

Linking Statistical Thinking to Six Sigma

Quality and Productivity Research Conference
Santa Fe, New Mexico
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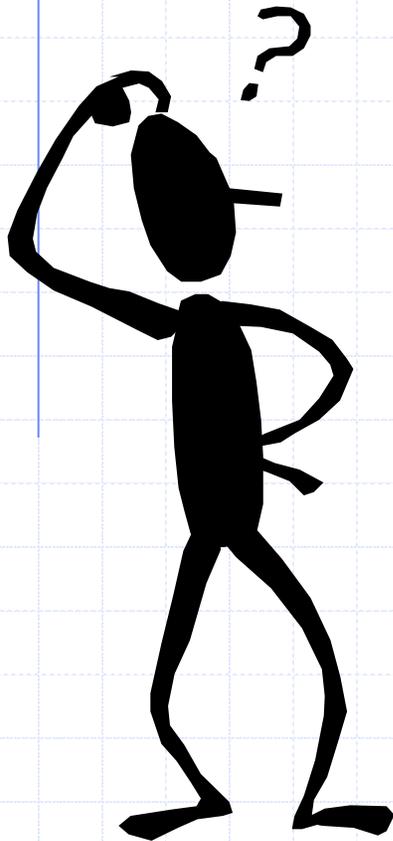
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Outline

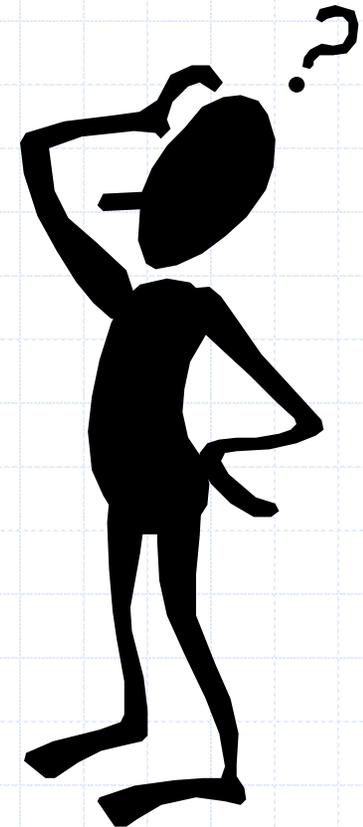
- ◆ Statistical Thinking Defined
- ◆ ST and Statistical Methods
- ◆ Requirements of the Link
 - Mindset
 - Understanding Sources of Variation
 - Quantifying Variation
 - Eliminating Variation
 - Holding the Gains
- ◆ Examples
- ◆ Question Dodging

What is Statistical Thinking?



Thousands of statisticians disagree ...

... but they seem unable to come up with a better definition than ...



Statistical Thinking is:

A philosophy of learning and action based on the following fundamental principles:

