Improper Use of Control Charts: Traps to Avoid

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Agenda

- Why Statistical Process Control?
- Data Assumptions
- Signal Rules
- Common Issues with Control Charts
- Summary

Why Statistical Process Control? (SPC)

Basic Uses

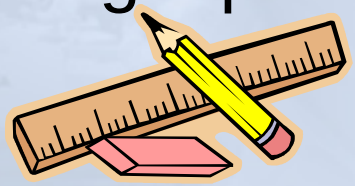
- A technique to understand variation
  - Identify signals for action

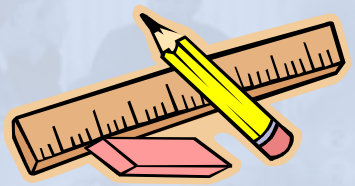
"In Control" Uses

- A technique to define the "result space" of a process
  - Useful for predicting or estimating future results

Data Assumptions for SPC

- Data must be sequential or time sequenced
- Data must be independent – one data point does not determine or impact the next data point
- Data must approximate a recognizable distribution
- Data must be from the same subprocess – related to a single process instantiation





Signal Rules for SPC

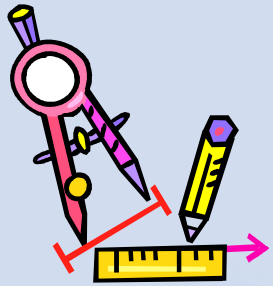
- A single point falls outside the 3-sigma limits.
- At least 2 out of 3 successive values fall on the same side of and more than 2 sigma units away from the centerline.
- At least 4 out of 5 successive values fall on the same side of and more than 1 sigma unit away from the centerline.
- At least 8 successive values fall on the same side of the centerline.

These are some of the most common rules. There are more that may also be used.

Common Issues with Control Charts

Most issues show up during the following activities:

- Selection of chart type
- Application to data
- Adjustment of control limits
- Other issues



Selection of Chart Type

Most commonly used chart types:

- XmR chart – used for normally distributed data
- P or np charts – used for binomially distributed data
- C or u charts – used for data with Poisson distribution

Why does it matter?

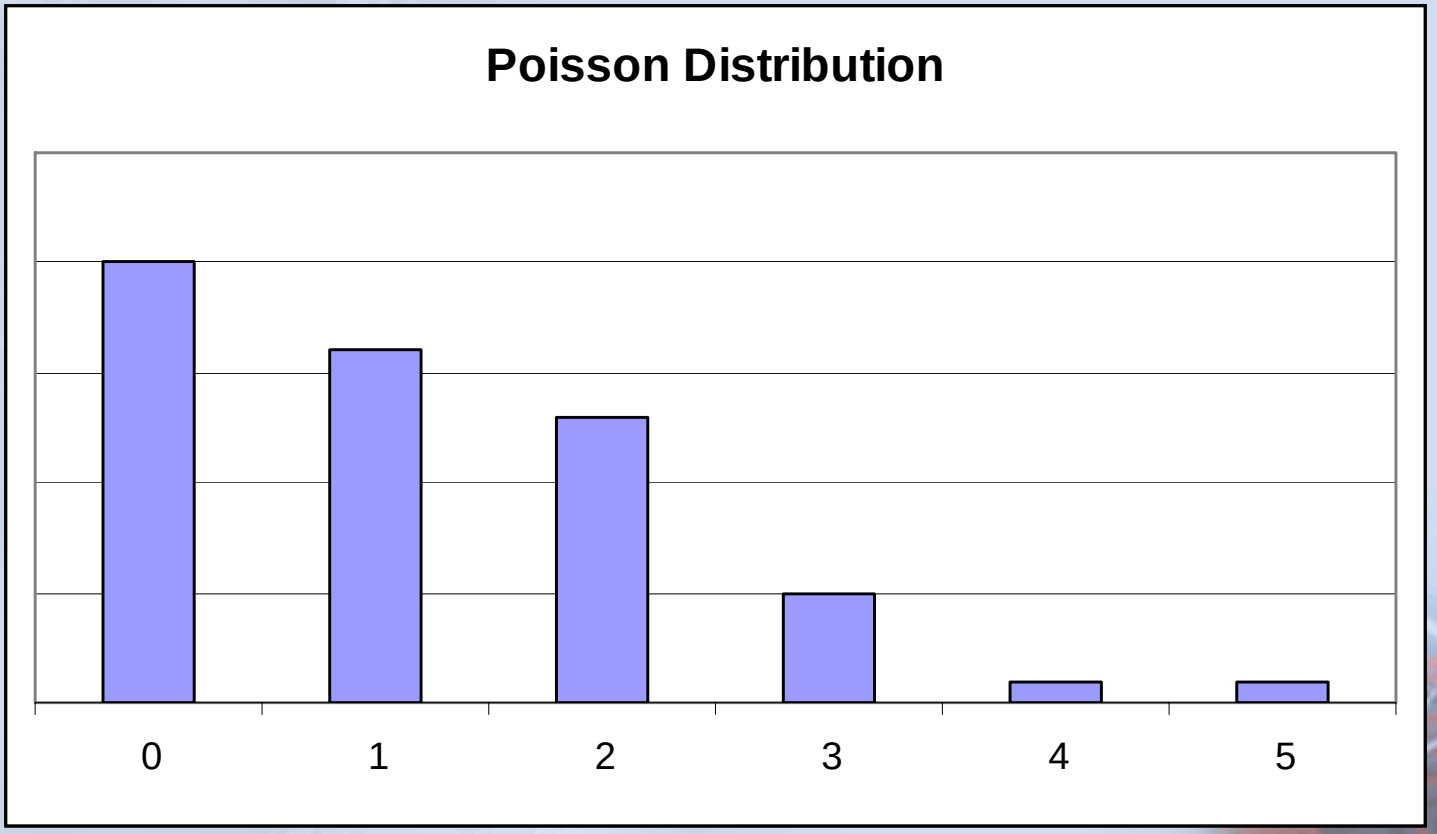
- Formulas for the different charts are based upon factors inherent in those types of distributions.

