The Coming Big Data Tsunami in Energy Market Analytics

Jeff Fong, Co-Founder, F S DataScience
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Outline

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II. What is Big Data & Analytics?

III. A “small” Big Data & Analytics example

IV. Big Data, Analytics and Energy Markets

V. Getting started if you haven’t already
Why are Big Data & Analytic concepts important in Energy Markets?
Big Data & Analytics

- The Past: A competitive advantage was often obtained with an asset.
  - Railroads, pipelines, refineries
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  ○ Railroads, pipelines, refineries
Big Data & Analytics

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  - Railroads, pipelines, refineries,
  - Water utilities
  - Power generation

WATER WORKS

If player lands on water works, they pay nothing to owner.
Instead, the player pays ₦250 to the owner of the electric company to give them electricity to pump water.

ELECTRIC COMPANY

If player lands on electric company, charge them anything between ₦150 and ₦500.
Whenever you feel like it, randomly charge them ₦2000.
Big Data & Analytics

- The Past: A competitive advantage was often obtained with an asset.
  - Railroads, pipelines, refineries,
  - Water utilities
  - Power generation
  - Asset based competitive advantage
  - Monopolies
Big Data & Analytics

- What we see today is a trend where analytics revolutionize industries
- Lower capital intensive industries were first
- We have already seen many industries revolutionized by companies that specialize in data and analytics (Google, Amazon)
  - Advertising and Sales
  - Logistics
  - Travel and Airlines
Big Data & Analytics

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- Energy markets are next!

I. The data is being stored
II. Sufficient processing power is now available
III. Markets are becoming integrated
Big Data & Analytics

- As energy markets continue to become more global, the competitive advantage from analytics will continue to grow
  - increased integration of global energy markets
  - new pipelines, transmission, energy technologies
  - growing amounts of data
  - increased competition and demand response
  - integration with financial markets

- The future of strategic discussions will include data analytics and algorithms as being competitive advantages
What is Big Data & Analytics?
What is “Big Data & Analytics”

- “Big” is relative
  - data starts to become big when you can’t make use of the raw data without summarizing it

- Three types of analytics
  1. Descriptive
  2. Predictive
  3. Prescriptive
Analytics: Descriptive

- Most data in its raw form is not suitable for human consumption
- Data must be condensed into useful pieces of information
- The purpose of descriptive analytics is to summarize what has happened
- The focus is on learning about your data (data discovery)
- 80% of business analytics is descriptive (think about your BI reports)
Analytics: Descriptive

- Averages, variance, correlations, principle components, distributions and summary statistics are all descriptive.
- They help you learn about your data, but are not in themselves, predictive or prescriptive.
- Example: How do interest rates, spot prices and volatility move together?
Analytics: Predictive

- Predictive analytics do not tell you will happen; it tells you what *might* happen. (probabilistic)
- In other words, using data you do have; fill in data you don't have
  - predict possible future data
  - fill in possible values for missing data
Analytics: Predictive (=modeling)

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- Model building is a big part of predictive analytics
  - Statistical models, data mining, machine learning, time-series, monte-carlo simulation, forecasting, neural nets are all predictive
  - They tell you what might happen, but not what to do about it
Analytics: Predictive

- Example: ‘Predict’ or model the value of an OTC call option
  - We use data we have (interest rates, spot prices and volatility) to predict data we don’t have (the call option value)
Analytics: Predictive

- Example: ‘Predict’ or model the value of an OTC call option
  - We use data we have (interest rates, spot prices and volatility) to predict data we don’t have
    - Possible future interest rates, spot prices and volatility
    - And possible future option values
Using our data, descriptive analytics and predictive models

○ We can prescribe an action that best achieves an objective

Prescriptive analytics needs “actionable data”

○ What actions can be taken that affect outcomes?
○ What are the objectives?

