

# **Actuarial Techniques in a Non-Insurance World**

2014 CAS RPM

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# Actuaries at Google

- Financial Risk Team
- Provide analytical support on insurance risk
  - Insurance, Captive Operations, Chauffeur, etc.
- Non-insurance analytical support
  - AdWords Business Credit, Demand forecasting, Vendor Risk Management, Fraud, etc.

# Motorola Acquisition (2012q2)

- Worldwide **Sales & Operations** Process
- Legacy Handset Portfolio + New Products
- Google's Financial Commitment
  - Return on investment
  - Forecast accuracy, process
  - Management of **Excess & Obsolete** Inventory

# “Traditional” Forecast Methodology

- Weekly demand by unit, customer, region
- Customer forecasts incorporated with tweaks
- Roll-up, with further adjustments, to global
- Mostly forward-looking
- Supply and demand are linked in system

# Data and ETL

- Weekly forecasts in Excel format
- OBIEE Databases
- 10 GB dataset derived from 104 individual xls files, Oracle extracts

# Sample Summarized Data

- Forecast/actual units by month, f/c date

Forecast date	January 2011	February 2011	March 2011	April 2011	May 2011	June 2011
1/7/2011	7,628.60	6,087.52	5,561.98	4,791.68	5,948.69	5,332.42
1/14/2011	7,589.25	6,017.03	6,021.15	4,727.36	5,914.28	5,038.23
1/21/2011	7,220.02	5,889.58	5,351.49	5,419.69	5,682.42	5,521.57
1/29/2011	6,649.91	5,820.23	5,431.33	6,026.50	5,525.97	5,358.13
2/4/2011	4,151.14	6,983.76	6,565.10	6,191.20	4,936.06	4,912.50
2/12/2011	3,826.49	6,952.45	6,271.69	7,067.64	5,564.42	4,840.05
2/19/2011	3,786.24	6,642.17	6,408.15	7,347.55	5,922.92	5,052.80
2/25/2011	3,786.31	5,745.88	6,740.79	7,350.93	6,208.64	5,525.05
3/4/2011	3,803.04	3,873.42	8,358.48	6,977.37	6,447.16	5,790.53
3/12/2011	3,827.95	3,952.18	8,234.71	7,219.87	6,392.05	5,510.90
3/18/2011	3,828.91	3,985.38	8,084.80	7,577.64	6,329.34	5,699.10
3/25/2011	3,828.98	4,002.41	7,814.87	7,411.22	6,327.97	6,221.90
4/1/2011	3,828.91	3,998.01	7,332.45	7,169.77	7,082.48	6,243.14
4/8/2011	3,829.09	3,997.82	6,886.94	7,519.17	7,009.67	6,934.26
4/15/2011	3,829.09	3,997.82	6,891.79	7,088.42	7,158.56	6,826.43
4/22/2011	3,829.09	3,997.82	6,888.59	6,994.99	7,409.11	7,000.98
4/29/2011	3,829.09	3,997.82	6,888.59	6,165.40	8,065.78	7,072.16

# Actuarial Concepts at Play

- Development
- Diagnostics / Adjustments
  - large regional shift for certain phones
  - price behavior
  - forecast/actual ratios
- Credibility vs. Homogeneity
  - segmentation
- Bias vs. Consistency
  - S&Op Process is very consistent!