- Use of incorrect chart may result in either lack of signals (limits too wide) or inappropriate signals (limits shifted based on incorrect assumptions)

Ensure Correct Selection

- **Graph the data histograms** on a regular basis to ensure that the data distributions are known, and that they don’t change over time.

What Data Could This Represent?



Which control chart formulas would we use?

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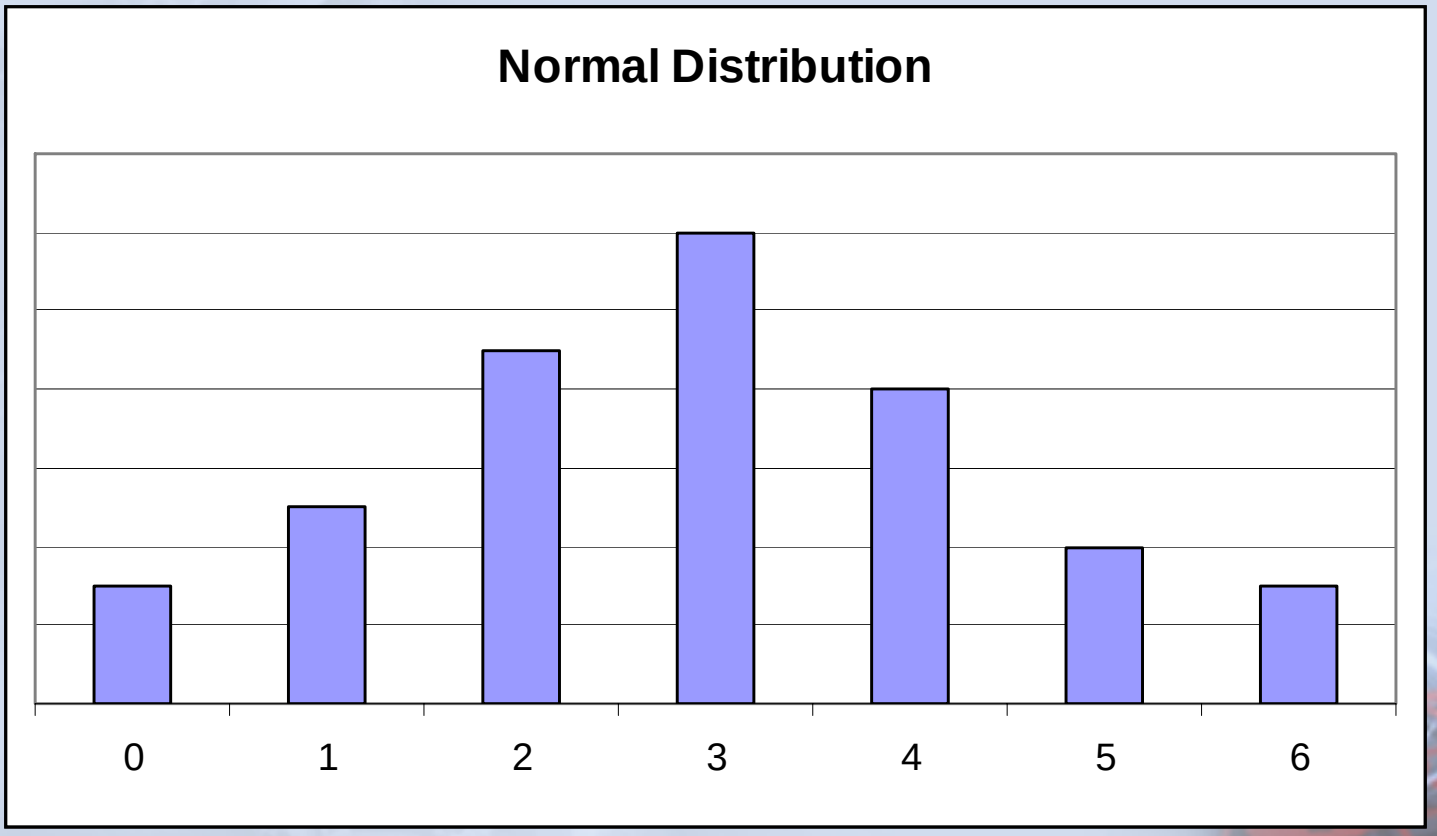

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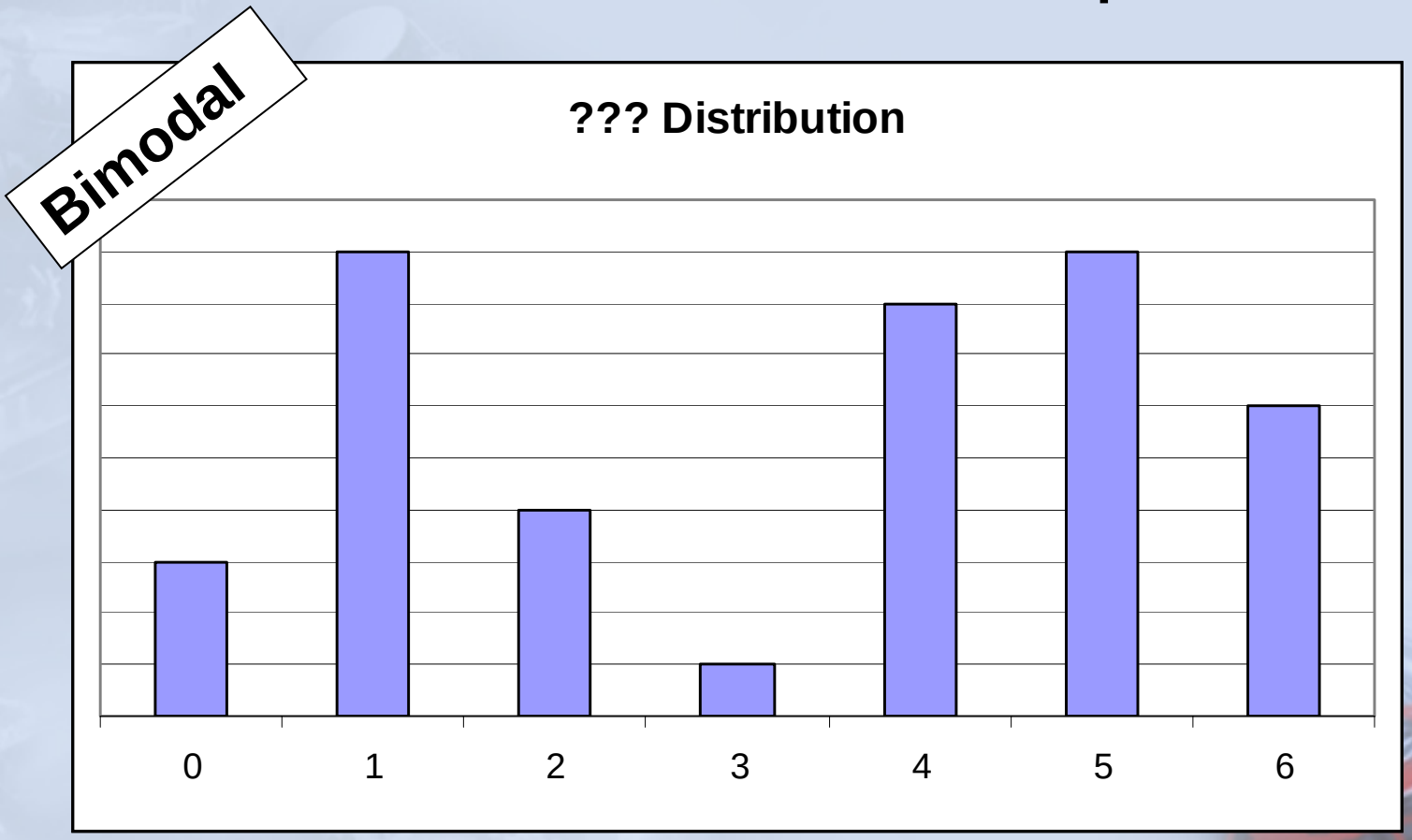
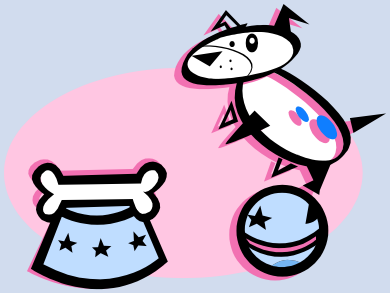


