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# Forecast Value Added Analysis

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# About SAS



- World's largest private software company
  - \$2.43 billion revenue in 2010
  - 50,000 customer sites / offices in 56 countries
  - Leader in advanced analytics software
    - 35.2% market share (per IDC) – more than double its nearest competitor



*Ranked #1 in Fortune's 100 Best Companies to Work For the past two years. Find more at [www.sas.com](http://www.sas.com).*

# Agenda

- Why Are Forecasts So Wrong?
- Worst Practices in Business Forecasting
- Forecast Value Added Analysis
  - Case Studies

# Forecasting Contest

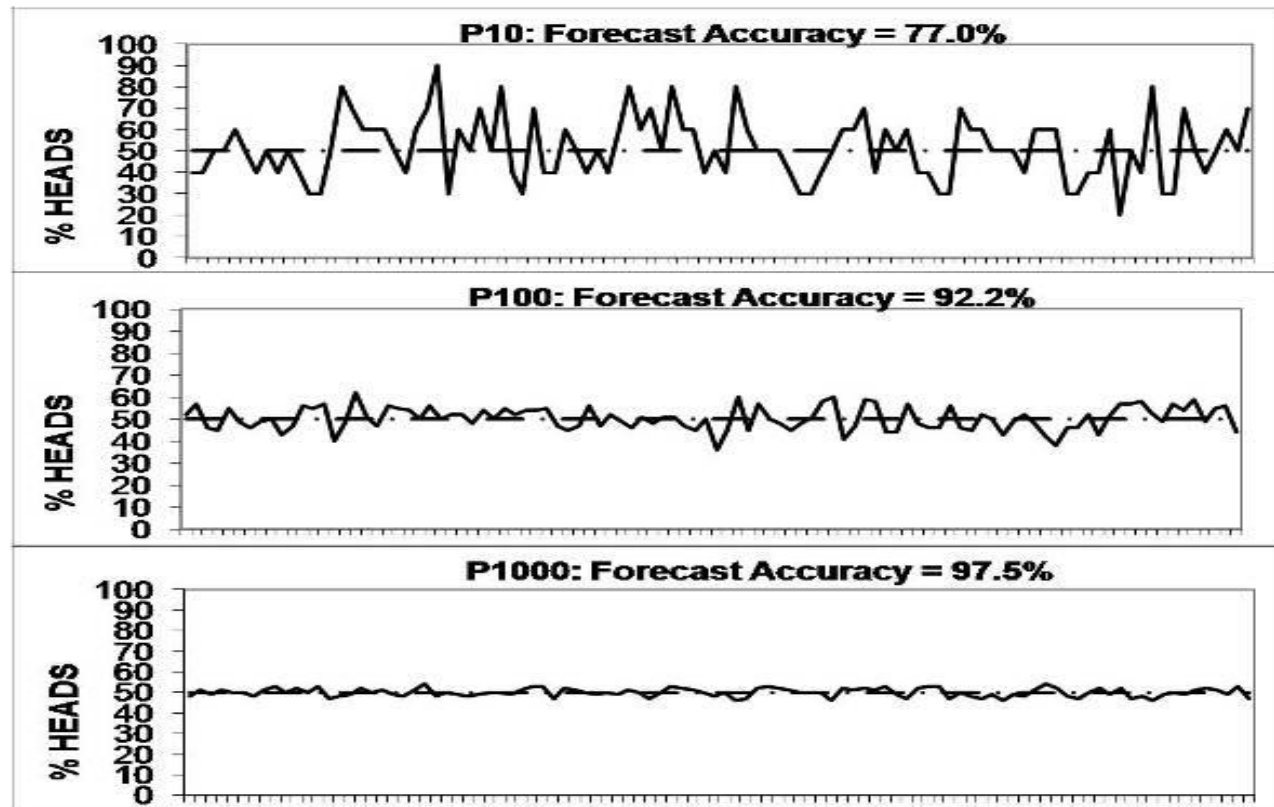
P10: % Heads in the tossing of 10 fair coins

P100: % Heads in the tossing of 100 fair coins

P1000: % Heads in the tossing of 1000 fair coins

- What is the only rational forecast for each process?
- Which process can we forecast most accurately, and why?

