



Optimizing Optimism in Systems Engineers

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and Its Applications to Systems Engineering*

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Roadmap



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Institute of
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- Optimism
 - Versus pessimism
 - Happiness
 - Benefits and origins
- Observing optimism
- Quantifying optimism
- Optimism across professions
- Survey results
- Downsides of optimism
- Calibration strategies



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Optimism

Motivating question:

How can something that is so good for you be so bad?

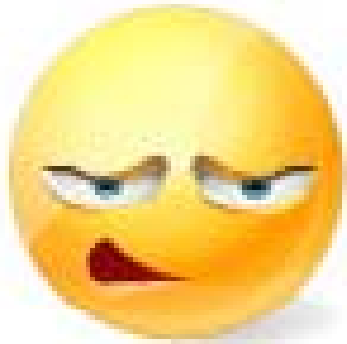
The notion of a **double-edged sword** represents **favorable** and **unfavorable** consequences of pessimism and optimism.



Definitions

Pessimism

- Realistic in terms of short and long-term goals
- Low expectations, low motivation
- Permanent, pervasive interpretation



Optimism

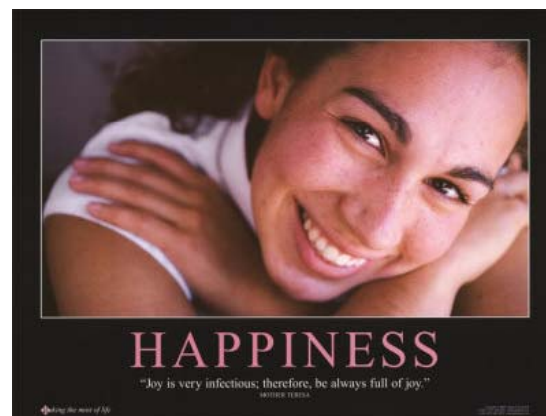
- Unrealistic about short-term goals, but realistic about long-term goals
- High expectations, high motivation
- Temporary, specific interpretation



(Seligman 2006)

Happiness Surrounds Us

- Golden mean: balance of two extremes defined by excess and deficiency (Aristotle 1974)
- Zen: wisdom, virtue (Gaskins 1999)
- Life, liberty, and the pursuit of happiness (U.S. Declaration of Independence 1776 & Constitution of Japan 1947)
- Optimist international: Friend of youth (1911)
- Happiness curve: obtained by eating fast food



Indirect Benefits

- Pessimistic people
 - Have poor health in middle and late adulthood (Peterson, et al 1998)
- Optimistic people
 - Live longer (Danner, et al 2001)
 - Have improved mental & physical health (Bower 2007)
 - Are more creative, productive (Estrada, et al 1994)
 - Perform better on cognitive tasks (Isen 1987)
 - Have higher odds of marriage, lower odds of divorce (Harker & Keltner 2001)
 - Are seen as competent, entrepreneurial (Russo & Schoemaker 1992)
 - Are not necessarily wealthier (Myers & Diener 1995)

Empirically-Based Origins



Sources of pessimism

- Set point (heritability)
 - Braungart, et al 2002
- Personality traits
 - Costa, et al 1987
- Hedonic treadmill
 - Brickman, et al 1978

Sources of optimism

- Interventions
 - Seligman, et al 2005
- Motivational & attitudinal factors
 - Lyubomirsky, et al 2005
- Age
 - Charles, et al 2001
- Intentional activity
 - Emmons & McCullough 2003

