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A Brief Note on Statistical Quality Control

K.Chellapriya[1], M.Sathya[2]

[1]*Department of Mathematics, KGiSL Institute of Technology, Coimbatore*
[2]*Department of Mathematics, KGiSL Institute of Technology, Coimbatore*

Abstract; Statistical quality control has now become an important integral part of almost every kind of industry. Control charts in Statistical quality control(SQC) provides a basis for deciding whether the variation in the output is due to random causes or due to assignable causes. It will assist us in making decisions whether to adjust the process or not. The various control charts used in SQC have been discussed briefly.

Keywords: Statistical Quality Control (SQC), Control Charts and Control Limits

Introduction

Statistical Quality Control (SQC) is a main tool in production process. Unsystematic inspection and supervision under the name of quality control does not say when or how the samples should be taken, what should be the sample size whereas statistical quality control methods avoid indecision inconsistency and arbitrariness because of its well thought out and systematic properly planned inspection. The word "quality " in statistical quality control is usually related to some measurement made on the items produced. A good quality item is one which confirms to the specifications predetermined by the design engineer. Statistical quality rests in the fact that repeated random samples from a fixed population will vary in a predictable pattern.

Types of control charts

1. Control charts for variables

The quality characteristics of a product that are measurable are called variables
Ex: Diameter of bolts, weights of items, lengths of rods

2. Control charts for attributes

The quality characteristics that are not amenable to measurement are called attributes
Ex: Number of defects in metal discs,holes in bottles

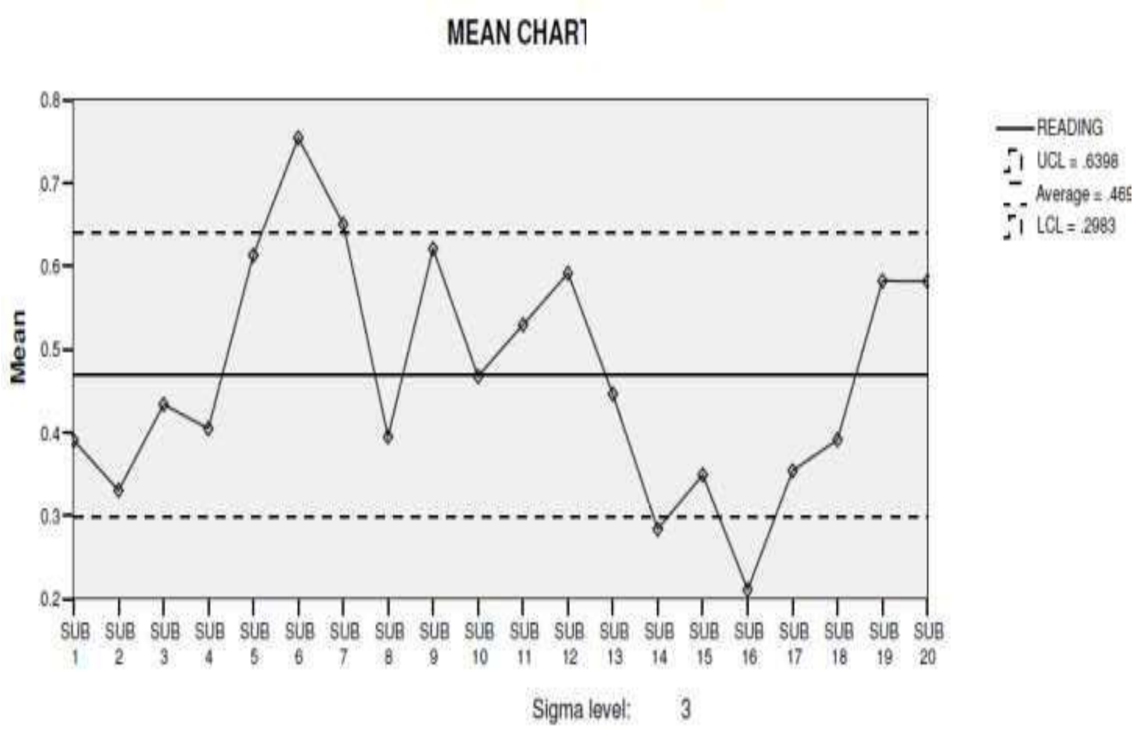
Constructing the Mean ($\bar{X}$) Chart

The $\bar{X}$ chart is based on the mean of a sample taken from the process under study. The sample contains four observations. To construct a mean chart we first need to construct the center line of the chart. This is done by calculating the means of each sample. The center line of the chart is then computed as the mean of all sample means, where represents the number of samples;