# Forecasting Contest



*The nature of the behavior – the degree of randomness – has determined the level of accuracy we will achieve*

# Why Are Forecasts So Wrong?

# Why Are Forecasts So Wrong?

- **Inadequate / unsound / misused software**
  - Lacks necessary capabilities
  - Mathematical errors
  - Inappropriate methods
  - Sound but misused
- Unskilled / inexperienced forecasters
- Contaminated / politicized / overly elaborate forecasting process
- Unforecastable demand

# Why Are Forecasts So Wrong?

- Inadequate / unsound / misused software
- **Unskilled / inexperienced forecasters**
  - Use inappropriate models
  - Over-adjustment (Deming's "fiddling")
  - Research on adjustments
- Contaminated / politicized / overly elaborate forecasting process
- Unforecastable demand

# Why Are Forecasts So Wrong?

- Inadequate / unsound / misused software
- Unskilled / inexperienced forecasters
- **Contaminated / politicized / overly elaborate forecasting process**
  - Should be objective, scientific, dispassionate
  - What management wants (should be “unbiased best guess”)
  - Ignores voice of the marketplace
  - Too many “touch points”
- Unforecastable demand

# Why Are Forecasts So Wrong?

- Inadequate / unsound / misused software
- Unskilled / inexperienced forecasters
- Contaminated / politicized / overly elaborate forecasting process
- **Unforecastable demand**
  - Not forecastable to accuracy desired
  - Nature of the behavior determines limit on accuracy of forecast (e.g. coin tossing)

# Worst Practices in Business Forecasting

# Inappropriate Accuracy Expectations

- Despite promises from vendors, there is no magic formula to assure accurate forecasts
  - (Banish “accurate” from forecasting conversation?)
- Accuracy is determined more by the nature of behavior you are forecasting (smooth & stable vs. wild & erratic) than by the method
- Sophisticated methods don't help with unforecastable demand

**Squandering organizational resources pursuing unachievable levels of forecast accuracy**

# Better Practice: Utilize Naïve Forecast

The “naïve forecast” sets the baseline against which all other methods are evaluated

- Random Walk – using last known actual as your forecast
- Seasonal Random Walk – using actual from prior year as your forecast

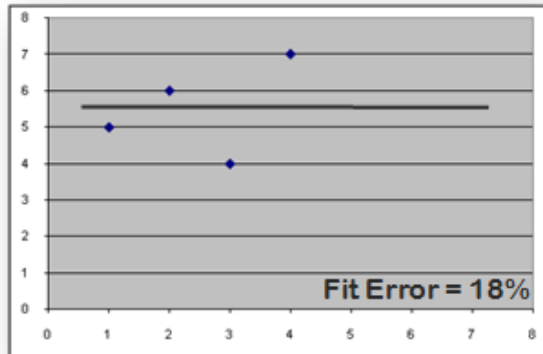
Something “free” – no elaborate system or process

**If your naïve model achieves X% forecast accuracy, then you should expect your forecast process to do at least that well**

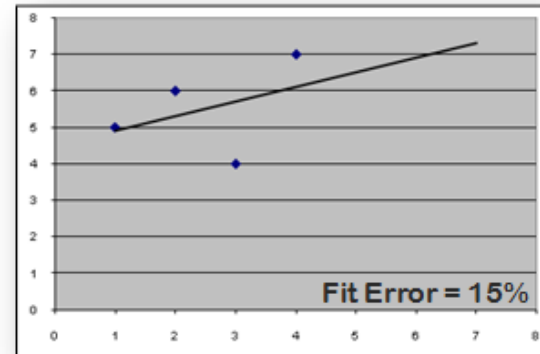
**If your process does worse, something is terribly wrong!!!**

