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Malice in Numberland™

An excerpt from the training program titled *Gleaning Facts From Figures™*

Presented by
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Objectives

Provider → Quantitative Information → Consumer

Project Manager as a quantitative-information provider …

- Clear and honest representation of critical project data
- Better able to communicate with your project stakeholders
- More likely to get the attention of senior managers when needed

Project Manager as a quantitative-information consumer ...

- Continually mindful of abuses and misuses of statistics and quantitative charts by those with self-serving interests
- Less susceptible to manipulation by product vendors, SIGs, etc.
- Able to spot common data manipulation tactics

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7 things PMs could do a better job at …

1. Describing project data in user-friendly frames and formats
2. Ensuring their project data answer the Big-3 Questions
3. Using a blend of qualitative and quantitative analysis tools
4. Ensuring risk models are credible but not oversold
5. Improving the data-to-ink ratio of their project data charts
6. Providing requirements-definition guidance to clients
7. Performing OoM estimates and BotEC “sanity” checks

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When Rocket Science Isn’t Rocket Science

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Lessons Learned from Challenger

- Reliability and risk factors are often based on subjective factors and biased by wishful thinking or over-optimism
- Quantifiable data are subject to political influence
- It's often more difficult (and risky) to prove something won't work on the assumption it will, than to prove it will on the assumption it won't
- Even when you have good data, it's of little value if you don't get your point across

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Non-Specific Quantities

Common Phrase	Absolute Value or Range
A couple	_____ to _____
A few	_____ to _____
Several	_____ to _____
Half a dozen	_____ to _____
A few hundred	_____ to _____
A couple of hundred	_____ to _____
Most (percent)	_____% to _____%
A vast majority (percent)	_____% to _____%
All/everyone (percent)	_____% to _____%
Absolutely all/everyone (percent)	_____% to _____%

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So, What's the Big Deal?

- Statistics have a superficial air of legitimacy that's often exploited
- A sound bite society – such as ours – is too impatient to bother with details underlying statistical "facts" … *"Just give me the bottom line!"*
- Statistics are difficult to challenge or refute in "real time"
- The validity of data may be questioned, but the motivations of the source-provider and the relevance of statistical methods often aren't
- Many journalists aren't math-savvy … are less scrupulous about statistical accuracy than grammatical accuracy
- Producers of statistical data often don't frame their insights in terms and mental models that appeal to less math-inclined colleagues

Upshot: Critical decisions are often predicated on bad data

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The Iceberg Analogy of Data

What You See

- What's presented
- Stated source of the data
- "Guided" interpretation of the results
- Summary statistics

What You Don't See

- What was left out or downplayed
- Hidden motivations or reservations
- Whether bias influenced how the data were collected – intentional or not
- How "outliers" were treated
- The original data

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Avoiding Type III Errors … The Big 3 Questions

1. **What question is this statistic or statistical chart trying to answer?**
2. **Does it answer the question?**
3. **And most important of all, does it …**

_____?

- Examples -

- A design specification expressed as a quantitative value
- Corrective action based on project performance data
- A vendor's fact-sheet filled with statistics and graphs
- (fill in the blank)_____

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Short List of Crimes & Misdemeanors

Numbers and Statistics

- Index abuse
- Flaw of averages
- Relative percentages
- Faux precision

Statistical Charts

- Scale manipulation
- Optical illusions

Logical Errors

- The awe factor
- Logical leaps
- Misappropriation of manufacturing math
- Better-than-nothing error
- Lord Kelvin fallacy
- Type III errors

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Numbers and Statistics

Index Abuse

- Overextended use of a single index to draw conclusions or make inferences about a complex system, process, or project
- Examples:
  - GDP doesn't account for the "underground economy"
  - SPI doesn't account for in-scope project requirement changes
- Key Point: Information is lost anytime variables are consolidated into a single index

Flaw of Averages

- 1) Failure to consider the range of values that go into computing an average and 2) Averaging or adding values that shouldn't be
- Examples:
  - Relying on a single value to represent the duration of the critical path
  - Averaging percentage values to get an "overall average percent"
- Key Point: Don't fall prey to the "just give me a number" syndrome