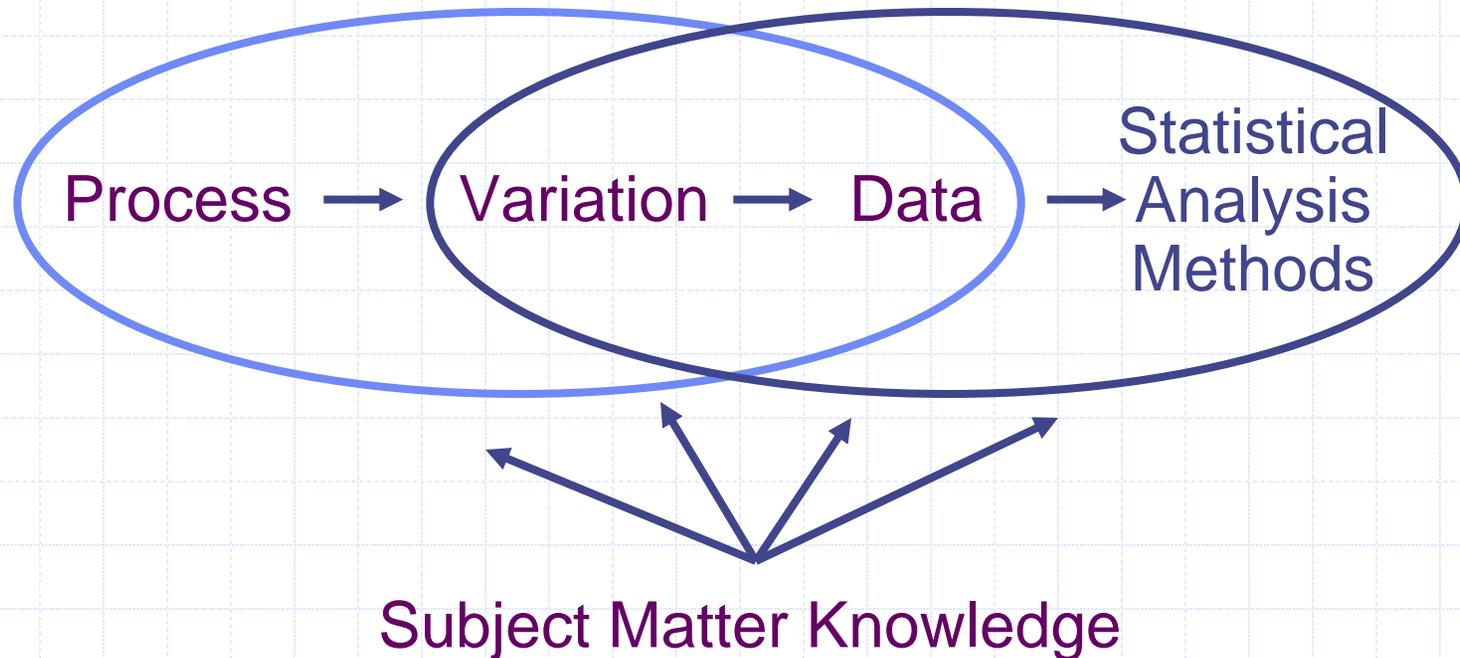
- ◆ All work occurs in a system of interconnected processes,
- ◆ All processes exhibit variation, and
- ◆ Understanding and reducing variation are keys to success.

Implications 

Scientific Problem Solving

Statistical Thinking

Statistical Theory
& Methods



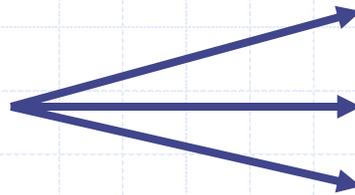
ST and Six Sigma (and DFSS)