# Selecting Model Solely by Historical Fit

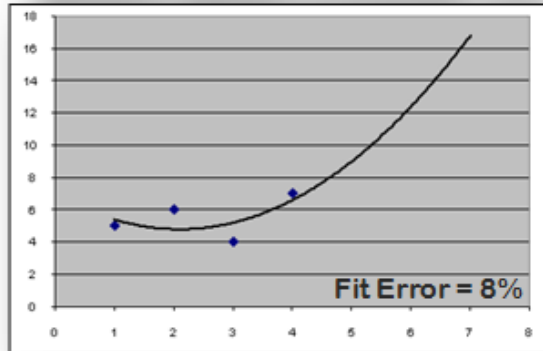
- Based on 4 weeks of data, what is forecast for week 7?



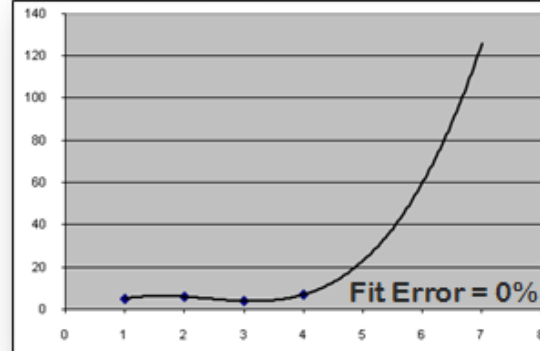
**Model 1: Week 7 Forecast = 5.5**



**Model 2: Week 7 Forecast = 7.2**



**Model 3: Week 7 Forecast = 16.5**



**Model 4: Week 7 Forecast = 125**

**Confusing 'Fit to History' with 'Appropriateness for Forecasting'**

# Assuming Model Fit = Forecast Accuracy

- Just noted the worst practice of selecting model based solely on fit to history
- Forecast accuracy will almost always be worse – and often much much worse – than the fit of the model to history
- A “dirty trick of selling” is to only show you the fit to history (and never show you the accuracy of the forecasts)

**If someone tells you they have a model with great fit to history, tell them: “So what – you haven’t proven anything yet!”**

# Inappropriate Performance Objectives

- When you assign unachievable goals (e.g. call coin toss 60%), people either give up or cheat
- Forecasting performance goals must be based on what accuracy is reasonable to expect given the nature of the demand patterns
  - Baseline for this is the naïve model
- Goals should not be based on:
  - What accuracy is “needed”
  - Industry benchmarks

# The Perils of Industry Benchmarks

- Forecasting performance benchmarks available from several sources
- Can you trust them?
  - Survey responses or audited data?
- Is measurement consistent across respondents?
  - Using the same formula, same time bucket, same granularity
- Is the comparison relevant?
  - **Is demand equally forecastable?**

# The Perils of Industry Benchmarks

## Worst case example:

- Benchmark study shows Company X has lowest forecast error
- Consultants and academics converge on Company X to study its forecasting process and publish reports on forecasting “best practices”
- Other companies begin to copy X’s “best practices”

## Upon further review...

- FVA analysis reveals that Company X had easy to forecast demand and would have had lower error had they used a moving average

