Reading in Data and Creating a User Interface

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Introduction

- This research covered two projects related to anomaly analysis of large sets of data
- Bonneville Power Administration (BPA) has recently switched from a DST/INI file type combination to a single PDAT style function.
- Statistical anomaly detection studies can also be applied to Mutual Funds and Exchange Traded Funds used to analyze previous performance and predict future outcomes.
- This data analysis can be used to better understand overall trends in power grid performance and financial standing, respectively.

PDAT versus DST/INI File Types:

- DST/INI File Type Outline
- Sort and manipulate data based on provided information
- Set up data frame in preparation of reading in observations
  - INI describes the organization of data
  - DST provides actual Phasor data

- **Example INI and DST Data**

```
[ALSN]
Name=Allston 500 A1 SA
PMU=0
NumberPhasors=13
NumberDigitals=1
Phasor1=V,1,25,0,0,500,North Bus
Phasor2=V,1,25,0,0,500,A phase North Bus
Phasor3=V,1,25,0,0,500,B phase North Bus
Phasor4=V,1,25,0,0,500,C phase North Bus
Phasor5=V,1,25,0,0,500,South Bus
Phasor6=V,1,25,0,0,500,A phase South Bus
Phasor7=V,1,25,0,0,500,B phase South Bus
Phasor8=V,1,25,0,0,500,C phase South Bus
Phasor9=I,1,0.2,0,1,1,  Napavine #1
Phasor10=I,1,0.2,0,1,1,  Keeler #1
Phasor11=I,1,0.2,0,1,1,  Paul #2
Phasor12=I,1,0.2,0,1,1,  Xfmr Bank #1
Phasor13=I,1,0.2,0,1,1,  Xfmr Bank #2
Frequency=F,1000,60,1000,0,0,Allston 500 A1 SA freq
```

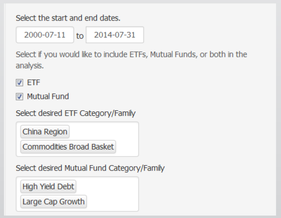
- PDAT File Type Outline
  - Combined file type
  - Stored in binary format and read in as Hexadecimal
  - Major Task: searching for separating factors in the binary data
- **Example PDAT Output**

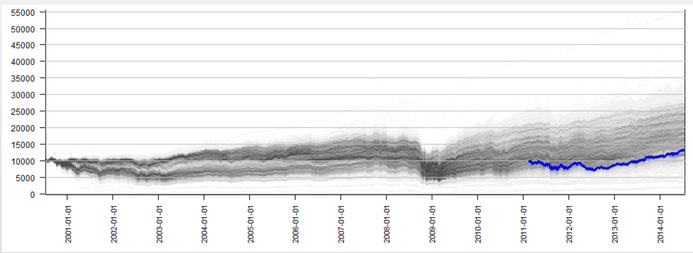
```
 [1] "ALSN 500 A1 SA"        "„à\017\r\n V1VPM"       "   VAVPM"
 [8] "   VBZPM"              "   VCZPM"               "   I1SPM"
[15] "   PMV64"              "   PMV63"               "   PMV62"
[22] "   PMV57"              "   PMV56"               "   PMV55"
[29] "   PSV53"              "   PSV54"               "   PSV55"
[36] "   PSV60"              "   PSV61"               "   PSV62"
[43] "   VAVPM"              "   VBVPM"               "   VCVPM"
```

```
"   VBVPM"                  "   VCVPM"                  "   V1ZPM"
"   I1TPM"                  "   I1UPM"                  "   I1WPM"
"   PMV61"                  "   PMV60"                  "   PMV59"
"   PSV49"                  "   PSV50"                  "   PSV51"
"   PSV56"                  "   PSV57"                  "   PSV58"
"   PSV63"                  "   PSV64"                  "  \003ALVY 500 A1 SA
```

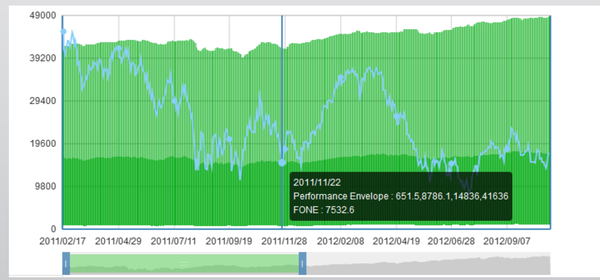
Creating an Interactive R User Interface

- Using readily available technology to make previously static plots (shown in upper plot) dynamic and interactive (shown in lower plot).
- These plots are dependent on user input as Indicated below.





All of these images illustrate the benefits of the user interactivity available through R and the Shiny package. These graphs were created dynamically based on user input and and generated in the same HTML frame



Future Work and Conclusions

- Generating this User Interface in R showed many of the possibilities available for data analysis and output with the constantly developing technology.
- Interactive analysis of large data provides for various needs including:
  - Past performance of data
  - Future predictions of data behavior
  - Comparison of variables
- A similar user interface is being created for the BPA data
  - Pending the function for PDAT data, BPA data analysis will be practically real-time
- Large data sets exist beyond financial and power grid data
- R has moved beyond a simple statistics language to allow for easier functionality for non-statistically familiar users
- This forward movement has allowed R to keep up with technology changes such as that from DST file type to PDAT file type
- Additionally, the new package Shiny s designed to highlight the interactivity available with R
  - This lead to the creation of the Mutual Fund and Exchange Traded Fund User Interface

ABOUT

Pacific Northwest National Laboratory

The Pacific Northwest National Laboratory, located in southeastern Washington State, is a U.S. Department of Energy Office of Science laboratory that solves complex problems in energy, national security, and the environment, and advances scientific frontiers in the chemical, biological, materials, environmental, and computational sciences. The Laboratory employs nearly 5,000 staff members, has an annual budget in excess of $1 billion, and has been managed by Ohio-based Battelle since 1965.

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