CH 19: Statistical Method for Quality Control Part 1

1. Basic Concepts

   (A) A Process is any business activity that takes imputs and transforms them into outputs.

   (B) Quality control: A series of inspections and measurements used to determine whether quality standards are being met. i.e., we use statistical methods to detect and fix problems in a process.

   (C) We will use control chart to achieve this goal.

2. Control chart: A graphical tool used to help determine whether a process is in control or out of control. In our study, the control chart displays successive measurement of a process together with a upper control limit (UCL) and lower control limit (LCL).

3. Control Chart for the mean: the $\bar{x}$ chart.

   (A) The $\bar{x}$ is used to monitor the process average.

   (B) The UCL and LCL for $\bar{x}$ chart with standard deviation (error) known:

   eq19.1: Standard Error of the Mean: $\sigma_{\bar{x}} = \dfrac{\sigma}{\sqrt{n}}$

   eq19.2: $UCL = \mu + 3\sigma_{\bar{x}}$ eq 19.3: $LCL = \mu - 3\sigma_{\bar{x}}$

   EX1 Temperature is used to measure the output of a production process. When the process is in control, the mean of the process is $\mu = 128.5$ and the standard deviation is $\sigma = 0.4$.
   a). Compute the UCL and LCL for an $\bar{x}$ chart if sample of size 6 is provided.

   b). If the first two measurements are $\bar{x}_1 = 129.25$ and $\bar{x}_2 = 128.2$, what can you say about the process?

   (C) The UCL and LCL for $\bar{x}$ chart with standard deviation (error) unknown:

   eq19.4: Overall Sample Mean: $\overline{\bar{x}} = \dfrac{\bar{x}_1 + \bar{x}_2 + \cdots + \bar{x}_k}{k}$

   eq19.5: Average Range: $\overline{R} = \dfrac{R_1 + R_2 + \cdots + R_k}{k}$

   eq19.8: Control limits (UCL, LCL) For an $\bar{x}$ standard deviation unknown:$\overline{\bar{x}} \pm A_2\bar{R}$

4. Control limits for an R chart:

   (A) The R chart is a control chart for the range (the largest value minus the smallest value). It's used to monitor the variation in the process.

   (B) The UCL and LCL for an R chart:

$$\text{eq19.14: } UCL = \overline{R}D_4$$

$$\text{eq19.15: } LCL = \overline{R}D_3$$

   (C) A_2, D_3, and D_4 is the control factors obtained from a table based on the sample size n.

EX 2 A toothpaste manufacturer monitors the amount of active ingredients found in a tube. Five samples are drawn each day for eight days with the following data.

(a) Find UCL and LCL for the $\bar{x}$ chart and the R chart,

(b) Is the process in control?

CH 19: Statistical Method for Quality Control Part 2

5. Review for the Control Chart: A graphical tool used to help determine whether a process is in control or out of control. In our study, the control chart displays successive measurement of a process together with a upper control limit (UCL) and lower control limit (LCL).

6. Control chart: p chart: The control chart used to monitor the proportion of defective items. Again, the control chart consists of the upper control limit (UCL), the lower control limit (LCL), the center line is also considered.

   (A) The data structure:

   (B) Find the proportion p (the center line).

   (C) Find the standard error of the proportion.

   $$\text{eq19.16: } \sigma_{\bar{p}} = \sqrt{\frac{p(1-p)}{n}}$$

   Where n is the sample size.

   (D) Find the Control Limits for a p Chart:

   $$\text{eq19.17: } UCL = p + 3\sigma_{\bar{p}}$$

   $$\text{eq19.18: } LCL = p - 3\sigma_{\bar{p}}$$

EX3 Given the following data for a period of 10 days of a manufacture process. a sample of 100 items were randomly selected and the number of defective items were recored.

(a) Find the proportion p (the center line)

(b) Find the standard error of the proportion $\sigma_{\bar{p}}$

(c) Compute the control limits

(d) Is the process in control or out of control?

(e) Graph the p chart