Data Driven Decision Making

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Statistics Division
The Global Voice of Quality™

ASQ's Statistics Division

- Mission
  - Improve understanding of statistical methods
  - More effective data-driven decisions through Statistical Thinking
  - Enhance use of data to improve processes

Discuss Among Yourselves

1. A fence to prevent pinball playing _____
2. A precise offensive move _____
3. Agile wood _____
4. A top-of-the-line prisoner _____
5. Attempting pouting _____
6. Arguing sister _____
7. Amazing jogging _____
8. Beautiful town _____
9. Alphabet cardigan _____
10. Animal watcher _____

Hink Pinks

Statistical Thinking

- The philosophy of **learning** and **action** based on the following fundamental principles:
  - all work occurs in a **system of interconnected processes** - a process being a chain of activities that turns inputs into outputs;
  - **variation**, which gives rise to uncertainty, exists **in all processes**; and
  - understanding and **reducing variation** are keys to **success**.

An approach to improvement

Discuss Among Yourselves

- What's the best way to compare A vs. B?

A	B
2.1	0.3
5.0	1.7
0.1	3.8
45.5	61.2
2.3	12.1
0.6	1.8
9.8	13.6

Importance of context

- Data apart from context is meaningless
- Statistical Process Control charts
  - context?
- Are differences statistically significant?
- Data mining – “find any patterns”, “interesting trends”
- Report
  - State the context
  - “These conclusions are valid under conditions … (detail the test conditions)”

Discuss Among Yourselves

- Measure with a micrometer
- Mark with chalk
- Cut with an axe
- File to fit
- Paint to suit

What's the goal?

- Measure with a micrometer
- Mark with chalk
- Cut with an axe
- File to fit
- Paint to suit

- "a chain of activities that turns inputs into outputs"
- Context

Addressing variation

*understanding and **reducing variation** are keys to **success***

- Method exist, not used much
  - Finance — sensitivity analysis, simulation
  - Measurement — propagation of error
  - Engineering — tolerance stack-up
  - Manufacturing — transmission of variance
- Afraid of the answer?

Significance

- Objective: Statistical Significance
  - Data consistent with the null hypothesis?
- Subjective: Practical Significance
  - Why should we care?

George Box

- It is the data that are real; they actually happened
- All models are wrong; some are useful

Data

Plot it

Plot it in time order

- Take data to take action
- Model the data to guide action
- Only stable processes enable predictions
- What's an unstable process worth?
  - Not much

Lessons Learned on:

SPC Charts
Surveys
Experimental Controls
Proportions and Percentages

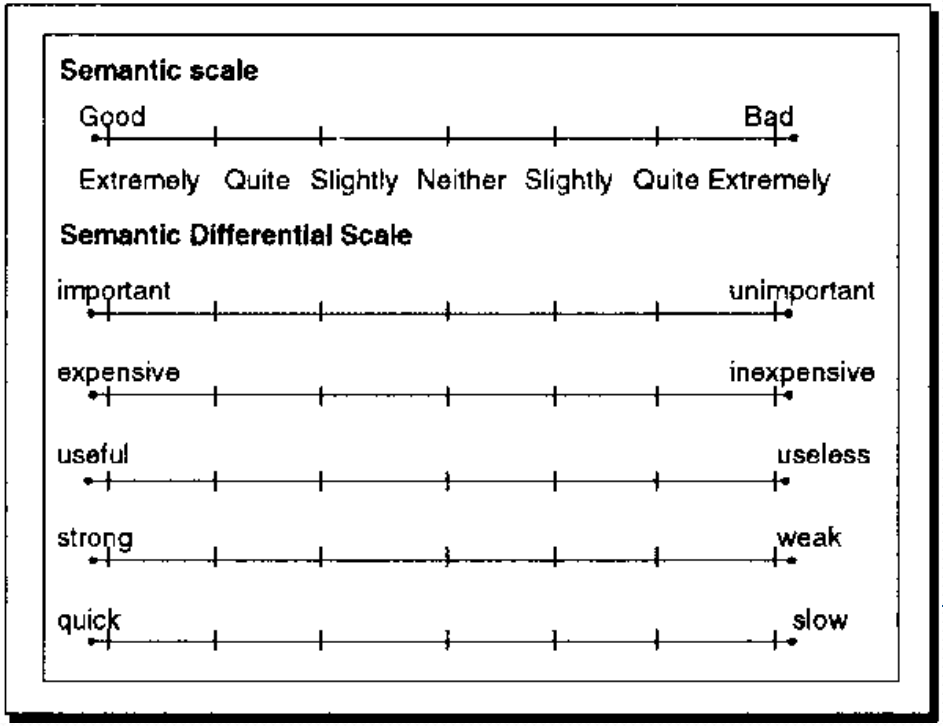
Statistical Process Control charts

- Ideal tool for verifying process stability
- Virtually all instruction and implementation has involved the construction of the charts
- The value lies in the Control
  - Never seen a control plan
  - Never talked to an operator who had a plan

➔ Start with basic run charts

Surveys

- Likert scales
  - Opinions that are quantified
  - Scale is symmetric
  - Use 9-point scales
    - Validated over 30 yrs.
    - Enable ANOVA analysis
      - Check residuals
    - Consolidate sparsely used ratings



Surveys

- Consumer sentiment: 5-point scales are predominant
- "Top 2"
  - 1-number summary
  - % favorable
  - Insensitive and unstable
- Top 1 is more reliable, powerful
- Bottom 2 has uses
  - % unfavorable

Surveys

- Take data to take action
- Thought experiment
  - If scores are above ___ we will do ___
  - If scores are below ___ we will do ___
- Need To Know only
  - Nice To Know -- counterproductive
- Pilot the survey

Proportions and Percentages

- Changes in stock market
  - Start with $100
  - 50% loss one year, 50% gain next
  - Average change = 0 ➔ back to even?
- Be cautious – associative and commutative laws don't apply
  - Not referring to ratios
  - Specific to proportions

Proportions and Percentages

- Take baseline measures
- Compare Current vs. Experimental
- Terms: change from baseline

$$\frac{\text{(Experimental result – baseline)}}{\text{baseline}} \times 100\%$$

- Tempting: don't have to specify customer perception
  - "Target a 10% improvement"

Proportions and Percentages

- High baseline ➔ handicap

$$\frac{(\text{result} - \text{baseline})}{\text{baseline}} \times 100\%$$

- Assumption: results need to be adjusted for baseline
- Test the assumption: add the baseline as a term, perform regression

Controls

- Situation: Idea/Product/Service you want to test
- If testing **conditions** largely out of your control
  - E.g. Field test with willing sites
- Include 4x – 5x as many control sites
- Provide context for Test site results
  - Seasonal?
  - Personnel change?

Controls

- Crossover design
  - alternative to Control sites
  - sometimes more feasible

Control (collect data)

➔ Experimental (collect data)

➔ Control (collect data)

Conclusion

- Hopefully we advanced the Mission
  - Improve **understanding** of statistical methods
  - More effective data-driven decisions through **Statistical Thinking**
  - Enhance use of data to **improve processes**

Thank you