Control Chart Analysis

Temporal Visualization

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Objective

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Apply methods of temporal analysis

Data Mining

- **Data mining domain has techniques for examining time series. Looking for**
  - patterns
  - anomalies

- **Enhance the visualizations**
  - show what is important

- **Used in exploratory analysis**
  - “I think this looks interesting, show me similar trends.”

Typical Time Series Analysis

Trend analysis

- A company's linear growth in sales over the years

Seasonality

- Sales are higher in summer than winter

Forecasting

- What is expected sales next quarter?

Control Chart Overview

Control Chart Components

- For temporal data, we can find anomalies using control chart methods
- Control charts consist of a statistic representing some measurement in time

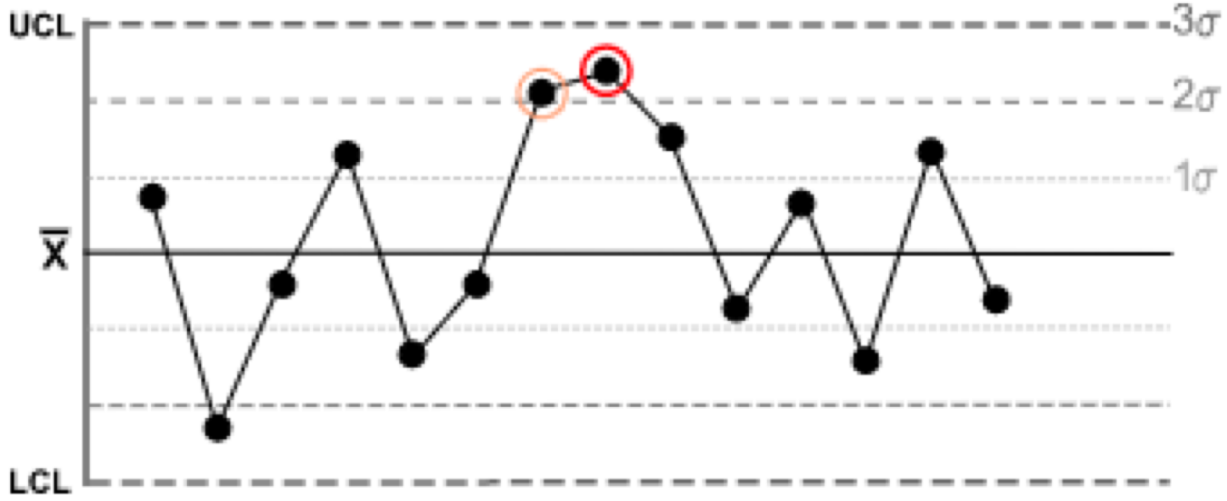
Calculations

- The mean and standard deviation of the statistic is calculated given all the available samples
- If the current value is greater than some pre-set number of standard deviations from the mean, then an alert is generated

What is a control chart?

- A graph used to study how a process changes over time
- Data are plotted in time order
- Always has a central line for average, an upper line for upper control limit and a lower line for lower control limit
- Lines are determined from historical data

Control Chart



When to use a control chart?

- Controlling ongoing processes by finding and correcting problems as they occur
- Predicting the expected range of outcomes from a process.
- Determining whether a process is stable (in statistical control).
- Analyzing patterns of process variation from special causes or common causes.
- Determining whether the quality improvement project should aim to prevent specific problems or to make fundamental changes to the process.

Control Chart Model

Upper Control Limit	Center Line	Lower Control Limit
$\mu + k\sigma$	μ	$\mu - k\sigma$

Moving Average/Range Charts

Moving Average Chart

- monitors the process location over time
- generally used for detecting small shifts in the process mean
- control limits are derived from average range on Range Chart

Range Chart

- monitors the process variation over time
- should be reviewed before Moving Average Chart

Moving Average: Stock Market Closing Example

Daily Closing Prices:

11,12,13,14,15,16,17

First day of 5-day SMA:

(11 + 12 + 13 + 14 + 15) / 5 = 13

Second day of 5-day SMA:

(12 + 13 + 14 + 15 + 16) / 5 = 14

Third day of 5-day SMA:

(13 + 14 + 15 + 16 + 17) / 5 = 15

Exponentially Weighted Moving Average

SMA:

10 period sum / 10

Multiplier:

(2 / (Time periods + 1)) = (2 / (10 + 1)) = 0.1818 (18.18%)

EMA:

{Close - EMA(previous day)} x multiplier + EMA(previous day)

The Lag Factor

Shorter Moving

- nimble and quick to change

Longer Lag

- Longer the moving average, more the lag

Longer Moving

- Longer moving - slow to change

Differences between simple moving averages and exponential moving averages, one is not necessarily better than the other

Length of your moving average depends on your analytical goal