Presence of Optimism



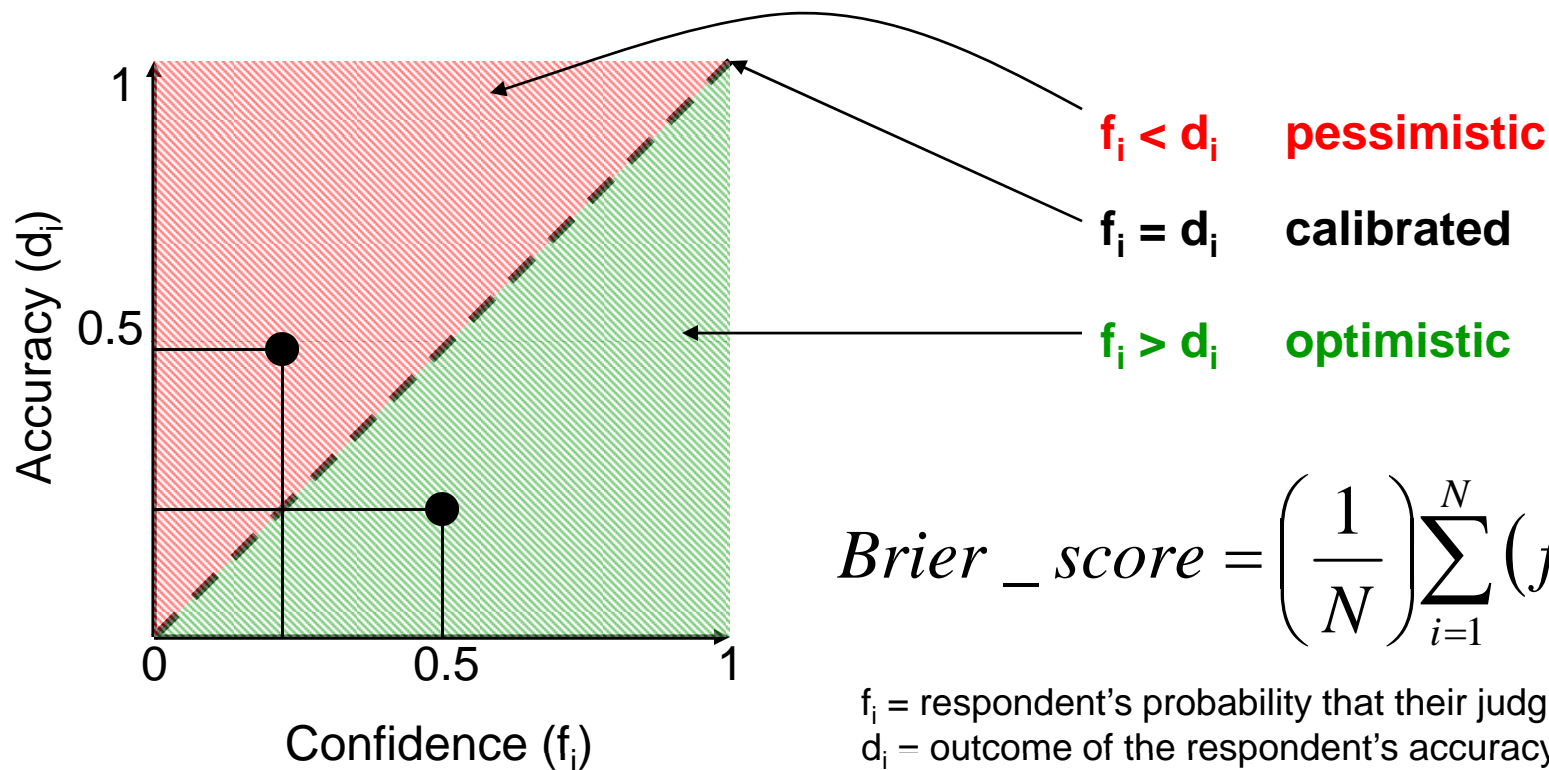
People are generally optimistic about:

- Length of future tasks (Roy, et al 2005)
- Their personal abilities (Russo & Schoemaker 1992)
- Their knowledge about history (Hubbard 2007)
- Completing their thesis (Buehler, et al 1994)
- Their favorite sports team (Babad 1987)
- Their sense of humor (Matlin 2006)

“For a man to achieve all that is demanded of him he must regard himself as greater than he is.”

Johann Wolfgang von Goethe (1749-1832)

