CWRU DSCI351-451: Semester Project 2- Time Series Analysis

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3 Semester Project 2: Time Series Analysis

Time series are a common type of data,

- consisting of measurements that are continuous over a time range.

In this project we will be using classical decomposition

- to perform analysis on a time series.

First as an introduciton to decomposition we will have a quick example.

3.1 Problem 1

- What is the decomposition of a timeseries?
- The AirPassangers data set of airline passangers every month for 12 years

```
library(datasets)
air <- as.data.frame(AirPassengers)
```

- Plot the total time series of air passangers
- What do you notice about the plot?
- Use the ts() function in base R
  - to define AirPassangers as a time series with a yearly trend
- If the data is taken monthly,
  - what will the frequency (points per season) of a yearly season be?

```
?ts()
```

- Use the decompose() function -to demcompose the time series and remove the seasonality
- The type for this time series is multiplicative
- Plot the decomposed time series, what do you notice about the trend?
- Isolate the trend and plot the trend on top of the raw data with the seasonality included
- How well does the trend represent the data?

3.2 Problem 2

Now lets try this with a real world time series. We'll be using one month of power and weather data from a solar power plant. The data set variables are as follows:

- time: The timestamp at which the data was taken
- ghir: Global Horizontal Irradiance from a sensor at the site,
  - the power from the sunlight over an area normal to the surface of the earth ($Watts/m^2$)
- iacp: The AC power from the power plant (kW)
- temp: The air temperature ($Celsius$)
- ghi_solargis: The Global Horizontal Irradiance, not from a sensor,
  - but predicted using weather modeling ($Watts/m^2$)
- clear: A logical indicating whether the sky was "clear" during measurement,
  - determined by comparing the ghi and ghi_solargis data
- ratio: the ratio of the Global Horizontal Irradiance
  - and the Plane of Array Irradiance (the irradiance normal to the surface of a tilted module)

The power from solar panels is dependant on the irradiance hitting it,

- so a power reading is often meaningless without a corresponding irradiance measurement.

It is useful to have multiple sources of irradiance measurements.

Sensors on the ground are useful because

- they strongly represent the irradiance that is hitting the module;
- however, sensors can begin to drift if not cleaned or calibrated properly.
- An unstable sensor can render an entire data set useless.

To combat this, we also have irradiance data from SolarGIS,

- a company that uses satellite images to model and predict
- the irradiance at the surface of the earth.
- Plot the irradiance and power for the first week of data,
  - how does the irradiance look compared to
  - what you would expect from the trend of sunlight?
  - How well does the power and irradiance match up?
- Use the ts() functions and the stlplus() function from the stlplus package
- to decompse the sensor and SolarGIS irradiance and the power
  - for the whole month.
- Plot each of the decompositions, what do you notice?

```r
# think carefully about the frequency you'll need to define for this data
# what is the seasonal component to this data and how nay data points make up a season?
# use s.window = "periodic" for the stlplus function
library(stlplus)
?stlplus()
```

- Isolate the trends for the 3 time series you just decomposed
  - and build a linear model for each one.
- Compare the models to each other, how are they different?
- Solar panel degradation leads to less power output over time
  - at the same irradiance conditions.

- Based on the linear models you found for the trends of power and irradiance,
  - is this system degrading over time?
- How do the sensor GHI and the SolarGIS GHI compare to power?

3.2.0.1 Links

http://www.r-project.org

http://rmarkdown.rstudio.com/

<!– # Keep a complete change log history at bottom of file. # Complete Change Log History # v0.00.00 - 1405-07 - Nick Wheeler made the blank script ##########