ENERGY CONSUMPTION OF BOSTON CITY

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Problem Statement

- Forecast energy consumption based on historical and consumption data
- Compare the energy consumption of different school, library, hospital
- Validate the Boston model, compare the results of simulation to actual energy consumption data
- Predict future power consumption
- Predict the demand forecast of each region

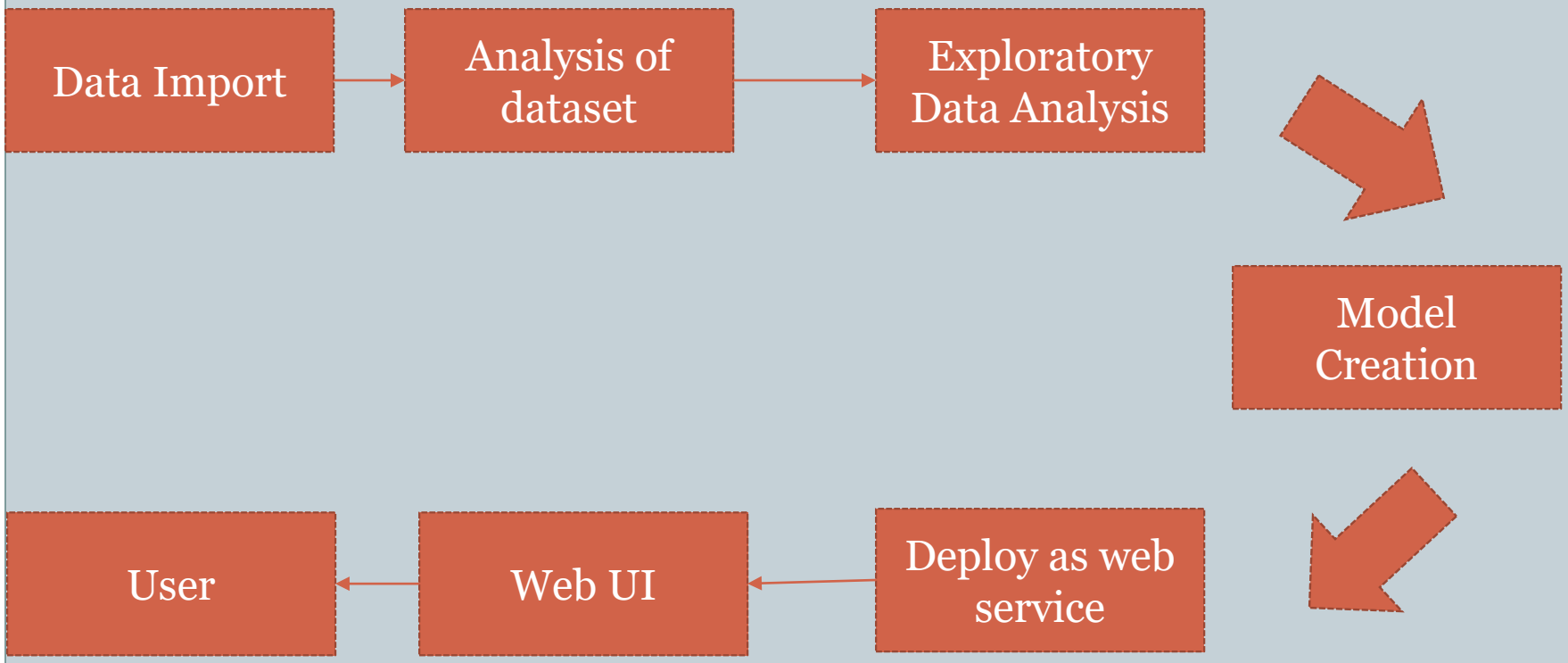
End Solution

- We'll do this using the related dataset so the models become more and more accurate
- With this model, the city will have a map to help target and reach proper goals
- Lower costs, reduce greenhouse gas emissions, and make Boston's energy system more resilient.

Things we plan to do:

- Exploratory Analysis – R/Tableau
- Data Cleansing – R/Wrangler
- Partitioning of data - Azure
- Modeling and predicting – Azure/R
- Evaluate the model – Azure/R
- Deploy on the web – Azure
- Setup Dashboards path
- UI Design– Bootstrap/JavaScript