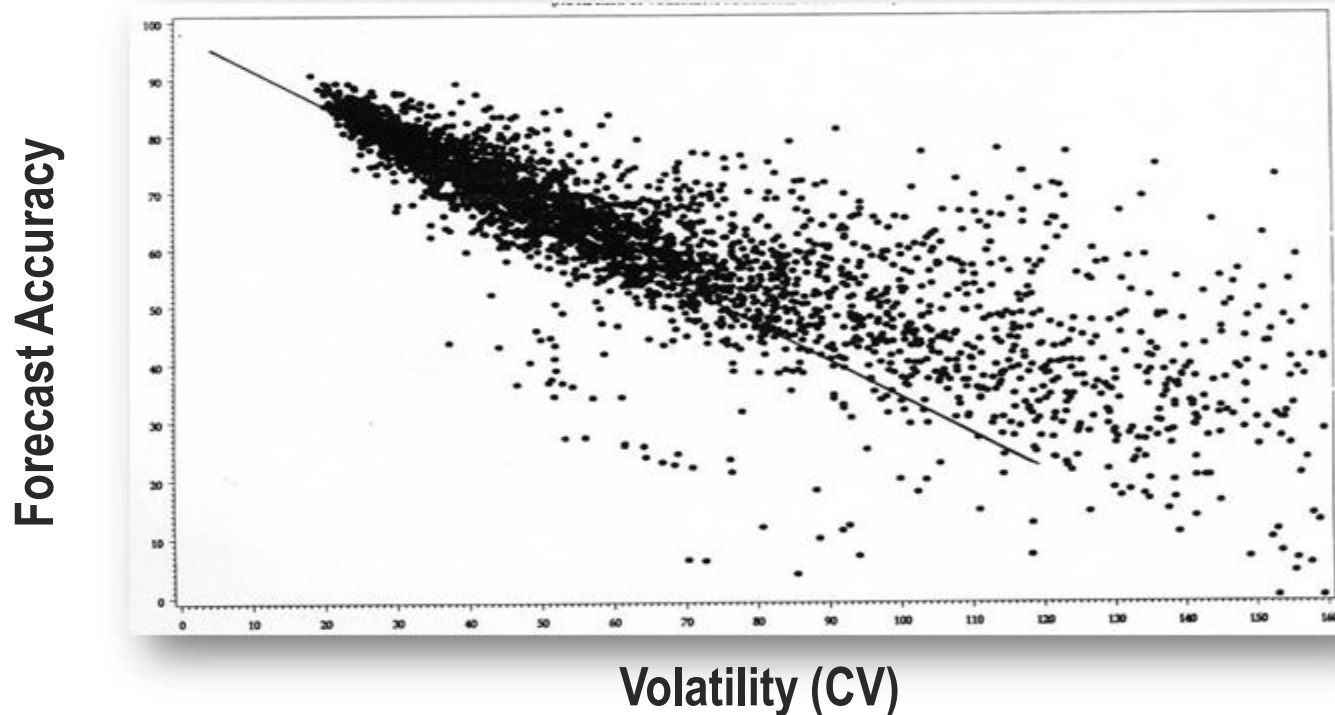
**Company X’s “best practices” made the forecast worse!**

# Better Practice: Beat the Naïve Forecast

- Ignore industry benchmarks – companies at top probably have easiest to forecast demand
- Do not set arbitrary forecast accuracy objectives
  - E.g. “MAPE < 20%” – consider forecastability instead
- The only reasonable forecasting performance objective is to beat the naïve forecast (or at least do no worse!) and to continuously improve the process

**Focus on process automation and efficiency; and  
the elimination of process waste**

# Adding Variation to Demand



**Forecastability of demand is largely dependent on the volatility of demand**

**The surest way to get better forecasts is to make the demand forecastable**

# Forecast Value Added Analysis

# What is Forecast Value Added?

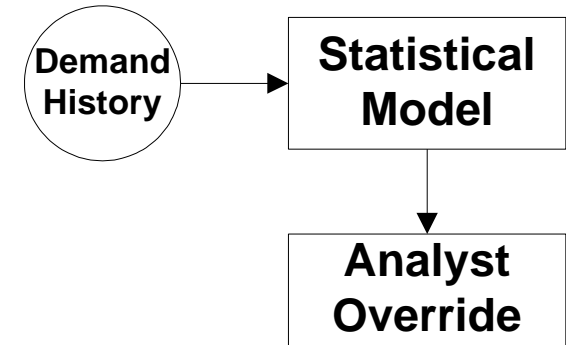
- Forecast Value Added is defined as

*The change in a forecasting performance metric (such as MAPE, Accuracy, or Bias) that can be attributed to a particular step or participant in the forecasting process*