To construct the upper and lower control limits of the chart, we use the following formulas:

The control limits can be constructed by using the sample range as an estimate of the variability of the process. The control limits for the range, R (max-value – min-value in the sample). $\bar{R}$ is the mean of the sample range

CL = $\bar{X}$
UCL = $\bar{X} + A_2\bar{R}$
LCL = $\bar{X} - A_2\bar{R}$ (A_2 has to be determined from the statistical table when the sample size n is known)



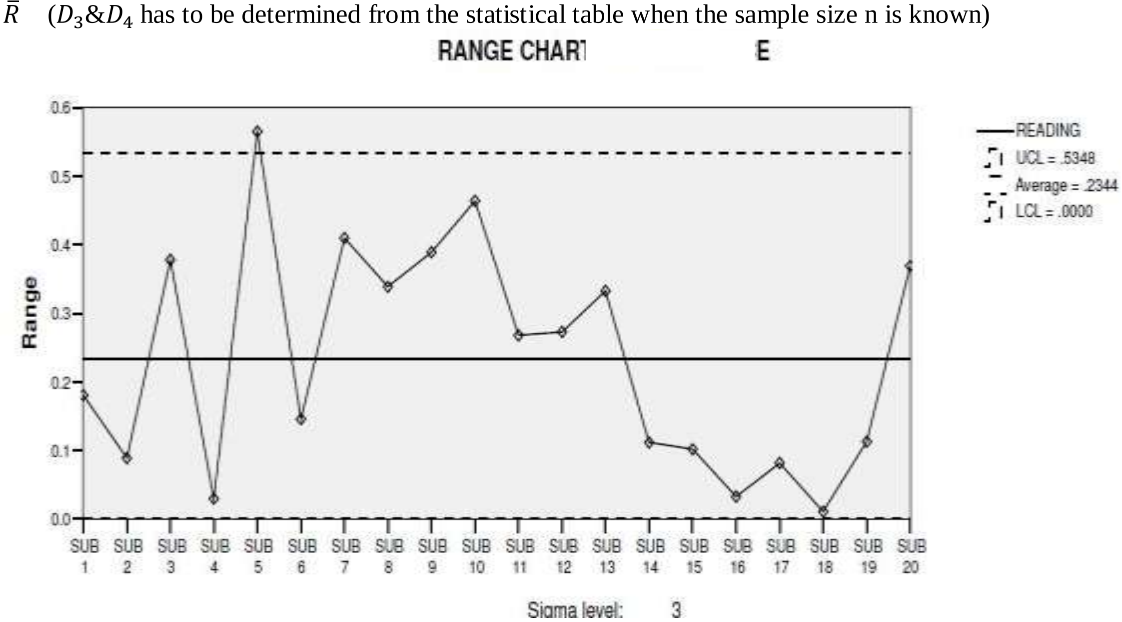
The sample means lying out of the control limits shows that the process is out of control. Remedial action should be taken to control the process

Constructing the Range (R) Chart

The R-Chart is constructed in a manner similar to x - Chart. The center line of the control chart is the average range, and the upper and lower control limits are computed as follows;

$\bar{R}$ is the mean of the sample range

CL = $\bar{R}$
UCL = $D_4\bar{R}$
LCL = $D_3\bar{R}$ (D_3&D_4 has to be determined from the statistical table when the sample size n is known)



The sample range lying out of the control limits shows that the process is out of control. Remedial action should be taken to control the process

