COMP 652: Project

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Presented to Dr. Doina Precup

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Introduction

The reliability of modern day energy markets is the responsibility of independent system operators (ISO) who are tasked with the governance of the energy network within a pre-definied geographic region. PJM Interconnection is such an organization. It is responsible for the proper functioning of the electric grid in Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

It ensures that loads on the system, such as cities, are serviced by a sufficient amount of generators, such as nuclear, natural gas or wind power plants at any given hour of the day. It does so by holding hourly auctions requesting that producers offer the quantity of megawhatts they are capable of producing and at what cost. Next, based on the demand for a given hour the ISO will request that the producers bring their generators online, prioritizing the most inexpensive power first while also ensuring that the grid operates at a sufficient level of reliability and redundancy.

The first priority of the ISO is the reliability of the system. If it does not provide a sufficient amount of power to satisfy the loads in the system it risks causing a brown out or a black out in the entire system. It also must ensure a certain level of redundancy as if a line or a power plant suddenly fails the energy grid must continue to operator as a whole. It's second priority is to provide loads with the most inexpensive power that it can find, nuclear is cheaper then natural gas, and natural gas cheaper then coal.

As such, the price of power through out the energy grid can be seen as being driven by three categories of variables: demand, supply and physical. With in the demand component variables will be ones that influence the amount of power being drawn from the grid. These will be things such as weather, season, day of the week, hour of the day, weather it's a holiday or normal work week. Supply will be made up of all factors influencing how generators are changing their bidding behavior. This will mostly be driven by fuel costs; uranium, natural gas, coal and the amount of wind. Physical variables will be the current status of the network; what outages and constraints there are on the system.

Congestion...

In order to protect generators from unforseen congestion events products called up to congestion (UTC) contracts were created...

Methodology

Ignoring potential variables such as fuel costs, weather and outages, as a a first attempt in trying to evaluate the value of a UTC contract a Markov Chain Monte Carlo approach will be used. The objective will be to use the previous distribution of differences between UTC contract prices and the last known price to estimate the most likely value in the future.

In order to create a first base case evaluation of the UTC contracts I decided to simplify the problem in two ways. First, instead of trying to evaluate all individual nodes in the system I chose two that are aggregates of many different ones in the system: Eastern Hub and Western Hub. The idea here is
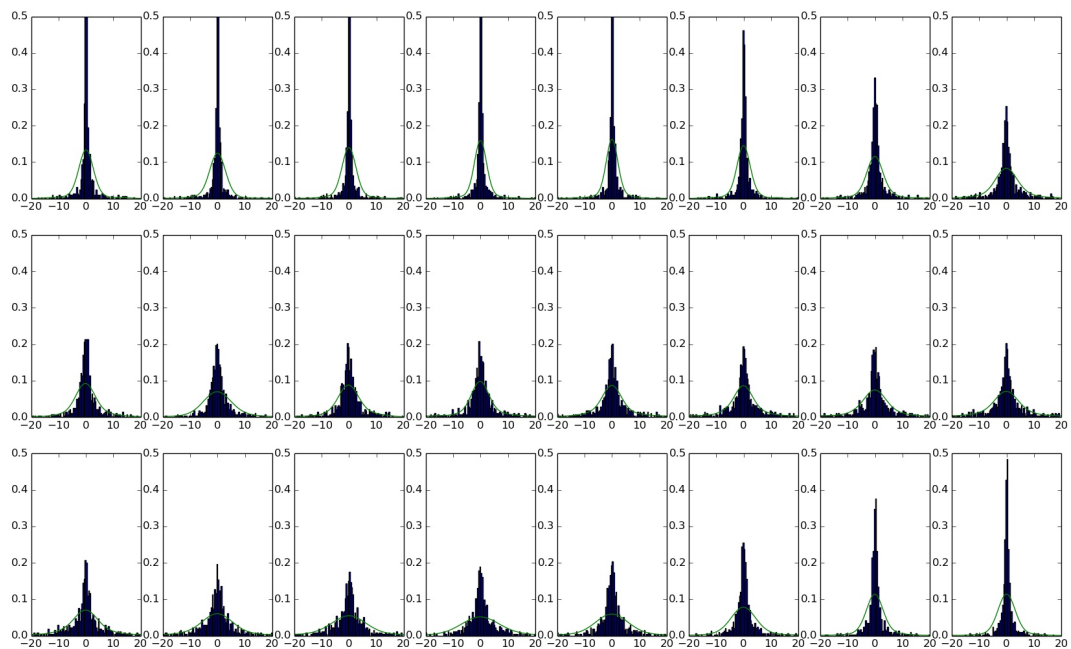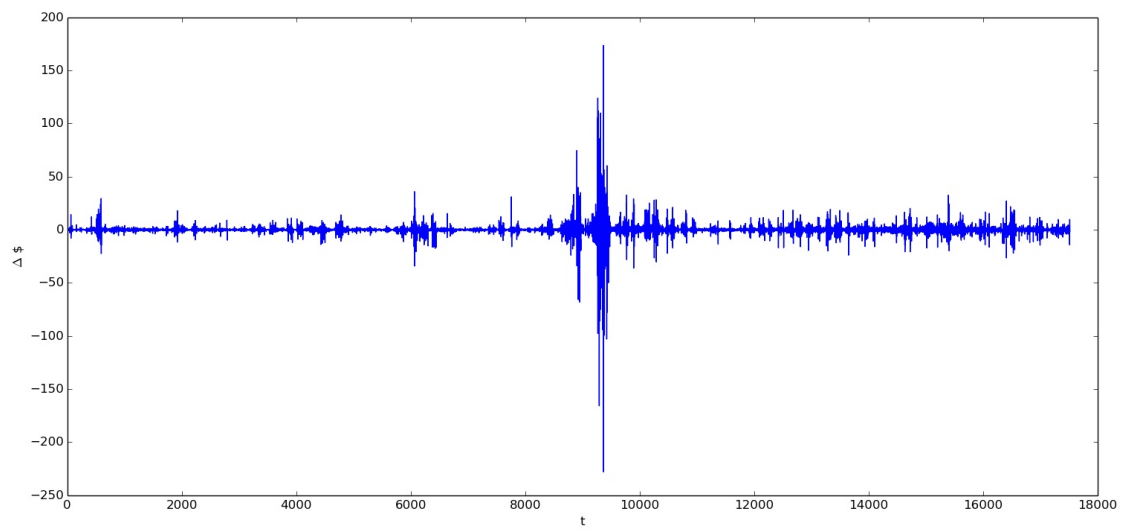
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Set-up

Results

Conclusions

Bibliography

[1] Eric Jones, Travis Oliphant, Pearu Peterson, et al. SciPy: Open source scientific tools for Python, 2001–. [Online; accessed 2015-04-20].