Statistical Thinking

◆ Process



◆ Variation



◆ Data



Six Sigma

◆ Define

◆ Measure

◆ Analyze

◆ Improve

◆ Control

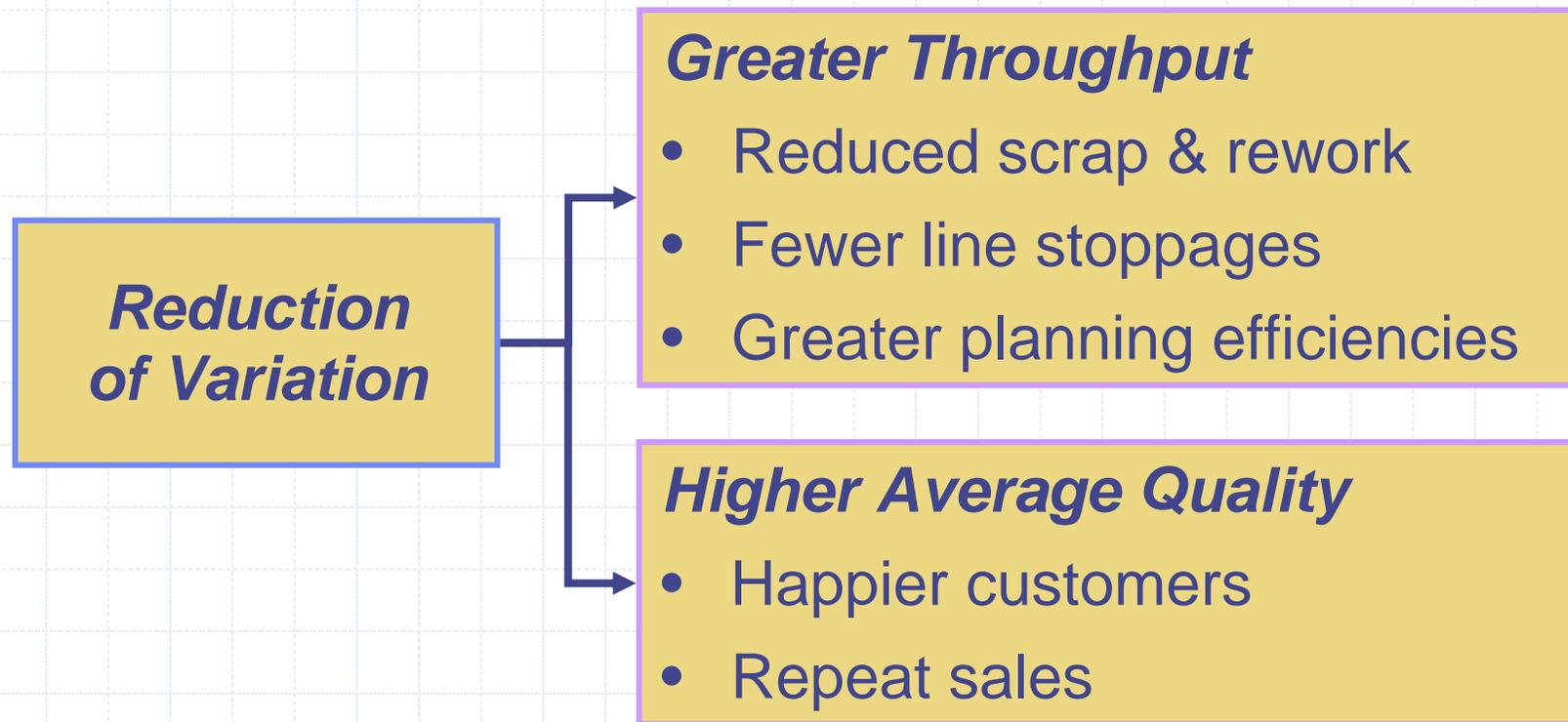
Requirements

- ◆ Mindset
- ◆ Understanding sources of variation
- ◆ Having a plan for the quantification of variation
- ◆ Eliminating sources of variation
- ◆ Holding the gains, once attained