- FVA is measured by comparing the results of a process activity to the results you would have achieved without doing the activity
- FVA can be positive or negative

# What is FVA Analysis?

- Data required (simple forecasting process):
  - Statistical model forecast
  - Analyst adjusted forecast
  - Actual
- FVA Analysis compares the accuracy of the statistical forecast (generated by forecasting software) to the accuracy of the analyst's manually adjusted forecast
- FVA Analysis also compares both to a “naïve” forecast



# FVA Analysis: The Naïve Forecast

- FVA Analysis is based on simple scientific method
  - For example, evaluate drug performance by comparing to a control group (receiving a placebo)
  
- A naïve forecast serves as the placebo in evaluating forecasting process performance
  - Something simple to compute, requiring the minimum amount of effort and manipulation to prepare a forecast
    - Random Walk (using last known actual)
    - Seasonal Random Walk (using year ago actual)
    - Moving Average

# FVA Analysis: Comparing to Naïve Forecast

- The most fundamental FVA analysis is to compare results of your forecasting process to the results you would have achieved by just using a naïve forecast
  - If you are doing better than a naïve forecast, your process is “adding value”
  - If you are doing worse than a naïve forecast, then you are simply wasting time and resources

Process Step	MAPE	FVA vs. Naive	FVA vs. Stat
Naive	30%	.	.
Statistical	20%	10%	.
Override	25%	5%	-5%

# Why Use FVA Analysis: Eliminate Waste

- FVA Analysis is used to identify and eliminate non-value adding activities
  - Streamline the process by eliminating wasted efforts
  - Direct resources to more productive activities
  - Potentially achieve better forecasts

*By eliminating those activities that are making the forecast worse, you get better forecasts for free!*

# Why Use FVA Analysis: Compare Performance

- Which Analyst is the best forecaster?

Analyst	MAPE
A	20%
B	30%
C	40%

- Traditional analysis based on MAPE says Analyst A is best

# Why Use FVA Analysis: Compare Performance

- FVA Analysis may reveal that having the lowest MAPE is not necessarily the same as being the best forecaster!

Analyst	Item Type	Item Lifecycle	Seasonal	Promos	New Items	Demand Volatility	MAPE	Naive MAPE	FVA
A	Basic	Long	No	None	None	Low	20%	10%	-10%
B	Basic	Long	Some	Few	Few	Medium	30%	30%	0%
C	Fashion	Short	Highly	Many	Many	High	40%	50%	10%

## *The Perils of Benchmarking:*

*Do not compare your performance to others if you do not know the underlying “forecastability” of their data*

# FVA Analysis: Reporting the Results

- Naïve forecasts can be surprisingly difficult to beat
- Results can be embarrassing to those participants failing to add value
  - Present the results tactfully – your purpose is to improve the process, not necessarily to humiliate anyone
  - Present the results privately – if they will be embarrassing to your boss or other executive managers
- Or....if you want to end your career with a bang:
  - Find the most embarrassing results you can and surprise your boss and executive management by presenting them in a large meeting

# FVA Analysis: Reporting the Results

- Be cautious in interpreting your FVA results
  - Don't draw conclusions without sufficient evidence
- One period of data is not enough!
  - Over short time periods, results may just be due to chance
- Use Donald Wheeler's book Understanding Variation: The Key to Managing Chaos to guide the analysis