Constructing the P - Chart

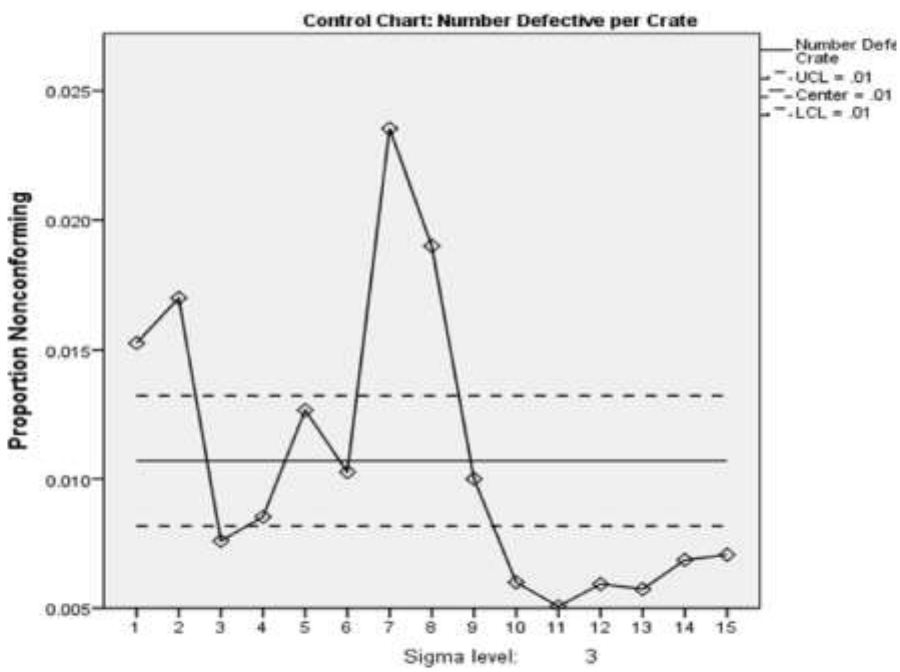
The computation of the center line as well as the upper and lower control limits is similar to the computation for other kinds of control charts. CL is computed as the average proportion defective in the population,

$$\bar{P} = \frac{Total\ number\ of\ defectives}{Total\ number\ of\ items\ inspected}$$

CL = $\bar{P}$

UCL = $\bar{P} + 3\frac{\sqrt{\bar{P}\,(1-\bar{P})}}{\bar{n}}$

LCL = $\bar{P} - 3\frac{\sqrt{\bar{P}\,(1-\bar{P})}}{\bar{n}}$



The proportional defectives lying out of the control limits shows that the process is out of control. Remedial action should be taken to control the process

C – Chart

C chart is used when the proportion value of the defectives is greater than or equal to 4 or the proportion value is small compared with the maximum number of defects given in the data

S – Chart

The standard deviation is an ideal measure of dispersion s-chart is the combination of control charts for the sample mean $\bar{X}$ and the sample S.D

np- Chart

The number of defectives in the sample and the proportion of defectives are considered np- chart is used to construct a chart for number of defectives

Statistical table used for calculation

Sample Size = m	A_2	A_3	D_2	D_3	D_4	B_3	B_4
2	1.880	2.659	1.128	0	3.267	0	3.267
3	1.023	1.954	1.693	0	2.574	0	2.568
4	0.729	1.628	2.059	0	2.282	0	2.266
5	0.577	1.427	2.326	0	2.114	0	2.089
6	0.483	1.287	2.534	0	2.004	0.030	1.970
7	0.419	1.182	2.704	0.076	1.924	0.118	1.882
8	0.373	1.099	2.847	0.136	1.864	0.185	1.815
9	0.337	1.032	2.970	0.184	1.816	0.239	1.761
10	0.308	0.975	3.078	0.223	1.777	0.284	1.716
11	0.285	0.927	3.173	0.256	1.744	0.321	1.679
12	0.266	0.886	3.258	0.283	1.717	0.354	1.646
13	0.249	0.850	3.336	0.307	1.693	0.382	1.618
14	0.235	0.817	3.407	0.328	1.672	0.406	1.594
15	0.223	0.789	3.472	0.347	1.653	0.428	1.572
16	0.212	0.763	3.532	0.363	1.637	0.448	1.552
17	0.203	0.739	3.588	0.378	1.622	0.466	1.534
18	0.194	0.718	3.640	0.391	1.608	0.482	1.518
19	0.187	0.698	3.689	0.403	1.597	0.497	1.503
20	0.180	0.680	3.735	0.415	1.585	0.510	1.490
21	0.173	0.663	3.778	0.425	1.575	0.523	1.477
22	0.167	0.647	3.819	0.434	1.566	0.534	1.466
23	0.162	0.633	3.858	0.443	1.557	0.545	1.455
24	0.157	0.619	3.895	0.451	1.548	0.555	1.445
25	0.153	0.606	3.931	0.459	1.541	0.565	1.435

Conclusion

The common statistical process control charts used for variable characteristics,, R charts and for attributes, P-chart were explored. To develop variable control charts for the measurable quality characteristics used during production. Given the initial set objectives of this research, which includes: determining if the process of production is statistically- in - control; building appropriate attributes control chart for the quality of products; and suggesting alternative control schemes for the future in event of out - of - control, we found that the production process based on the observed characteristics, is largely out-of-control across

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