

Answer the following questionsQuestion I:

- (a) What do we mean by Quality?
- (b) Twenty successive hardness measurements are made on a metal alloy and the data are shown as follows : 51, 52,54,55,55,51,52,50,51,56,51,57,58,50.53,52,54,50,56,53.
- (1) Using all the data, compute trial control limits for individual observations and moving- average charts. Construct the chart and plot the data. Determine whether the process is in control. If not, assume assignable causes can be found to eliminate these samples and revise the control limits.
- (2) Estimate the process mean and standard deviation for the in control process.

Question II:

- (a) Define the following statements:

- (1) A process is out of control.
- (2) A process is in control.

(b) The following represent the number of solder defects observed on 24 samples of five printed circuit boards: 7,6,8,10,24,6,5,4,8,11,15,8,4,16,11,12,8,6,5,9,7,14,8,21.

- (1) Using all the data, compute trial control limits for a control U chart, construct the chart and plot the data.
- (2) Can we conclude that the process is in control using a U chart? If not assume assignable causes can be found, list points and revise the control limits.

Question III:

- (a) What is meant by the field of Statistical Quality Control?
- (b) The following are the numbers of defective solder joints found during successive samples of 500 solder joints 106,116,164,89,99,40,112,36,69,74,42,37,25,88,101,64,51,74,71,43,80.
- (1) Using all the data, compute trial control limits for a fraction- defective control chart. Construct the chart and plot the data.
- (2) Determine whether the process is in statistical control. If not assume assignable causes can be found and out of control points eliminated. Revise the control limits.

With my best Wishes



Solve the following questions:

Question one:[20 mark]

- What is the concept of: Quality – Specifications and control limit – Quality Control.
- A TiW layer is deposited on a substrate using a sputtering tool. The table below contains layer thickness measurements on 20 subgroups of four substrates.

Sample number	X1	X2	X3	X4
1	459	449	435	450
2	443	440	442	442
3	457	444	449	444
4	469	463	453	438
5	443	457	445	454
6	444	456	456	457
7	445	449	459	445
8	446	455	449	452
9	444	452	457	440
10	432	463	463	443
11	445	452	453	438
12	456	457	436	457
13	459	445	441	447
14	441	465	438	450
15	460	453	457	438
16	453	444	451	435
17	451	460	450	457
18	422	431	437	429
19	444	446	448	467
20	450	450	454	454

- Set up \bar{x} and R control on this process. Is the process in control? Review the control limits as necessary.
- If the specification are at 450 ± 30 estimate the process capability.

Question two [15 mark]

- Define: Process Capability - Capability index C_p , C_{pk}
- The specification limits for product $USL = 6.5$ and $LSL = 6.3$ and the standard deviation $s = 0.038$. After improvement the standard deviation becomes $s = 0.026$. Compute the capability index C_p before and after improvements, comment.
- Compute the capability process, if you have the range of 25 samples of size 4 as follows
7, 5, 5, 3, 2, 4, 5, 9, 4, 5, 4, 7, 5, 7, 3, 4, 4, 5, 6, 4, 7, 7, 5, 5, 7

Question three:[20 mark]

- i) Define: The principle component for quality control – Quality assurance.
- ii) Frozen orange juice concentrate is packed in 6-oz cardboard cans. These cans are formed on a machine by spinning them from cardboard stock and attaching a metal bottom panel. By inspection of a can, we may determine whether, when filled, it could possibly leak either on the side seam or around the bottom joint. Such a nonconforming can has an improper seal on either the side seam or the bottom panel. We wish to set up a control chart to improve the fraction of nonconforming cans produced by this machine. To establish the control chart, 30 samples of size $n=50$ cans each were selected at half-hour intervals over a three-shift period in which the machine was in continuous operation. The data shown in the following table:

Sample number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of nonconforming	12	15	8	10	4	7	16	9	14	10	5	6	17	12	22
Sample number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Number of nonconforming	8	10	5	13	11	20	18	24	15	9	12	7	13	9	6

Choose the appropriate chart for these data and write a comment.

Question four [15 mark]

The viscosity of an aircraft primer paint is an important quality characteristic. The product is produced in batches, and because each batch takes several hours to produce, the production rate is too slow to allow for rational subgroups of size greater than one. The viscosity of the previous 20 batches is shown in the following table:

Batch number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Viscosity x	34	34	33	35	34	33	33	33	34	34	33	33	33	34	34
Batch number	16	17	18	19	20										
Viscosity x	33	34	34	33	34										

Set up the control chart for individual observations and comment

*With my best wishes
Prof. Elsayed Elsherpieny*