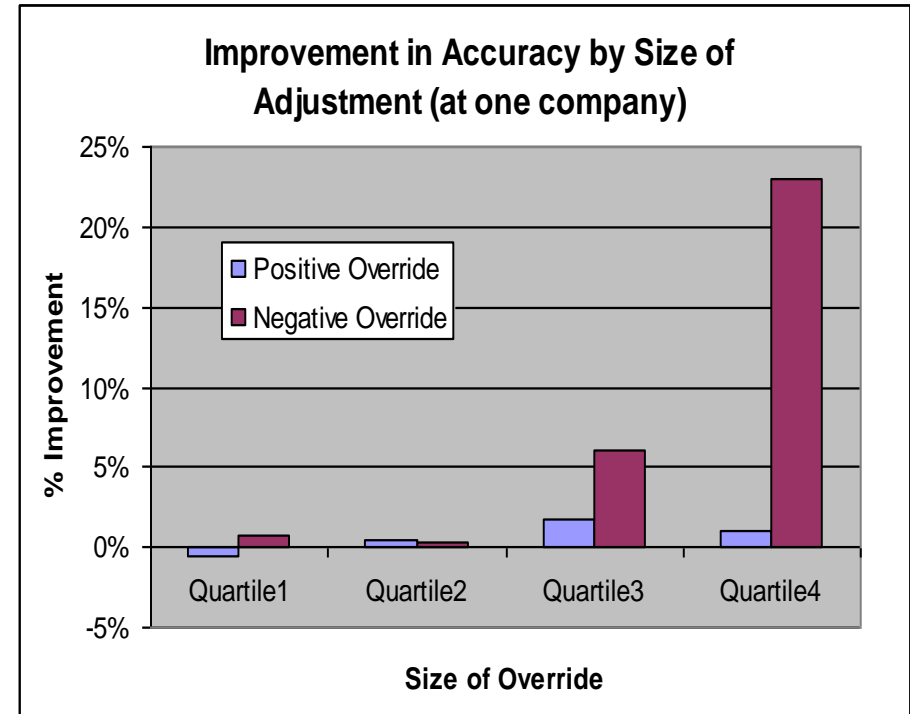
*If you haven't conducted FVA analysis and know that  
you are beating a naïve forecast...  
then maybe you aren't!!!*

# FVA Case Studies

- FVA has been applied by companies in several major industries:
  - Pharmaceuticals
  - Retail
  - Technology Manufacturing
  - Home Furnishings
  - Transportation
  - Apparel
  - Food & Beverage

# Case Study: Academic Research

- Studied 60,000 forecasts at four supply chain companies
- 75% of statistical forecasts were manually adjusted
- Large adjustments tended to be beneficial
- Small adjustments did not significantly improve accuracy and sometimes made the forecast worse
- Downward adjustments were more likely to improve the forecast than upward adjustments



Source: “Good and Bad Judgment in Forecasting.”  
Fildes and Goodwin, *Foresight*, Fall 2007.

# Case Study: Premium Bedding Manufacturer

- Collaborative forecasting process
  - Baseline Model + Market Intelligence = Collaborative Forecast
- Benefits of FVA
  - Visibility into forecasting process
  - Identifies opportunities for improvement
  - Sales learns not to forecast but to “add value”
  - More accurate forecasts!
- FVA appeals to competitive nature of sales reps – beat the nerd running the statistical software

Source: “How to Speak Sales.” J. Eric Wilson, IBF Supply Chain Forecasting Conference, February 2008.

# Case Study: Pharmaceutical

- Uses FVA as part of *Forecast Quality Dashboard*
  - Governance – was the forecast on time and complete
  - Behavior – was forecast followed, or tampered with
  - Accuracy – forecast accuracy, bias, and value-added
  
- Attention to “forecastability” of products
  - Stable vs. unstable demand
  - Assess risk, and build plans accounting for the risk

Source: “Measuring and Reporting Forecasting Performance.”  
Joseph & Gilliland, IBF Supply Chain Forecasting Conference,  
October 2007.

