samples of size 5 are randomly chosen from the process. The process mean and standard deviation are estimated to be 120 kg and 8 kg, respectively. [3]

i. If the control limits are placed 3 standard deviations from the process mean, what is the probability of a type I error?

ii. If the process mean shifts to 125 kg, what is the probability of concluding that the process is in control and hence making a type II error on the first sample plotted after the shift?

Q4 (a) Why it is usually necessary to monitor both the mean value of the quality characteristic and its variability when dealing with a variable quality characteristic? [2]

(b) A factory produces 100 cylindrical containers per hour. Samples of 10 containers are taken at random from the production at every hour and the diameters of containers are measured. Draw X-bar and R charts and decide whether the process is under control or not. [3]

(For n=4 A2= 0.73 D3= 0, D4=2.28)

Sample	x1	x2	x3	x4
1	230	238	242	250
2	220	230	218	242
3	222	232	236	240
4	250	240	230	225
5	228	242	235	225
6	248	222	220	230
7	232	232	242	242
8	236	234	235	237
9	231	248	251	271
10	220	222	224	231

PTO

Q5 (a) What is acceptance sampling? What are the situations in which acceptance sampling is used? [2]

(b) What is average outgoing quality? Consider the single sampling plan N = 2000, n = 100, c = 3. Suppose that the incoming quality of batches is 2% nonconforming. Calculate AOQ. [3]

Q6 (a) Consider a single sampling plan with a lot size of 2000, sample size of 100, and acceptance number of 3. Construct the OC curve. If the acceptable quality level is 0.1% nonconforming and the limiting quality level is 8% nonconforming, describe the protection offered by the plan at these quality levels. [5]

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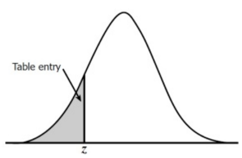

Table1: Standard Normal Probabilities

Table entry for z is the area under the standard normal curve to the left of z.

Z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-1.90	0.02872	0.02807	0.02743	0.02680	0.02619	0.02559	0.02500	0.02442	0.02385	0.02330
-2.9	0.00187	0.00181	0.00175	0.00170	0.00164	0.00159	0.00154	0.00149	0.00144	0.00140
-3.0	0.00135	0.00131	0.00126	0.00122	0.00118	0.00114	0.00111	0.00107	0.00104	0.00100
-3.1	0.00097	0.00094	0.00090	0.00087	0.00085	0.00082	0.00079	0.00076	0.00074	0.00071
1.5	0.93319	0.93448	0.93574	0.93699	0.93822	0.93943	0.94062	0.94179	0.94295	0.94408
1.6	0.94520	0.94630	0.94738	0.94845	0.94950	0.95053	0.95154	0.95254	0.95352	0.95449
1.7	0.95543	0.95637	0.95728	0.95818	0.95907	0.95994	0.96080	0.96164	0.96246	0.96327
1.8	0.96407	0.96485	0.96562	0.96638	0.96712	0.96784	0.96856	0.96926	0.96995	0.97062
2.9	0.99813	0.99819	0.99825	0.99831	0.99836	0.99841	0.99846	0.99851	0.99856	0.99861
3.0	0.99865	0.99869	0.99874	0.99878	0.99882	0.99886	0.99889	0.99893	0.99896	0.99900
3.1	0.99903	0.99906	0.99910	0.99913	0.99916	0.99918	0.99921	0.99924	0.99926	0.99929
3.2	0.99931	0.99934	0.99936	0.99938	0.99940	0.99942	0.99944	0.99946	0.99948	0.99950

Table 2: Cumulative Poisson Probabilities

λ=np

X	0.01	0.1	0.5	1	1.5	2	2.5	3
0	0.995	0.9048	0.6065	0.3679	0.2231	0.1353	0.0821	0.0498
1	1	0.9953	0.9098	0.7358	0.5578	0.406	0.2873	0.1991
2	1	0.9998	0.9856	0.9197	0.8088	0.6767	0.5438	0.4232
3	1	1	0.9982	0.981	0.9344	0.8571	0.7576	0.6472

X	3.5	4	4.5	5	6.5	7	7.5	8
0	0.0302	0.0183	0.0111	0.0067	0.0015	0.0009	0.0006	0.0003
1	0.1359	0.0916	0.0611	0.0404	0.0113	0.0073	0.0047	0.003
2	0.3208	0.2381	0.1736	0.1247	0.043	0.0296	0.0203	0.0138
3	0.5366	0.4335	0.3423	0.265	0.1118	0.0818	0.0591	0.0424