Quantifying Optimism Bias



$$Brier_score = \left(\frac{1}{N} \right) \sum_{i=1}^N (f_i - d_i)^2$$

f_i = respondent's probability that their judgment is correct

d_i = outcome of the respondent's accuracy

N = total number of judgments

Where

f_i is a subjective probability

d_i is an objective (empirical) probability

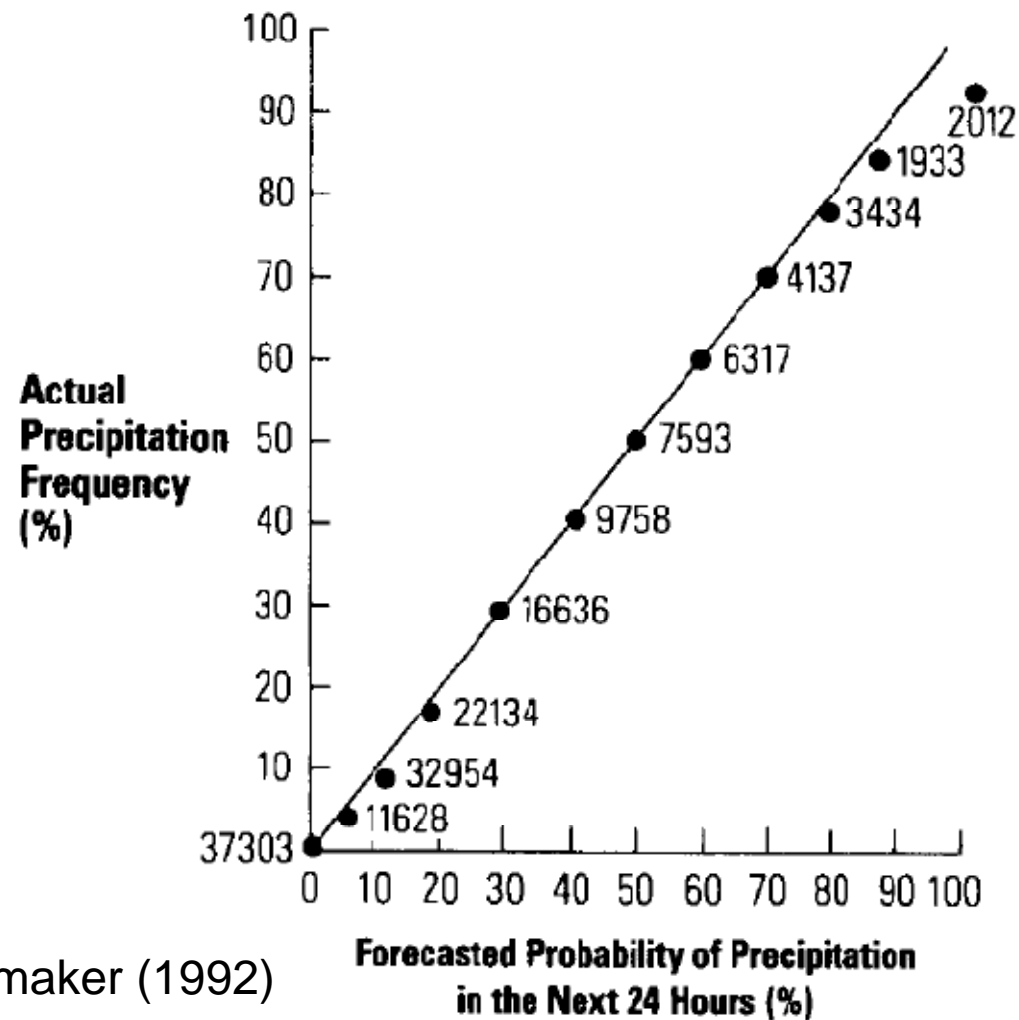
(Brier 1950)

Calibrated Professions



- Well calibrated professions:
 - Bookies, meteorologists, accountants, loan officers
 - Immediate feedback, a direct relationship to their professional success, no overreaction to extreme events
- Poorly calibrated professions:
 - Strategic planners, doctors, psychologists, systems engineers
 - No incentive mechanisms in place

Figure 2 U.S. Weather Service Forecasting Accuracy



Russo & Schoemaker (1992)

Optimism in Systems Engineers – a Survey

Confidence Interval Questions

Please provide a “lower bound” and an “upper bound” answer for each question based on your 90% confidence level.

#	Question	Confidence Interval	
		Lower Bound	Upper Bound
1	In 1938 a British steam locomotive set a new speed record by going how fast (mph)?		
2	In what year did Sir Isaac Newton publish the universal laws of Gravitation?		

Binary Questions

Please provide a “True” or “False” response to each question and your corresponding level of confidence in your answer on a range between 50% and 100%.

