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Common Practitioner Mistakes in Data Analysis

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Outline

1. Define Practitioner
2. Six Sigma Training
3. General Statistics
4. Basic Statistics
5. Regression
6. Quality Tools
7. Design of Experiments
8. Closing Remarks

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1. Practitioners

- Who are they?
  - Anyone who needs to analyze data
  - Not sophisticated
  - Very little formal training in statistics
  - For many it is more about getting the answer

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1. Practitioners

- Who are they?
  - Software is very important
  - Want a handful of tools they can use for any situation
  - Want very clear “rules of thumb”

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2. Six Sigma Training

- Anywhere from 2 to 5 weeks of training
- Approximately 50% of time on statistics
- Many times there is no time to practice
- Many companies do not have a Statistician or MBB

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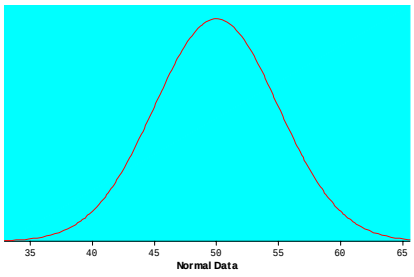
3. General Statistics

Normality

- Data must be normal to do any analysis



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3. General Statistics

- Consultant: “If your data is not normal, find out why it is not normal and fix it.”
- Just a month ago: “If the data is not normal, you cannot do any statistics on it.”
- Most are not aware of other techniques: transformations, nonparametrics

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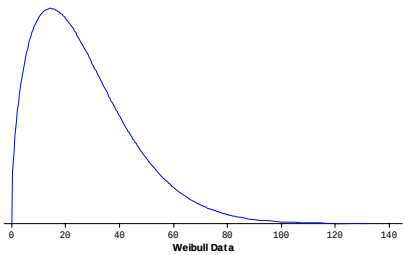
3. General Statistics

- Ignore very skewed distributions with little attention paid to normality
- EX: Capability Analysis



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3. General Statistics

One-sided Specification Limits

- EX: Ceiling tiles fire resistant to at least 20 feet
- Most are around 20 but some are much higher
- Confusing since this causes problems in the analysis---increase variation and forces distribution to be nonnormal

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4. Basic Statistics

Confusing a CI and a PI

- EX. Weights of cereal boxes
- Want to talk about some sort of confidence on individual boxes
- Really thinking about capability

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4. Basic Statistics

Overlapping CIs

- For a Two-Sample t-test or One-Way ANOVA, just do individual CIs on the means and see if they overlap
- The CIs can overlap by as much as 18% and still be significantly different

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4. Basic Statistics

Continuous Versus Categorical

- Take continuous data and make it categorical---many times binary to use simpler tools such as proportions test or chi-square test
- Loss of information and power

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4. Basic Statistics

Continuous Versus Categorical

- Treat categorical data as continuous
- EX: make defect/nondefect into 0/1
  - now it is continuous---right?????

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5. Regression

R^2

- Too much emphasis on R^2
- 1. Should always be above 90%---agricultural, taste testing
- 2. Small R^2 but important predictors
- 3. Predictive Models --- with a large R^2 value but a low R^2 predicted

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5. Regression

Assumptions

- Many people check the data for assumptions instead of the residuals from the model
- Most of the focus is on normality and not constant variance

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6. Quality Tools

Gage R&R

- Using a sample of parts that is not representative of the population of parts
- 1. Pull off the process at relatively the same time-under estimate process variation (gage looks bad)
- 2. Ask JOE for parts (usually scrap laying around)---over estimate process variation (gage looks good)

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6. Quality Tools

Control Charts

- Confusing Specification Limits and Control Limits
- Not taking a large enough base period to get good estimates of the control limits
- Not Fixing the Control Limits once they have a stable process

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7. Design of Experiments

Variation

- Difference between replicates and repeats
- Are they really being taught that they must reset between runs?
- Error based on repeats is small

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7. Design of Experiments

Screening

- Factorial designs are only for screening
- You cannot find the best settings from a factorial design
- You cannot build a model from a factorial design

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7. Design of Experiments

Reducing Models

- Many are taught to reduce the model one term at a time

  --- biasing the error term

- Orthogonal designs

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7. Design of Experiments

Center Points

- Many times they put all of the center points together at the end of the design---repeats
- Copying a design of a popular textbook such as Montgomery
- “Why did I run these center points?”

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7. Design of Experiments

Advanced Tools

- Handling of Covariates in the Analysis
- Binary Response Data---logistic regression
- Hard-to-Change Factors
- Mixture Experiments (with process variables)

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8. Closing Remarks

- Movements such as Six Sigma have brought statistics to the mainstream
- Majority of people using statistics are not Statisticians (as it should be!)
- Very little formal training
- Doing some “wrong” things with statistics versus not even looking at data

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8. Closing Remarks

- Our customers are a pretty good sample of quality professionals, engineers, scientists, financial analysts, Belts of all sorts
- I have shared some of the things I have seen in the last 8 years

THANK YOU!

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