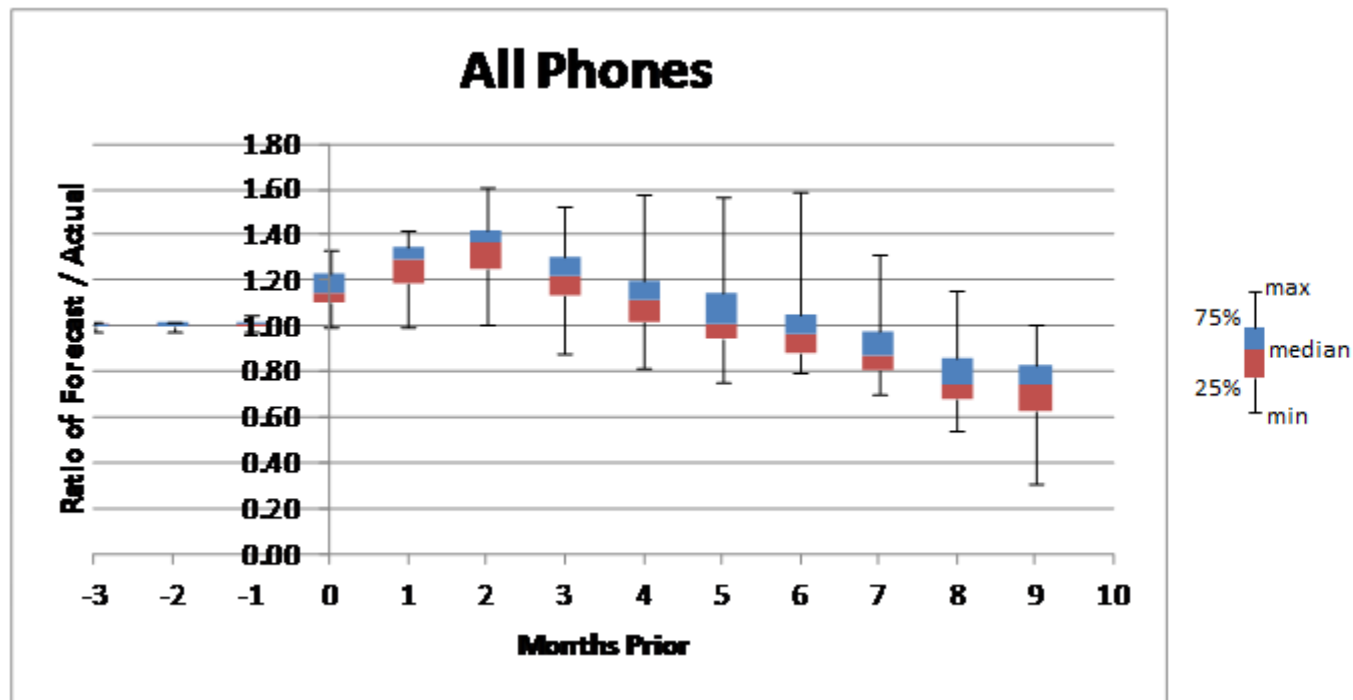


# Basic Approach

- Take advantage of consistent demand forecasting process
- Segment phones into categories
- Use forecast / actual ratios as DF's
- Simulate resulting sales

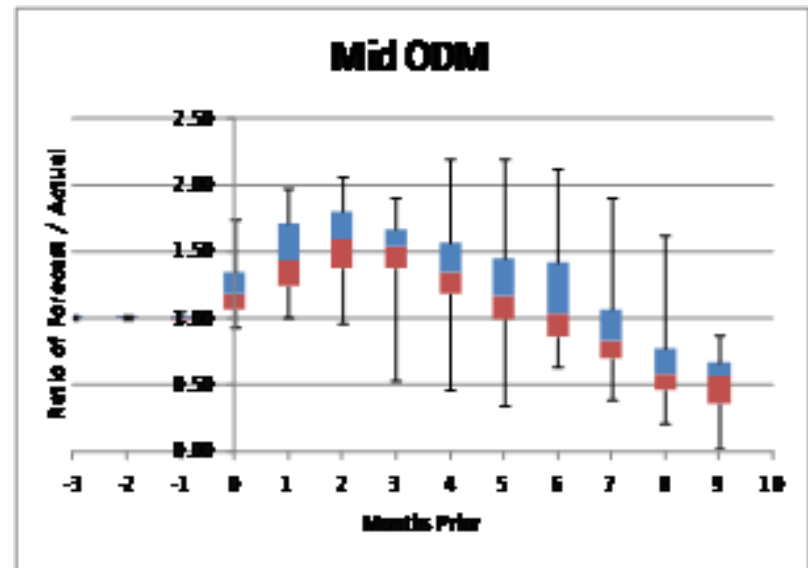
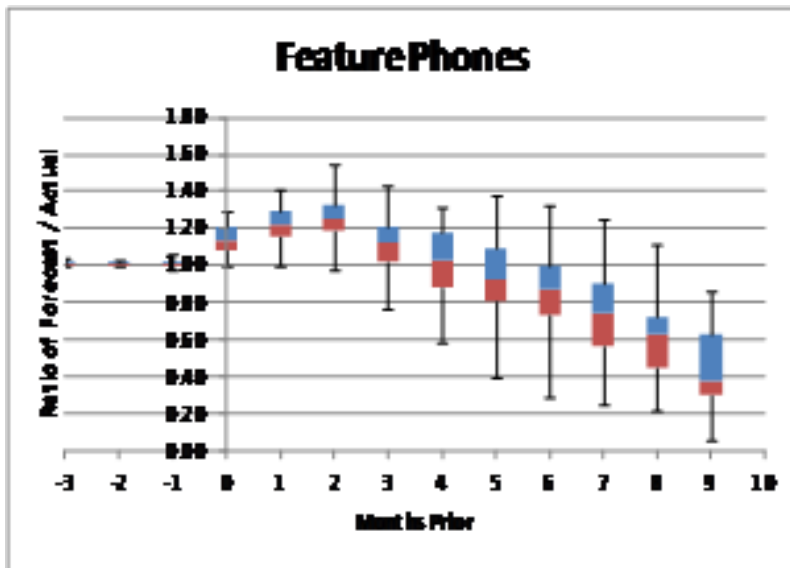
# Forecast / Actual Ratio

- Quarterly adjustment
  - Use three-month rolling period of forecast / actual
  - Month 0 : the last month of the 3-month period
  - Post month 0, there are adjustments for returns, etc.