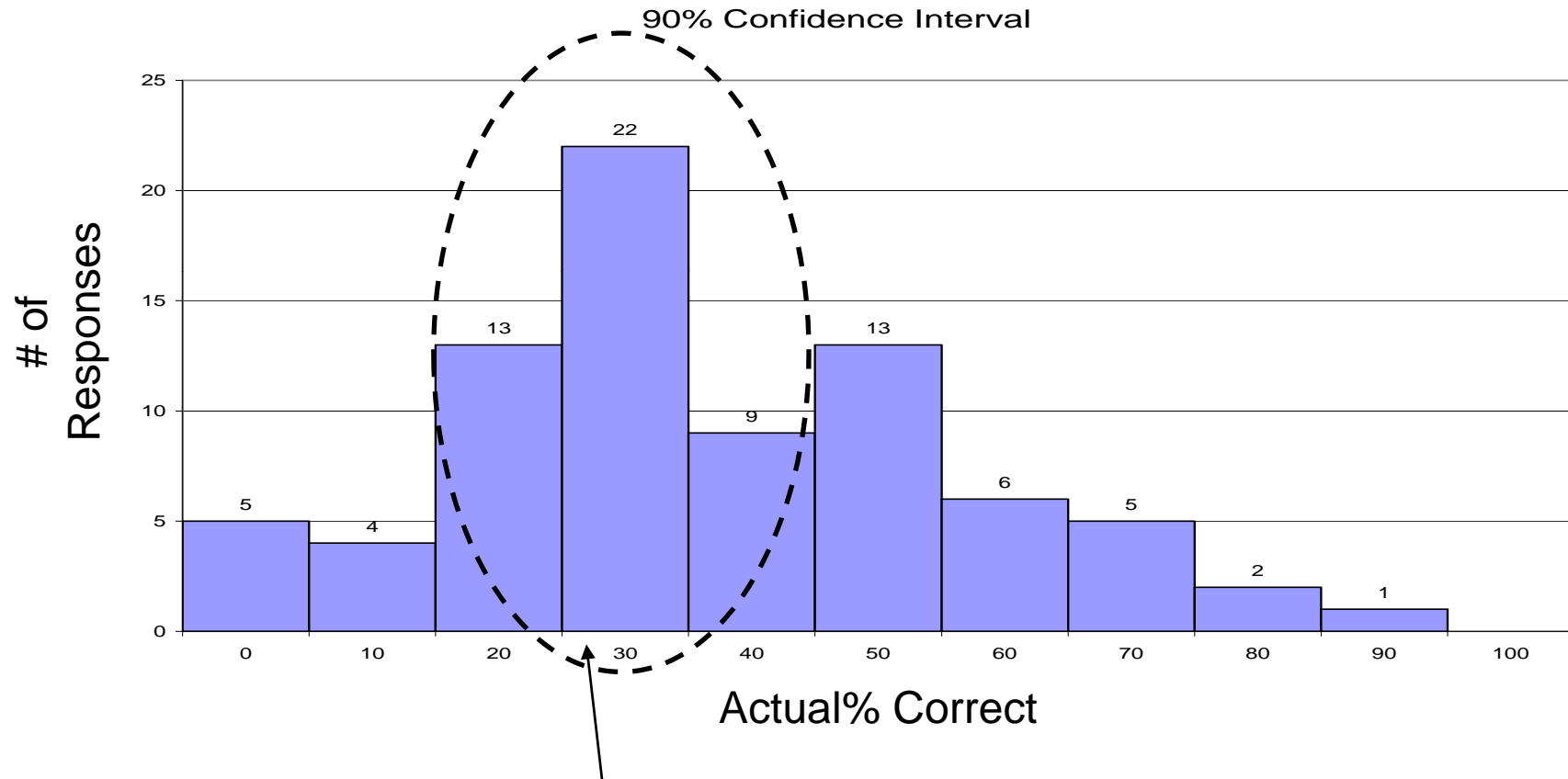
#	Statement	Confidence Interval	
		Answer (T/F)	Confidence (50-100%)
1	The ancient Romans were conquered by the ancient Greeks.		
2	“M” is one of the three most commonly used letters.		