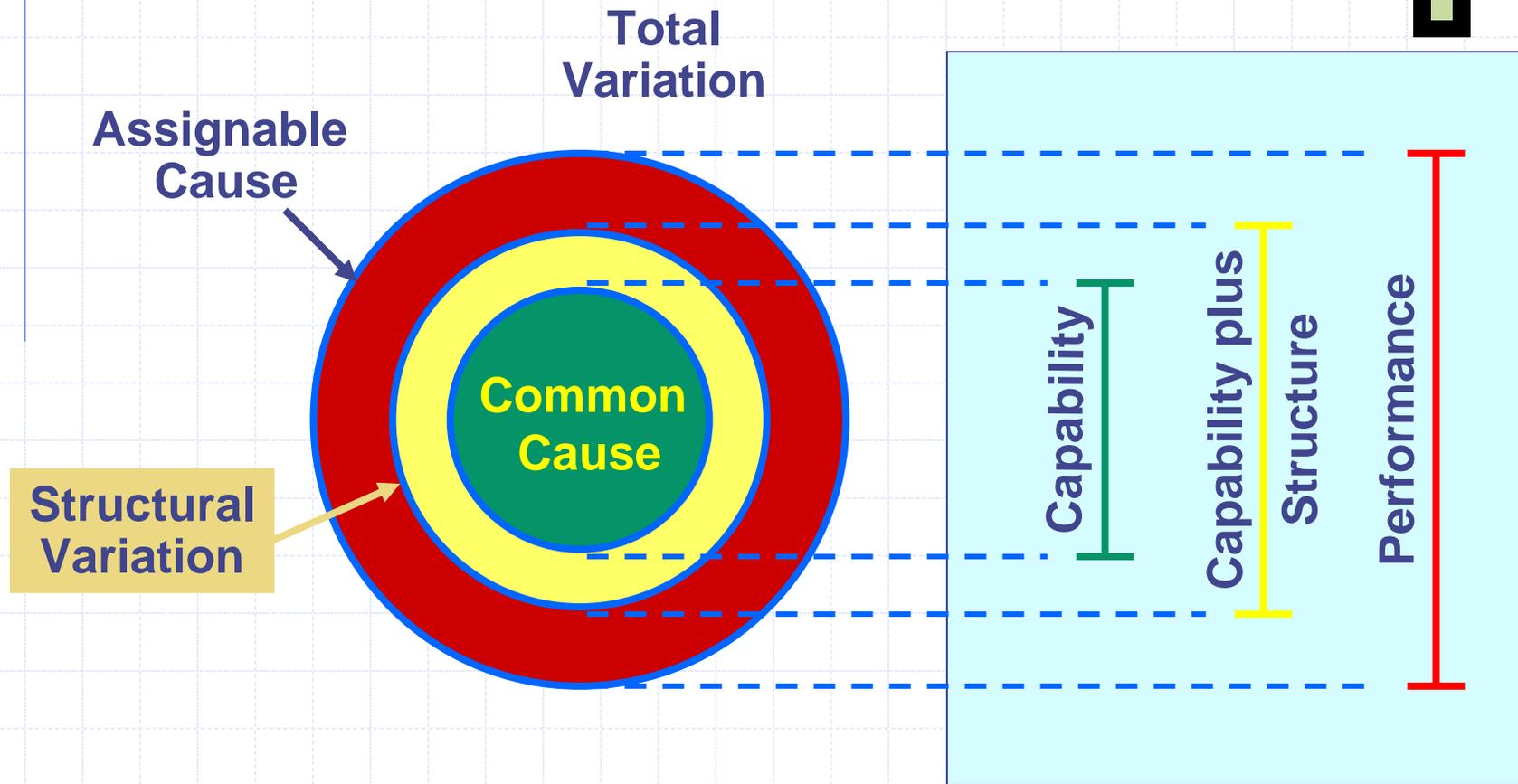
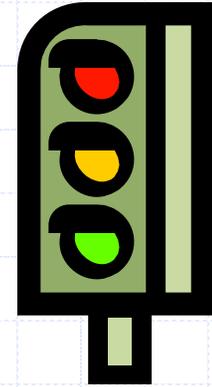
Mindset

- ◆ A drive for continuous improvement
 - Healthy discontent for the status quo
 - Fire in the belly
- ◆ Management involvement
- ◆ Financial drive
- ◆ Data integrity
- ◆ Open minds and teamwork

