

Indian Statistical Institute, Bangalore
MS (QMS) First Year
First Semester - Statistical Process Control I

Final Exam
Maximum marks: 50

Date: November 12, 2018
Duration: 3 hours

1. Write the following are true or false. If false give the correct answer [5]
 - a. A supplier ships a component in lots of size $N = 6000$. The AQL has been established for this product at 1%. The tightened single sampling plan for this situation from MIL-STD 105E, assuming that general inspection level II is $n = 200$, $A_c = 2$ and $R_e = 3$.
 - b. The R library needed for constructing control charts using the R package is *spc*.
 - c. In MIL-STD 105E sampling schemes, the inspection level III requires about twice as much inspection as that of level II.
 - d. In the R code for constructing the individual chart, the type should be specified as *Individual* (*type = "Individual"*).
 - e. A product is shipped in lots of size $N = 3000$. Assuming that the process average is 0.5% defective, Dodge – Romig single sampling plan with the $LTPD = 5\%$, is $n = 105$ and $c = 2$.
2. Briefly explain the switching procedure between normal, tightened and reduced inspection in MIL-STD 105E? [5]
3. The specifications on a critical dimension of a process subject to tool wear are 1.0025 ± 0.0010 . Thirteen samples of subgroup size 5 are collected at every half an hour interval and the \bar{x} and range (R) computed. The data is given below. [15]

SL No	\bar{x}	R	SL No	\bar{x}	R
1	1.0018	0.0005	8	1.0028	0.0007
2	1.002	0.0008	9	1.0029	0.0005
3	1.0021	0.0006	10	1.0029	0.0005
4	1.0022	0.0009	11	1.0031	0.0007
5	1.0024	0.0005	12	1.0032	0.0006
6	1.0025	0.0006	13	1.0033	0.0005
7	1.0026	0.0006			

- a. Set up the R chart on this process and estimate the process standard deviation?
- b. Can this process capable enough to monitor using a sloping control chart?
- c. Suppose the linear model for \bar{x} in terms of time h is $\bar{x} = 1.0026 + 0.000123h$, set up a sloping control chart to monitor the process?
- d. Estimate the duration and number of samples after which the process needs to be reset?
- e. How much should be the reset values?

4. Suppose that a product is shipped in lots of size $N = 5000$. The receiving inspection procedure used is single sampling with $n = 50$ and $c = 2$. [15]
- Draw the OC curve for the plan?
 - Suppose $\alpha = 0.005$ and $\beta = 0.1$, compute the corresponding AQL and LTPD values from the OC curve?
5. A company uses a double sampling plan with $n_1 = 30$, $c_1 = 2$, $n_2 = 50$ and $c_2 = 4$ for incoming inspection where the supplier ships the product in lots of size $N = 9000$. Compute the probability of acceptance, ASN, AOQ and ATI for the incoming fraction nonconforming $p = 0.05$ and 0.07 ? [15]