N=80, INCOSE 2008 Symposium Attendees, Utrecht

Answers

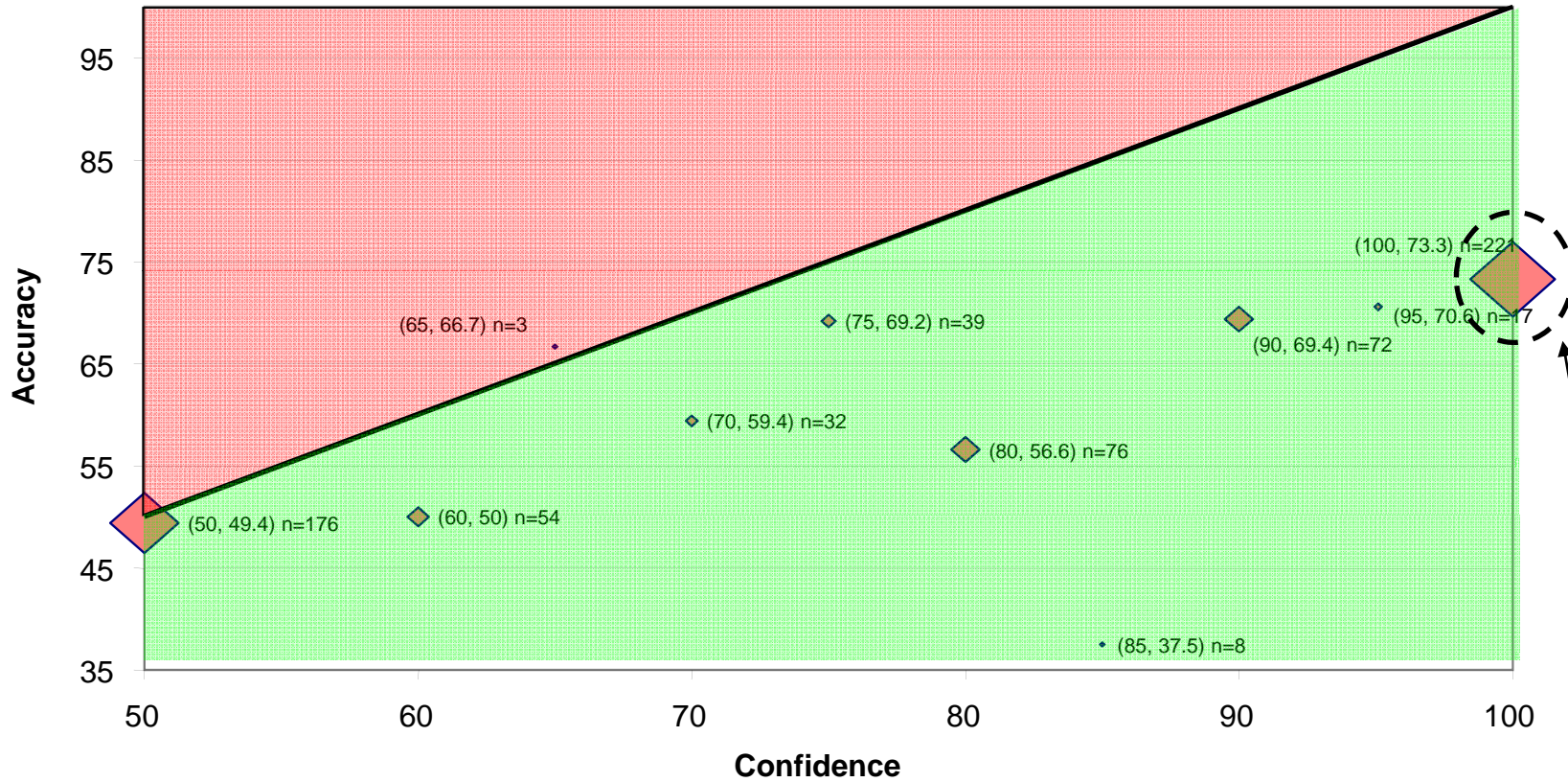
- | | |
|--|---------|
| 1. Countries with McDonald's | 120 |
| 2. Minuteman Missile range (mi) | 5,000 |
| 3. Stop in the name of love (m:s) | 2:52 |
| 4. 50 ft up, airborne time? (s) | 3.525 |
| 5. # of England rulers in last 1,000 yrs | 47 |
| 6. % of testing software | 25 |
| 7. Sears height (m) | 443 |
| 8. Cars & trucks MPG | 19.8 |
| 9. Avg. home price in '01 | 179,500 |
| 10. Avg. actual software project length | 33 |

Confidence Interval Results



Over $\frac{1}{2}$ the population was 20-40% accurate
when they asked to give their 90% confidence answer

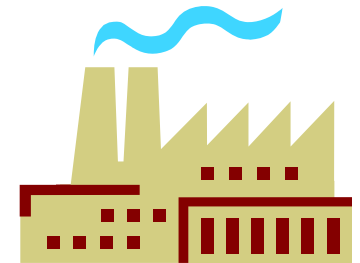
Binary Results



Of 221 occurrences, when SEs said to be 100% confident in an answer, they were right only 73.3% of the time!