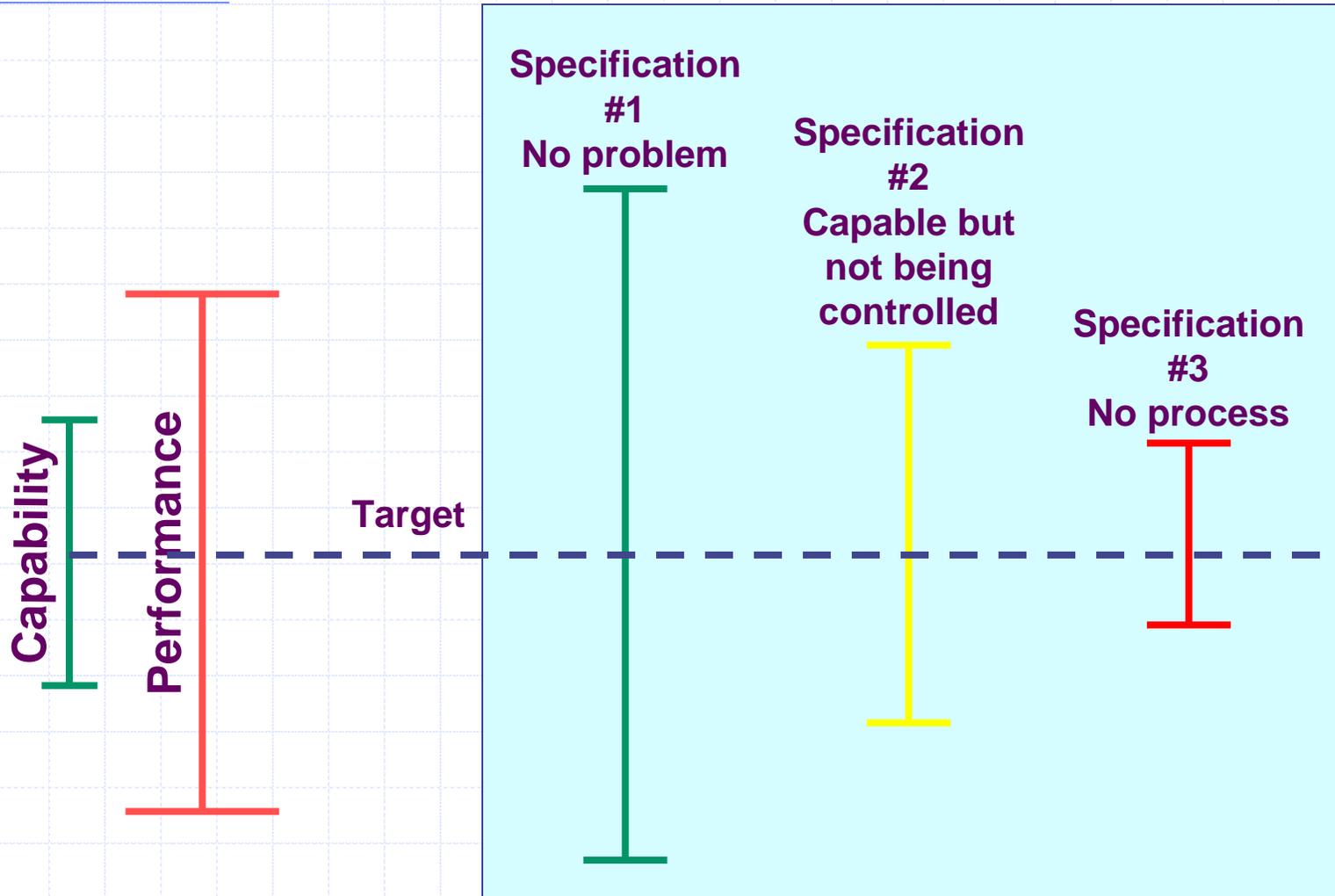
Why Reducing Variation is Important



Understanding Sources of Variation



Understanding Sources of Variation: Relationship Between Process Variation and Specifications



Having a Plan for the Quantification of Variation

- ◆ “The right amount of the right kind of data”
- ◆ Estimating capability alone
- ◆ Estimating structural variation
- ◆ Estimating assignable cause variation