Histograms can also indicate when data is *not from the same subprocess*…

Application to Data

- Data should be from the same subprocess



  - Usually needs to be from a single project instantiation of a subprocess

Examples of Improper Application

- Applying to data across “large” processes such as “requirements” or “development”
- Applying to a single process across multiple projects (tends to be done by organizations)
- Applying to cumulative data

Applying to “Large” processes

- Data from many different subprocess could hide signals
  - Control limits become wider
  - Control charts less sensitive to “special” causes
- Large processes don’t typically support real-time control
- Processes may seem to be in control – but they’re not!

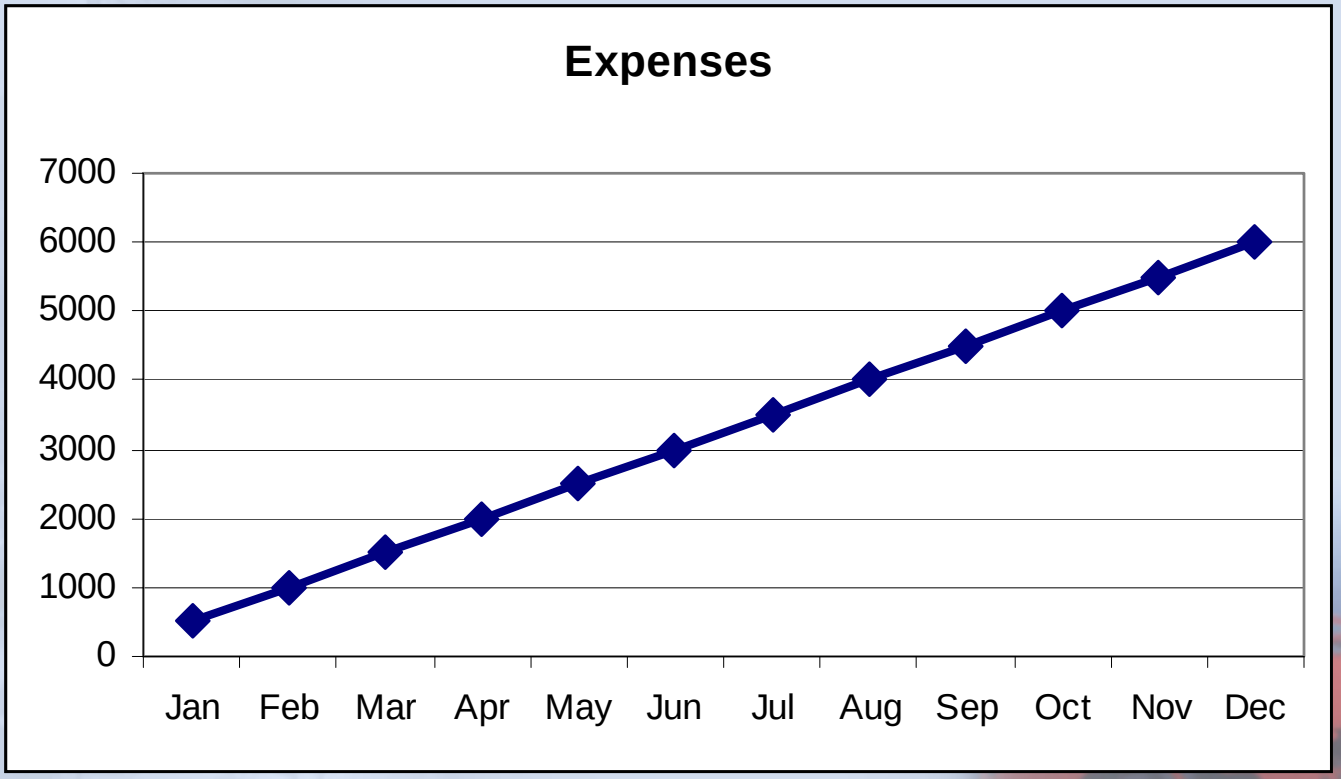
Applying across Organizations

- Same as “large process” issues, only worse
- Results of analysis tend to significantly lag actions, effectively eliminating one of the main benefits of this technique
- Projects find it hard to determine “signal” applicability to their instantiation of the process.
- Organizational groups cannot typically determine project activities that caused signals – still need project input

Applying to Cumulative Data

Data Rules?

Signal Rules?



Ensure Correct Application

- Apply to **very specific sub-process elements**
- **Projects should apply SPC** to their own instantiations of the process
- **Do not** apply to **cumulative data**

Adjustment of Control Limits

Most SPC practitioners struggle with the question of when to adjust control limits, and when to leave them alone.

Control limits are based on the control parameters – changing control parameters will adjust the limits.

Examples of Improper Adjustment

- With every new data point added to the chart
- Lack of adjustment and relying solely on organizational baselines