Downsides of Optimism

- If projected demand ranges are too narrow, a factory will be unable to meet fluctuating demand
- If the outlook on the real estate market is not conservative enough, a drop in home values lead to mortgage crisis
- If investments in drilling oil & gas are too confident, dry-wells will lead to lost investments



*Optimists are seen as detached from reality
“half of the glass is 100% full” (Ben-Shahar 2008)
Pollyanna principle (Matlin & Stang 1978)*

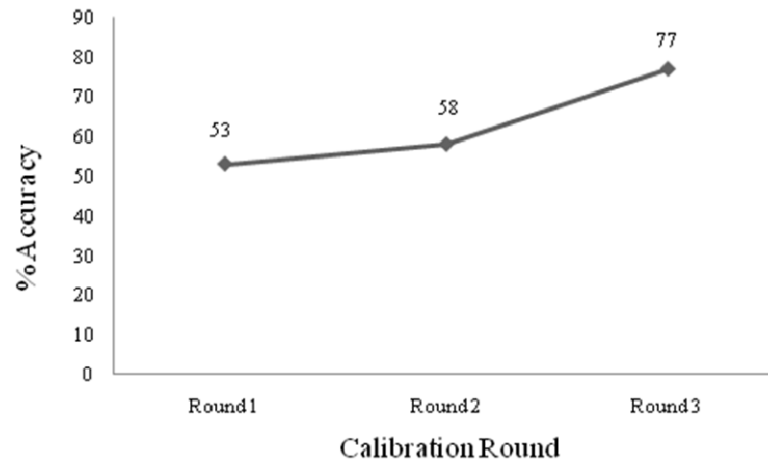
Inspired by Russo & Schoemaker (1992)

Optimizing Optimism



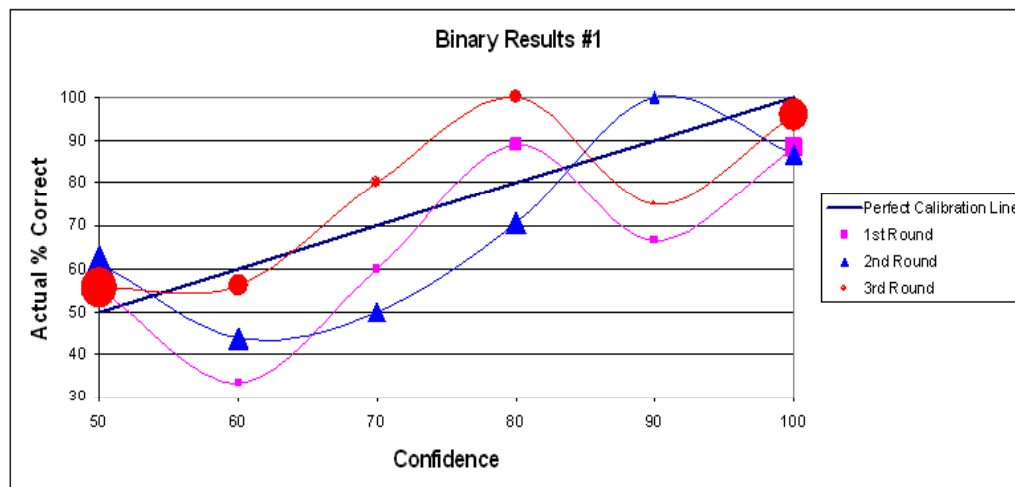
- Calibrate experts (Brier 1950)
 - Well-calibrated: Bookies, weather reporters, accountants, and loan officers
 - Poorly-calibrated: Physicians, psychologists, strategists, systems engineers
- Seek clear and immediate feedback (Bukszar 2003)
- Avoid false optimism (Maslow 1971)
- Use optimism as an interpretation style, not a naïve outlook on life (Ben-Shahar 2008)
- Balance confidence with realism (Russo & Schoemaker 1992)
- Use observers (Koehler & Harvey 1997)
- Bet money, or pretend to bet money (Bukszar 2003)

Optimism Calibration – a Trial Experiment



By round 3, 4 of 5 students were between 80 and 90% accurate in their estimates

Round 3 exhibited the least variance between the results & the perfect calibration line



Hypothesis: Immediate feedback will improve future estimation accuracy

Result: Despite variance, increasing calibration is seen as a positive sign for future studies

Conclusions

- Calibration exercises can be used to calibrate systems engineers and other poorly calibrated professions
- Experience does not necessarily matter in terms of becoming a more accurate estimator – calibration exercises are an adequate substitute for experience (time & resources can be saved)
 - But not everyone is trainable
- Better calibrated people don't have better information or possess superior guessing skills, they are more in tune with their cognitive abilities and more realistic about their judgments – a skill that requires an understanding of the connection between subjective probabilities and objective outcomes
- Next Steps: develop a formal methodology & guide for systems engineering estimation calibration; INCOSE Tutorial

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