Eliminating Sources of Variation – An Example

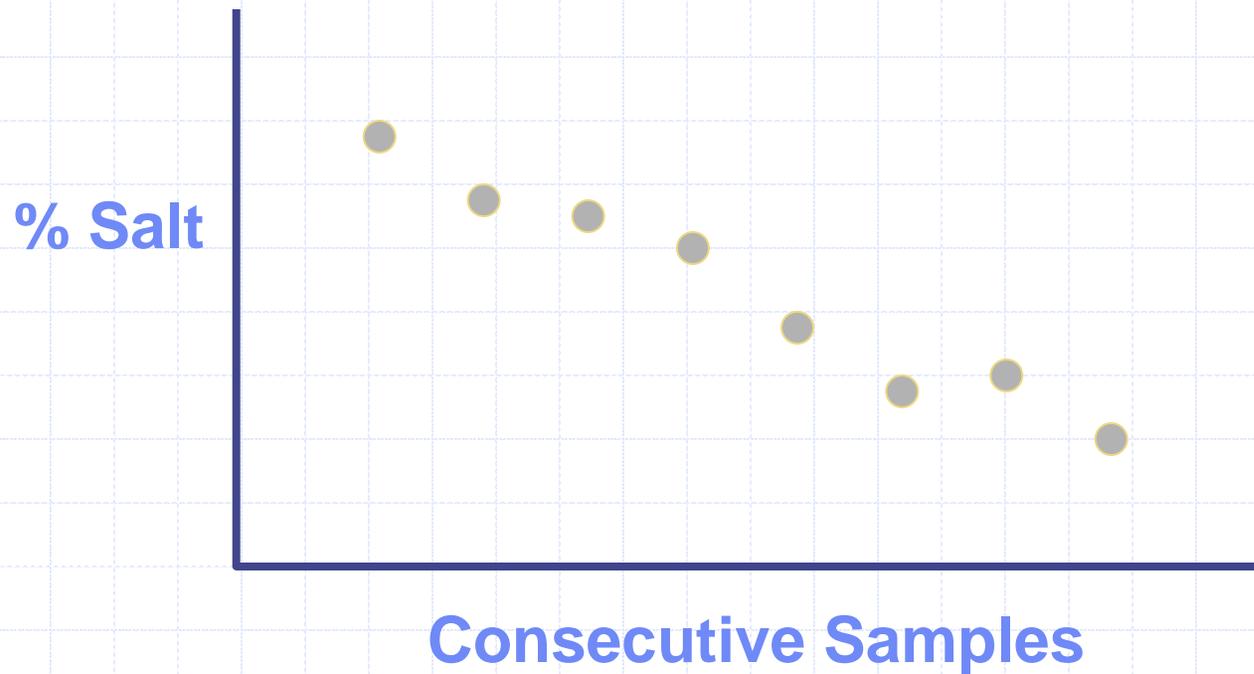
But first a word from our sponsor.

Hare's first rule of data analysis:

“Always, always, always, without exception, plot the data – and look at the plot.”

If you don't learn anything else from this talk, learn that!

What Can Go Wrong When You Don't Plot the Data:



If this message is unclear:

