Chapter 12: Control Charts for Binary Variables

p charts

Here we consider subgroups from Bernoulli processes with success rate π. In this chapter successes will be called ***defectives*** (or noncomforming products).

We should use control charts to monitor the process to ensure that π remains constant over time.

Since π determines all aspects of the process we do not need to monitor mean level and variability separately as we do with continuous variables.

The *p* Chart

A *p* chart displays a sequence plot of successive proportions of defectives from successive subgroups randomly selected from the Bernoulli process.

Let y_i denote the total number of successes from the i^{th} subgroup of size n_i. Let

$$p_i = \frac{y_i}{n_i}$$

be the proportion of defectives in the i^{th} subgroup.

As before we have *k* subgroups.

We know that the p_i are approximately normally distributed with mean π and standard deviation

$$\sigma_p = \sqrt{\frac{\pi(1-\pi)}{n_i}}$$

Since π is unkown (and unknowable) we estimate it with the grand proportion of defectives

$$\bar{p} = \frac{\text{Total number of defectives}}{\text{Total number of trials}}$$

Then the control limits for the i^{th} subgroup are obtained from

$$\text{UCL}_i = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n_i}}$$

and

$$\text{LCL}_i = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n_i}}$$

with a center line at $\bar{p}$.

If the LCL is negative it is set to zero.

Interpretation is like any other control chart. As long as the sequence of subgroup proportion decfectives remain within the control limits there is no evidence of special causes.

Examples:

Document processing.