# Case Study: Automotive Supplier

- Focus on the cost of forecast error to get management support
- Developed a “Cost of Inaccuracy” metric
  - Too high: cost of carrying slow-moving goods
  - Too low: cost of back orders (lost revenue, loss of credibility as a supplier)
- Evaluated management adjustments using FVA
- Applied COI to determine cost / benefit of management participation

Source: “How to Optimize Management Input to Statistical Forecasting.” Jonathon Karelse, IBF Supply Chain Forecasting Conference, October 2007.

# Case Study: Technology Manufacturer

- Initial FVA results
  - For the average of the 6 years reviewed:
    - Naïve model met or beat forecast in 50% of cases
    - Positive FVA results were <10%
    - Naïve models less biased
  - Proved that in many cases, same or better results could be achieved with less effort, variability and bias
  - Facilitated agreement that change is necessary
  - Encouraged creative process re-engineering ideas
- For alternative forecasting process / methods:
  - Is the FVA *greater* than the FVA of the original?
  - Does the improvement in FVA *justify* the implementation costs?

Source: "Putting FVA to Work." Rodriguez & Gilliland, IBF Supply Chain  
Forecasting Conference, February 2008.

# Case Study: Specialty Retailer

- Benchmark process capability (how process performed vs. naïve model)
  - Compare statistical vs. judgmental forecasting
    - 75% of analyst overrides failed to beat 5-week moving average
- Validate process improvement prototypes
  - Measure FVA Prior to Process Improvement
  - Implement Process Improvement on Pilot Basis
  - Measure FVA After Improvement
  - If FVA is Positive, Proceed with Total Process Improvement
- Compare software packages

Source: "Simple Tools to Assess and Improve Forecasting Performance." Harwell & Gilliland, IBF Best Practices Forecasting Conference, April 2006.

# Case Study: Food & Beverage

- Overall process added 4 percentage points of improvement (from 64% to 68% accuracy at DC/Item/Week level)
- Most of improvement was due to statistical forecast beating the naïve forecast
  - Analyst overrides made forecast worse 60% of the time
- Determined that sales inputs to forecasting process were not adding value (did not improve DC/Item forecast)

# Lean Approach to Forecasting

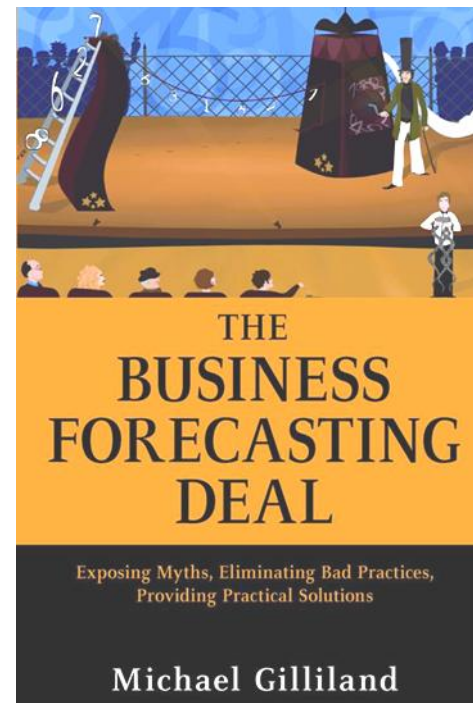
- Lean is all about identify and eliminating process waste
- FVA analysis is one tool in the lean approach
- The objective is to generate forecasts as accurate an unbiased as you can reasonably expect them to be, and do this as efficiently as possible
- Focus on process efficiency and elimination of process waste – getting rid of those activities that just make the forecast worse

*You can get better forecasts for free!*

# Additional Resources on FVA Analysis

- “Forecast Value Added Analysis: Step-by-Step”
  - SAS on-demand webcast  
<http://www.sas.com/events/cm/176129/index.html>
  - SAS white paper  
<http://www.sas.com/reg/wp/corp/6216>
- Blog: *The Business Forecasting Deal* (blogs.sas.com/content/forecasting)
- Book: *The Business Forecasting Deal* (available on amazon.com)

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