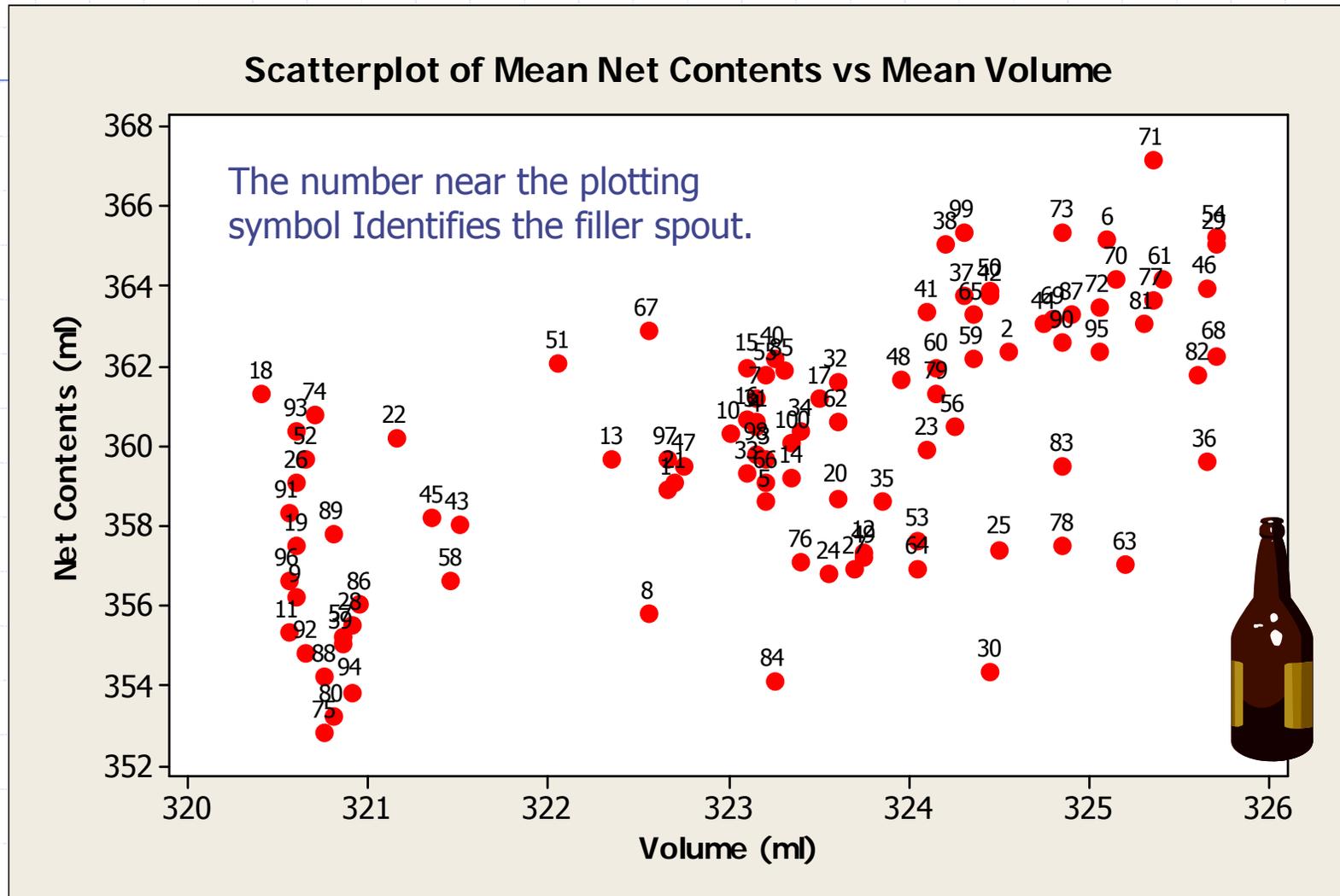
- ◆ Spanish: Siempre, siempre, siempre, sin excepción, haga un gráfico de los datos – y mira el gráfico.
- ◆ Portuguese: Sempre, sempre, sempre, sem exceção, faça um gráfico dos dados – e analise o gráfico.
- ◆ Dutch: Altijd, altijd, altijd, en zonder uitzondering, zet de gegevens grafisch uit – en bekijk de grafiek.
- ◆ German: Immer, immer, immer, ohne Ausnahme, ermittle eine grafische Darstellung der Daten – und schau die Grafik an.
- ◆ French: Toujours, toujours, toujours, sans exception, fait un graphique des données – et regarde le graphique.
- ◆ Chinese: 永远, 永远, 永远, 无一例外地将数据绘制成图, 并研究图中所传达的信息.
- ◆ Russian: Всегда, всегда, всегда, без исключений, стройте графики данных – и анализируйте эти графики.