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Numbers and Statistics

Relative Percentages

- Expressing change as a percent of a percent
- Examples:
  - Using RP values to exaggerate small changes in absolute values
  - A schedule overrun of 4% last month and 3% this month represents a *relative* 25% decrease but an *absolute* 1% decrease
- Key Point: Understand the reference point anytime percentages are used

Faux Precision

- Using a greater number of significant digits to represent a value than can be justified by the precision, accuracy, or certainty of the metric
- Examples:
  - Calculating earned value to six decimal places
  - Dividing a "round number" into fractions that have more significant digits than the original number
- Key Point: Faux precision is often used as a persuasion tactic

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Logical Errors in a Nutshell

The Awe Factor
Tendency to accept the validity of numbers at face value

Logical Leaps
Overextending the use of statistics to justify an action or decision

Misappropriation of Manufacturing Math
Applying the math that describes the variability of machines to humans and human supported processes – i.e., variance error

Better-Than-Nothing Error
Claims asserting a greater than 100% improvement

Lord Kelvin Fallacy
Belief that data must be quantifiable to be of any value

Type III Errors
Solving the wrong problem precisely; also mistaking means for ends

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Compelling Statistics

An astounding 84% of all major software development projects are either abandoned during development or are functionally obsolete by the time they are delivered.

On average, a mere 36 minutes of a software developer's day is actually spent working on software projects.

What do these numbers say about …

Software Development? _____

Software PMs? _____

Reforms needed? _____

Note: These are bogus "facts" intended to make a point about the power of uncontested statistics.

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Division-Precision

2008 Bond Proposal

Pre-funded Projects	$	27,850,000
New Construction	$	140,855,112
20-Year Renovations	$	121,166,629
Additions and Modifications	$	62,182,369
Capital Improvements (Instructional)	$	10,497,000
Capital Improvements (Physical)	$	25,203,500
Systems and Compliance (47 sites)	$	36,154,394
Curriculum & Technology	$	66,090,996

Does the precision of these numbers suggest meticulous analysis?

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Better than Nothing! … How'd They Do That?

Excerpt from a 1999 article touting the success of self-managed work teams.

Hallmark * 200 percent reduction in design time

Excerpt from a US DOT Federal Highway Admin. Report, March 29, 2007.

On SC 14 in Greenville, all 9 recommendations were implemented with a 150 percent reduction in fatalities and cost savings of $3.66 million.

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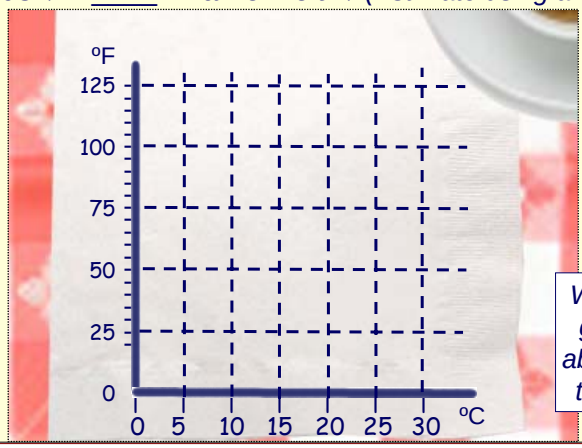
Using BotEC for Rapid Reality-Checking

"Experts estimate that global temperatures could rise as much as 5.8 Celsius (42.5 degrees Fahrenheit) this century."

— Times of India website, February 2001

6 º Celsius ↑ = ____ º Fahrenheit ↑ *(Estimate using a Napkin Graph)*



Equivalencies

0 ºC = 32 ºF

25 ºC = 77 ºF

What does your graph suggest about the error in the statement?

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Avoid the Linearity Trap

Linearity Trap … attempting to add values that are not additive, such as percentages, standard deviations, ratios, and certain indices

Example 1: A certain chain bookstore issued a discount coupon to its "Members" who currently receive a 10% discount on all purchases. The coupon read as follows:

**"You'll get 15% off any item of your choice,
on top of your everyday 10% Member discount."**

The implied 25% discount is actually a ____% discount in absolute terms.

