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X Chart Control Charts

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FLUOR®

SPC Trending Primer/ Two Day Training

http://www.efcog.org/wg/esh_es/Statistical_Process_Control/index.htm

X Chart Control Charts

- We will work from a set of “real”data
- The X chart is the generic control chart, use this format when in doubt

http://www.efcog.org/wg/esh_es/Statistical_Process_Control/docs/xchart.pdf

Excel Spreadsheet Data

- Open file X chart data.xls
- This is the monthly average time to approve work packages in days
- It is a real set of data for a Department of Energy facility for a certain work package type
- Column A is the month completed, Column B is the monthly average cycle time.
- Columns C, D, and E will be used for Average, UCL, and LCL

Run Chart

- Highlight A2 to F47.
- Hit F11. This will make a bar chart.
- Change chart type to line, delete the background, grid lines, and legend.
- You now have a “run chart”, a line chart of the raw data.

Calculate the Baseline Average

- We will use the first 25 data points for our initial baseline
- Type =average(B2:B26) in cell B49. This is the baseline average
- Copy and paste special (values) into the C column

Calculate the Standard Deviation

- For this chart, we will use the actual standard deviation of the data.
- In cell B50, type =stdev(B2:B26).
- Note – this is the statistical standard deviation. Another method is the moving range.

Calculate the LCL and UCL

- In D49, type =B49 + 3 * B50
- Copy and paste special values up the D column
- In E49, type =B49 – 3 * B50
- Copy and paste special values up the E column
- Check the chart for any trends

Definition of a Trend

- One point outside the control limits
- Two out of Three points two standard deviations above/below average
- Four out of Five points one standard deviation above/below average
- Seven points in a row all above/below average
- Ten out of Eleven points in a row all above/below average
- Seven points in a row all increasing/decreasing.

See SRS Procedure Q1-1 105 or Institute of Nuclear Power Operations Good Practice 07-007

There are trends in the data!

- We now start cutting back the baseline time interval into sections, and finding stable regions of the data to use for creating baselines
- This may also involve throwing out extremely high or low points (circle them)
- This is a recursive and self-correcting process
- Aim is to have an explanation with the least number of shifts of the baselines and circles of outliers
- What is the prediction of the future?

Standard deviation from Moving Range

- **Let's calculate the standard deviation for January 2004 – October 2005 using the Average Moving Range**
  - The answer is 5.2 using stdev
- **In G15, type =ABS(B15 – B14)**
  - This takes the absolute value of the difference between two successive values
- **Copy this formula down to row 35**

Moving Range (2)

- **Calculate = average(G15:G35)**
- **Divide this number by 1.128**

  = average(G15:G35)/1.128
- **This gives 5.7, fairly close to 5.2**
- **The interpretation of the data do not change.**
- **As long as a stretch of data are chosen that are stable, the two standard deviations will be close to each other. Outliers might "blow up" the statistical standard deviation.**

Which Standard Deviation to Use?

- Traditionally, the moving range is used
- Computers allow the statistical standard deviation to be calculated more easily
- Shewhart's original theory based upon the statistical standard deviation*
- Dr. Wheeler does disagree
- I have found little difference in my data experience
- Q1-1 105 and INPO 07-007 allows for either

* Economic Control of Quality of Manufactured Product, Walter Shewhart, 1930. Chapter 19