# Segmentation

- Categorizing by type of phone has greater 'between variance' than regional, other cuts



# Bootstrapping The 2013q1 Forecast

- Take forecasts by phone type for 2013q1 made over the past quarter (12 weeks)
- Select a random forecast / actual ratio appropriate to development period
- Simulate actual units sold by applying ratio to forecast

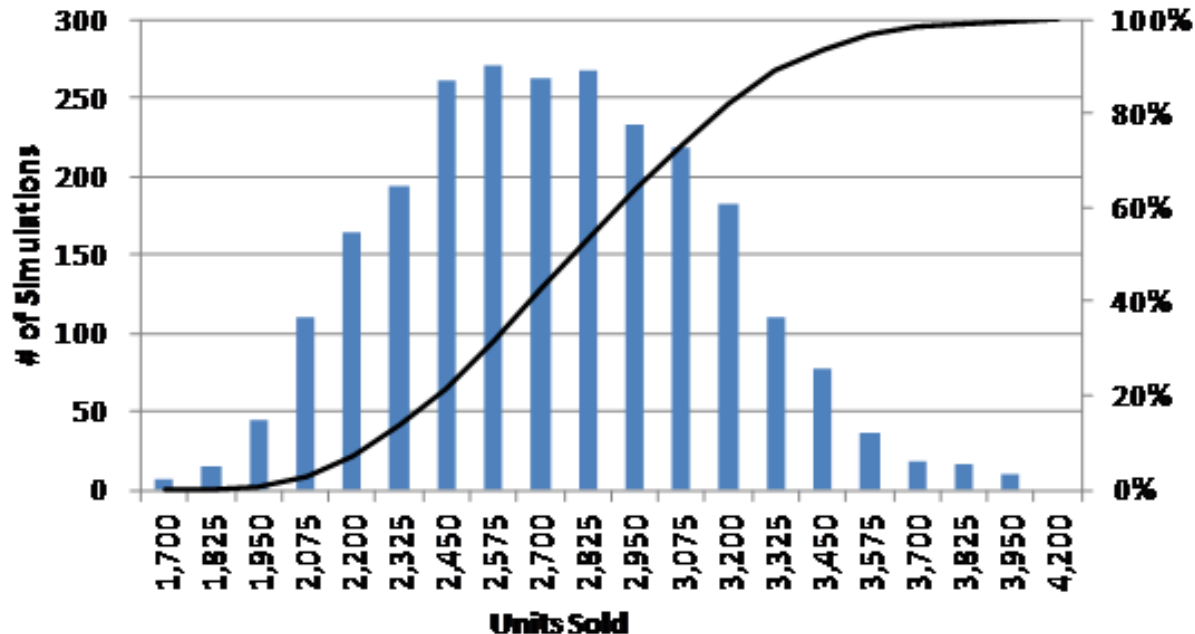
# Example

- Using a single forecast (from 2012q4) for 2013q1 Feature Phones

Forecast as of 10/6/2012, Feature Phones			
	January 2013	February 2013	March 2013
Units	760.66	233.42	65.92
Months Out	3	4	5
Selected F/A Ratio 1	1.11	0.83	1.79
Selected F/A Ratio 2	1.08	0.96	0.95
Selected F/A Ratio 3	1.39	1.18	1.11
Simulation 1	686.28	914.22	424.83
Simulation 2	706.03	795.19	798.02
Simulation 3	547.78	645.53	688.09

# Results for 2013q1

- 2,500 simulations
- Official YE forecast of 3,050 units (75th %ile)
- 2013q1 emergence: 2,850 units



Minimum	1,692.97
Maximum	4,151.92
Average	2,801.40
40th %ile	2,670.39
50th %ile	2,791.86
70th %ile	3,026.04
90th %ile	3,349.04

# Next Steps

- Methodology works for legacy phones only as it is dependent on consistent S&Op process
- Additional forecasts built by fitting activation data to Gompertz and logistic curves as well as the Bass diffusion model
- Actuarial applications?