Example 2: If four project team members each have 20 years of experience, it's misleading to say the team has 80 years of experience

Example 3: If the SPI values for 3 projects in a portfolio are 1.2, 1.1, and 0.9, it's misleading to assert that the average of the three is 1.07

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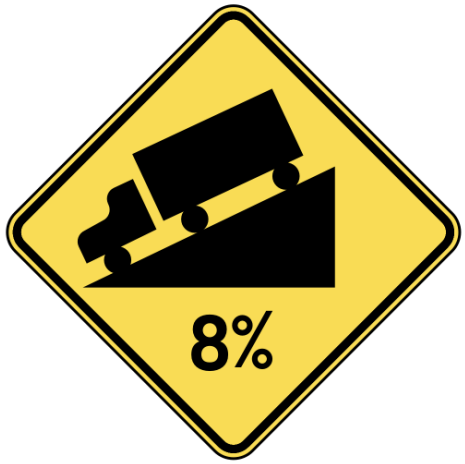
The Elusive Reference Point



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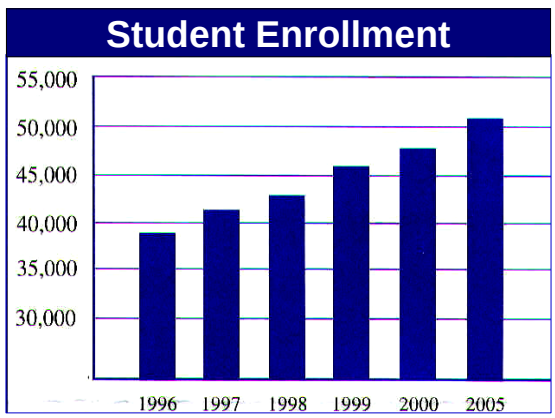
What question is this chart attempting to answer?



(Sept. 2000, Voter Information Newsletter)

Does it answer the question?

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How Decision Makers Make Decisions

Normative Approach

Predicated on the theory that *rational* decisions are based on maximizing "expected value," where EV = Probability x Payoff

- Assumes all, or the most relevant, alternatives can be identified
- Assumes probabilities and payoffs can be objectively assessed

Descriptive Approach

Predicated on the fact that decision makers typically base their decisions on both subjective and objective factors

- Recognizes that time constraints prohibit exhaustive analysis of options
- Recognizes that probability and payoff are often *valued* non-linearly

What do differences in these approaches suggest WRT the way PMs might best communicate quantitative information to senior executives?

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Avoiding Type III Errors … The Big 3 Questions

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2. **Does it answer the question?**
3. **And most important of all, does it …**

_____?

"It often occurs that the major contribution of the operations research worker is to decide what is the real problem."

—Philip Morse (1903-1985)
Princeton physics professor and "Father of Operations Research"

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Summary Suggestions for Stat Users and Providers

When you are a statistical data user …

- Don't take a number or statistic at face value … practice subjecting statistical data to "The Big Critical-3 Questions"
- Be wise to the ways in which numbers, graphs, surveys, etc. can be manipulated … intentionally or naively
- Keep in mind that no statistical technique can glean facts from data that's predicated on faulty assumptions or premises
- Practice using BotEC to test the validity of *astonishing* statistics

When you are a statistical data provider …

- Explicitly state what conclusions can't be drawn from the data
- Don't imply that correlation is tantamount to causation
- Avoid "percentage abuse" and misleading averages
- Avoid graphical deception … apply standards and best practices
- Use statistics to support your case … not make it

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Recommended Reading

SPC for Right-Brain Thinkers, Lon Roberts, Quality Press, 2005

The Sum of Our Discontent: Why Numbers Make Us Irrational, David Boyle, TEXERE Pub., 2001

The Visual Display of Quantitative Information, Edward R. Tufte, Graphics Press, 2001

How To Lie With Statistics, Darrell Huff, W.W. Norton & Company, 1993

Stat-Spotting: A Field Guide to Identifying Dubious Data, Joel Best, 2008

The Flaw of Averages, Sam L. Savage, John Wiley & Sons, 2009

Dirty Rotten Strategies, Ian I. Mitroff & Abraham Silvers, Stanford University Press, 2010

Training Courses

- Gleaning Facts From Figures
- Gleaning Facts From Figures II
- SPC Workshop for Users
- Quantitative Tools for Project Managers
- Analytical Skills for Admin. Professionals

See descriptions at
www.R2assoc.com/Trainp.htm

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