- Lack of adjustment because data is “in control”, even if evidence of a process shift

Why the Confusion?

Control parameters should be adjusted when there is reason to believe that the current limits are not appropriate to provide adequate signals for action.

Ensure Correct Adjustment

Three common situations in which control parameters should be revised:

- When the **process has changed**
- When the parameters are "**trial**" control parameters or baselines
- When the **initial calculation** of the parameters is inflated – typically due to small sample size

Organizational guidance should be provided

Other Issues

- Data not charted sequentially
- Removing data from charts

Data not Charted Sequentially

With some processes it is not obvious what the chronological ordering of activities is.

- Violates data rule #1

If this is difficult to do, then consider

- Working with a **portion of process** that is chronologically mapable
- Combining results that effectively occur at the same time into a subgroup
- **Using another technique** besides SPC to monitor these activities

Removing Data from Charts

Some tools require removal of data points to recalculate control limits

- Cannot evaluate signal rules, especially those for trends and runs

Best to ensure **all data points remain** on the charts, even those removed from the calculation of the control limits.

Summary

Control Charts are a powerful technique for understanding variation in our processes…

WHEN USED CORRECTLY

References

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- Florac, William A. and Anita D. Carleton. Measuring the Software Process: Statistical Process Control for Software Process Improvement. Reading Massachusetts: Addison-Wesley. 1999.
- Wheeler, Donald J. and David S. Chambers. Understanding Statistical Process Control. Second Edition. Knoxville, TN: SPC Press, Inc. 1992.

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