Minimize risk?
Maximize reward?
Maximize Sharpe ratio?
Analytics: Prescriptive

- Example: Actions to hedge a call option
  - We have the data for interest rates, spot prices & volatility
  - We have a predictive model for an option price
  - Objective: Maximize return per unit of risk

*Dynamic hedging is a prescriptive strategy*
- *delta / gamma hedge*
- *hedge greek exposures*
A “small” Big Data & Analytics example
A Portfolio Trading example

1. SPY - S&P500 index
2. TLT - 20+ year Treasury bonds ETF
3. VXX – S&P500 Volatility ETF
A Portfolio Trading example

Mini universe of 9 stocks and ETFs

1. SPY - S&P500 index
2. TLT - 20+ year Treasury bonds ETF
3. VXX – S&P500 Volatility ETF
4. JNK - High yield corporate bond ETF
5. UGA - Gasoline futures ETF
6. VLO - Valero Energy Corp (refinery)
7. USO - Oil (WTI) futures ETF
8. JO - Coffee ETF
9. SBUX - Starbucks
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How can we methodically construct a trading strategy?
Mini universe of 8 stocks and ETFs

Calculate:
- means, variances
- correlations, autocorrelations
- principle components

Discover features about this dataset
Predictive

- This “small” example isn’t really that small. There are $2^8=256$ possible combinations of underliers to include, each with endless possibilities of share combinations.

- With some data mining (We’ll make the code available for you to try yourself), we can build a (predictive) model of a cointegrated portfolio from our mini universe of stocks and ETFs.
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With some data mining *(We’ll make the code available for you to try yourself)*, we can build a (predictive) model of a cointegrated portfolio from our mini universe of stocks and ETFs.

In other words, we can build a portfolio that mean reverts using predictive (modeling) analytics.
Predictive

Mini universe
Predictive

Mini universe

Data-Mined subset
Predictive

1. long 7.0136 shares of JNK @ $40.31 = $282.72
2. short 2.0775 shares of UGA @ $48.87 = ($101.53)
3. short 1.2010 shares of VLO @ $48.36 = ($58.08)
4. short 2.7351 shares of USO @ $30.64 = ($83.80)
Predictive

5 year history of the net value of the model cointegrated portfolio
Predictive

5 year history of the net value of the model cointegrated portfolio

Distribution of the net portfolio value over the 5 years
Let’s create a simple (prescriptive) strategy with the objective being to generate trading profits!

*This is not a recommendation! Do your own due diligence!*
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Big Data, Analytics and Energy Markets
Energy Market Big Data Analytics

- Modeling energy markets is a difficult and complex problem
  - complex distributions
  - large constrained optimization problems
  - market feedback loops
- Problems in energy markets, get very big, very fast!
Energy Market Big Data Analytics

- Digging into the details is like opening pandora’s box
- If we look at a power plant, at its surface it seems simple
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What is the optimal hedge?

What other assets complement my existing portfolio?

How sensitive is my portfolio to EIA numbers?

What’s the impact of a transmission or pipeline disruption?
The “Real” World
The “Real” World

Hundreds of nodes and relationships

Dozens of different asset types

Many constraints and market rules to consider

A lot of analytics and software/hardware are required to analyze such complex problems
Energy Market Big Data Analytics

- Even the largest problems can still be broken down
  - Use an analytics based approach to simplify the problems
  - Include top down quantitative methods with bottoms up fundamental based modeling
  - Leverage “Big Data” technology once its needed
    - Hadoop (reading / writing)
    - Distributed and cloud computing (large scale computations)

*Hadoop and distributed / cloud technologies can be extremely powerful in helping you solve large problems*
Getting started if you haven’t already
Learn as much as you can!

- Learn to work with and analyze large data sets
  - SQL (any will do)
  - Any good programming or statistical language such as R
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- Free online universities and excellent courses
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- Go write the ERP exam!
Gaining Adoption

- Gaining adoption can be difficult at first
- Start with small, easy to handle projects
  - Try descriptive analytics first
- Focus on solving specific problems first to show ROI
- Share results often and invite feedback
  - Incorporate feedback and use rapid prototyping
- Teach & collaborate!
Resources

- Free online courses
  - coursera.org
  - udacity.com

- Open source software options
  - www.mysql.com
  - hadoop.apache.org
  - www.r-project.org
  - http://d3js.org
  - Javascript libraries

- Commercial software options
  - www.tableausoftware.com
  - Matlab
  - MS SQL / Oracle
QUESTIONS?
Creating a culture of risk awareness®

Global Association of Risk Professionals

111 Town Square Place
14th Floor
Jersey City, New Jersey 07310
U.S.A.
+ 1 201.719.7210

2nd Floor
Bengal Wing
9A Devonshire Square
London, EC2M 4YN
U.K.
+ 44 (0) 20 7397 9630

www.garp.org

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