Now Back to Our Example



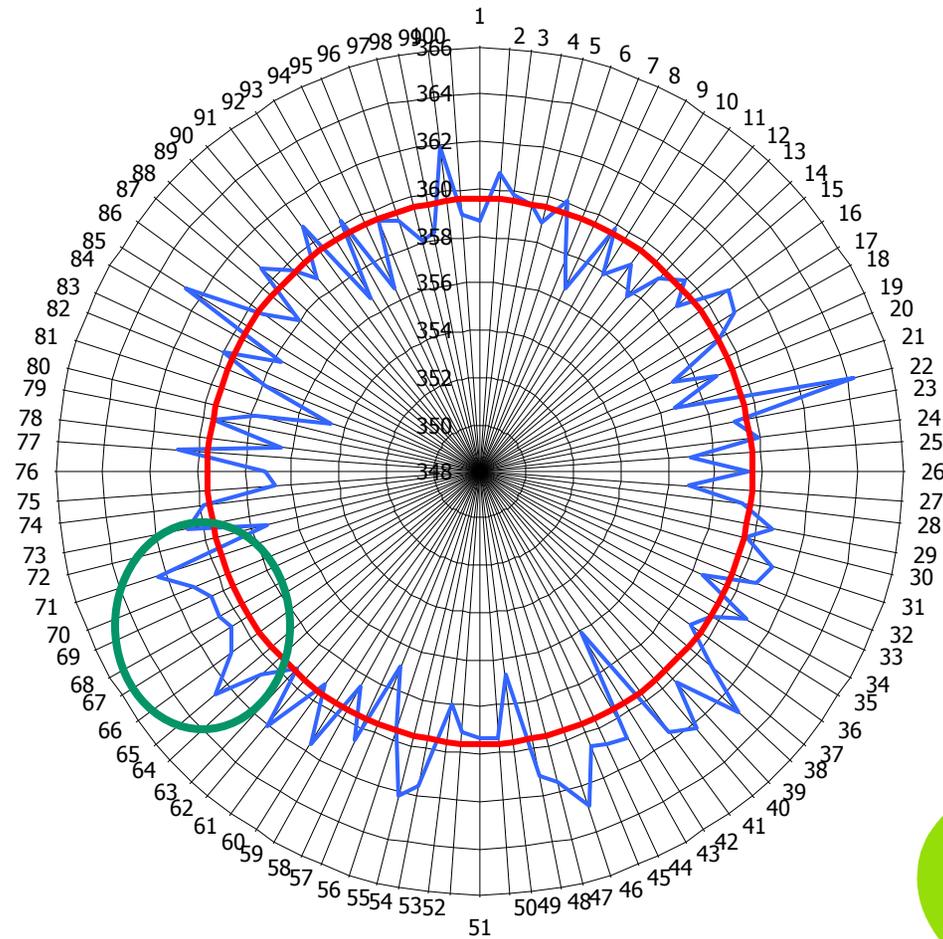
- ◆ Beer filler like this one, only with 100 filler spouts.
- ◆ Giving away too much beer.
- ◆ Sampling plan:
 - Four passes.
 - Measured bottle capacity and net fill volume for each spout, back-to-back.
 - That's 800 bottles of beer. You can't let that go to waste!

Key Findings



Key Findings

Net Contents (ml) by Filler Spout



Conclusions

- ◆ The bottle supplier controls, partially, the net contents.
- ◆ Some filler spouts are more generous than others.
- ◆ Follow-up study is needed.

Holding the Gains

Team Tools

- ◆ Process Maps
- ◆ Quality Function Deployment
- ◆ Affinity Mapping
- ◆ Cause and Effect Matrices
- ◆ Failure Modes and Effects Analyses

Analytical Tools

- ◆ Gage R&R Studies
- ◆ Process Capability Studies
- ◆ Multi-vari Studies
- ◆ Design of Experiments
- ◆ Statistical Process Control
- ◆ Financial Analysis

Management should assure these tools are used productively.

Applications other than beer?

Marketing – Poor Planning

Manufacturing – The Hidden Plant

Research – The Hidden Laboratory

Sales – Missed Opportunities

Supply Chain - Waste

Purchasing – Billing Errors

Finance - Errors

Legal – Duplication of Effort

Human Resources – Wrong Incentives

Quality – Missed Audit Items

Market Research – Wrong Decisions

Etc., etc., etc, ...



Question Dodging

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Thanks!



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