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P-CHARTS

In today's business world every organization is concerned with quality. Total Quality Management (TQM) systems use Statistical Process Control (SPC) to insure their operations maintain product quality.

Shortly after World War II, a quality expert and consultant named W. E. Deming was invited to Japan to conduct lectures on improving product reliability. Many experts believe this to be the beginning of Japan's commitment to TQM.

It is very difficult to talk about TQM in production management without referring to Statistical Process Control. SPC is a process, which uses control charts to evaluate whether any part of the production process is out of control. The result would be a quality failure or product defection. Its main function is to prevent quality defects before they occur. Many companies spend huge amounts of resources to insure proper training in both TQM and SPC methods.

Control charts are graphs that reflect a visual diagram to see if sample products remain inside of their control limits. These control charts revolve around two main functions: the first is to establish control limits for the process and the second is to monitor when the production process is outside of these controls.

P-Chart construction begins with the first step of establishing control limits. There are some assumptions made regarding the discrete attribute measure. The main assumption is while the sample size gets larger, the proportion of defects can be placed into a normal distribution curve. This enables us to use the following statistical formulas to complete the first steps of constructing a P-Chart: establishing the Upper Control Limit (UCL) and Lower Control Limit (LCL).

$$UCL = \textit{pbar} + z\sigma_p$$

$$LCL = \textit{pbar} - z\sigma_p$$

Where z = the number of standard deviations from the process average.

pbar = the sample of the proportion that is defective.

σ_p = the standard deviation of the sample proportion.

The standard deviation is computed as

$$\sigma_p = \sqrt{\textit{pbar}\,(1 - \textit{pbar})/n}$$

Where n = sample size

Occasionally you will see a z value of 2.00 but more often than not z is setup as 3.00. This allows a probability of 99.74 percent under normal distribution circumstances.

Once the Upper and Lower Control Limits are established, it becomes just a matter of plotting the points on a graph or chart to determine the number of defects that exist. Where all plotted points are within the control limits there is a 99.74% comfort level, which exists. If for whatever reason points fall outside the control limits corrective action should be taken to maintain the quality the organization is trying to achieve.

The following is a typical problem and solution for the construction of a P-Chart:

Twenty samples of n = 200 were taken by an operator at a workstation in a production process. The number of defective items in each sample were recorded as follows.

SAMPLE	NUMBER OF DEFECTIVES	p	SAMPLE	NUMBER OF DEFECTIVES	p
1	12	0.060	11	16	0.080
2	18	0.090	12	14	0.070
3	10	0.050	13	12	0.060
4	14	0.070	14	16	0.080
5	16	0.080	15	18	0.090
6	19	0.095	16	20	0.100
7	17	0.085	17	18	0.090
8	12	0.060	18	20	0.100
9	11	0.055	19	21	0.105
10	14	0.070	20	22	0.110

Management wants to develop a p-chart using 3-sigma limits. Set up the p-chart and plot the observations to determine if the process was out of control at any point.

Solution

Step 1. Compute *pbar*:

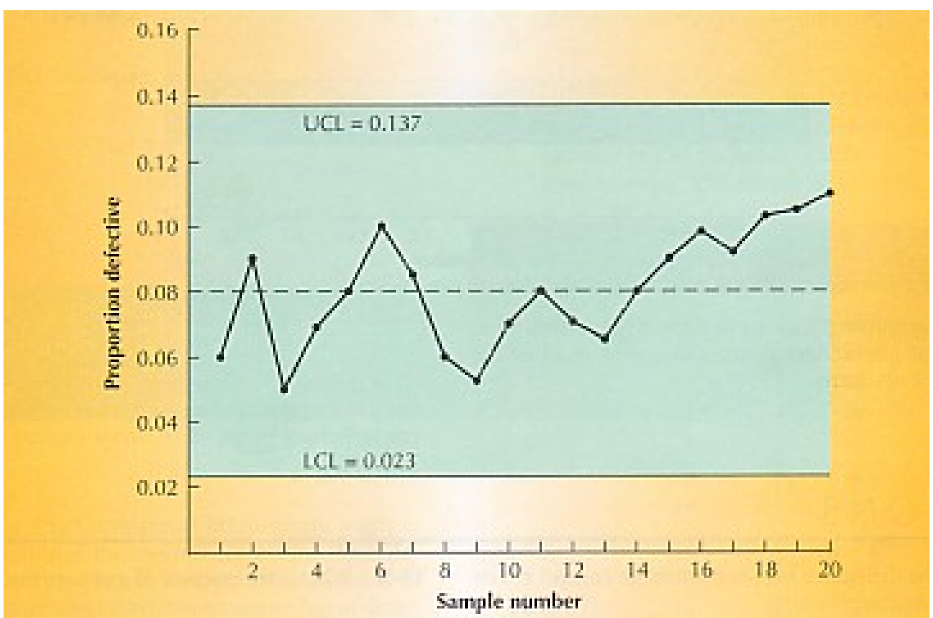
pbar = total # of defectives/total # of observations = 320/(20)(200) = 0.08

Step 2. Determine the control limits:

UCL = *pbar* + z √ *pbar* (1- *pbar*)/n = 0.08 + (3.00)(0.019) = 0.137

LCL = *pbar* – z √ *pbar* (1 – *pbar*)/n = 0.08 – (3.00)(0.019) = 0.023

Step 3. Construct the p-chart with *pbar* = 0.08, UCL = 0.137, and LCL = 0.023. The process does not appear to be out of control.



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