Flow Diagram



Dataset

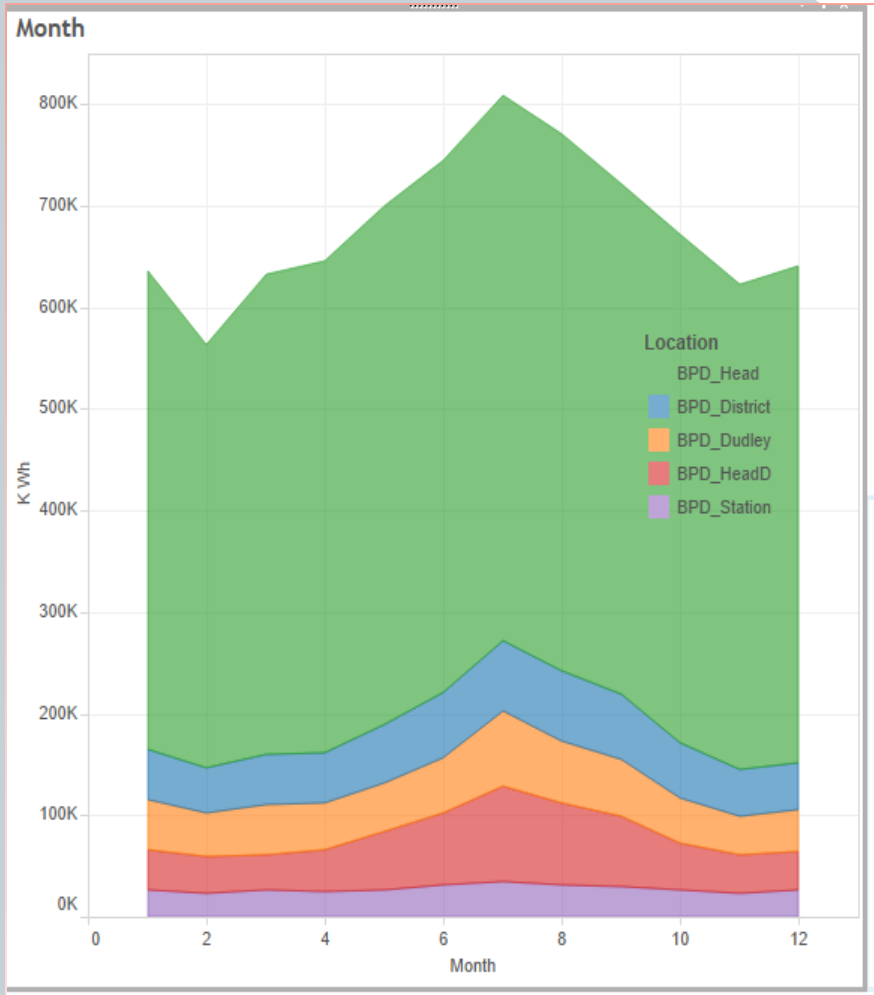
A	B	C	D	E	F	G	H	I	J	K	L
	Account	Date	month	day	year	Time	KWh	powerfact	KVARh	hour	minute
11	2.85E+10	1/1/2014	1	1	2014	X0.05	5.454	0.963654	1.512	0	5
1.1	2.85E+10	1/1/2014	1	1	2014	X0.10	5.166	0.956996	1.566	0	10
1.2	2.85E+10	1/1/2014	1	1	2014	X0.15	5.094	0.956797	1.548	0	15
1.3	2.85E+10	1/1/2014	1	1	2014	X0.20	5.364	0.960791	1.548	0	20
1.4	2.85E+10	1/1/2014	1	1	2014	X0.25	5.148	0.957642	1.548	0	25
1.5	2.85E+10	1/1/2014	1	1	2014	X0.30	5.076	0.957452	1.53	0	30
1.6	2.85E+10	1/1/2014	1	1	2014	X0.35	5.112	0.957081	1.548	0	35
1.7	2.85E+10	1/1/2014	1	1	2014	X0.40	5.274	0.959522	1.548	0	40
1.8	2.85E+10	1/1/2014	1	1	2014	X0.45	5.346	0.974058	1.242	0	45
1.9	2.85E+10	1/1/2014	1	1	2014	X0.50	5.724	0.96141	1.638	0	50
1.1	2.85E+10	1/1/2014	1	1	2014	X0.55	5.814	0.982071	1.116	0	55
1.11	2.85E+10	1/1/2014	1	1	2014	X1.00	5.796	0.976543	1.278	1	0
1.12	2.85E+10	1/1/2014	1	1	2014	X1.05	5.634	0.981534	1.098	1	5
1.13	2.85E+10	1/1/2014	1	1	2014	X1.10	5.13	0.957363	1.548	1	10
1.14	2.85E+10	1/1/2014	1	1	2014	X1.15	5.328	0.96029	1.548	1	15
1.15	2.85E+10	1/1/2014	1	1	2014	X1.20	5.058	0.956219	1.548	1	20
1.16	2.85E+10	1/1/2014	1	1	2014	X1.25	4.95	0.954418	1.548	1	25
1.17	2.85E+10	1/1/2014	1	1	2014	X1.30	5.112	0.956142	1.566	1	30
1.18	2.85E+10	1/1/2014	1	1	2014	X1.35	5.148	0.957642	1.548	1	35
1.19	2.85E+10	1/1/2014	1	1	2014	X1.40	4.968	0.954726	1.548	1	40
1.2	2.85E+10	1/1/2014	1	1	2014	X1.45	5.094	0.953939	1.602	1	45
1.21	2.85E+10	1/1/2014	1	1	2014	X1.50	5.67	0.980581	1.134	1	50

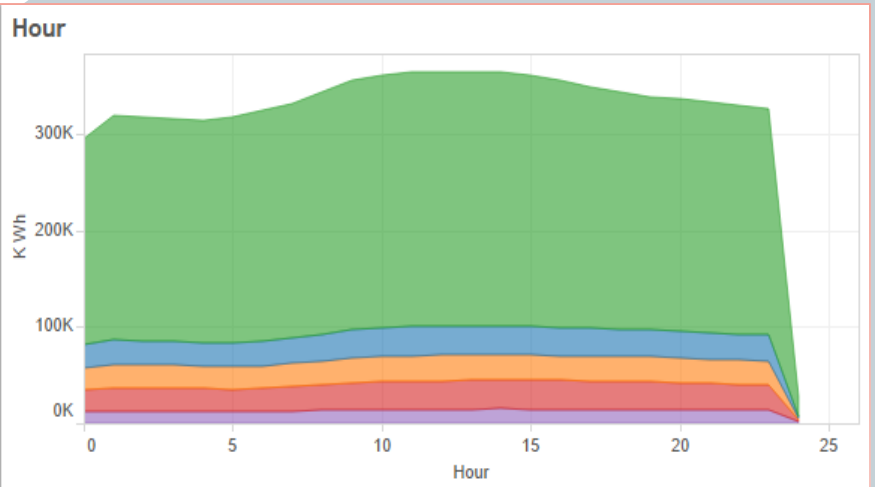
R Code for the Analysis of Data

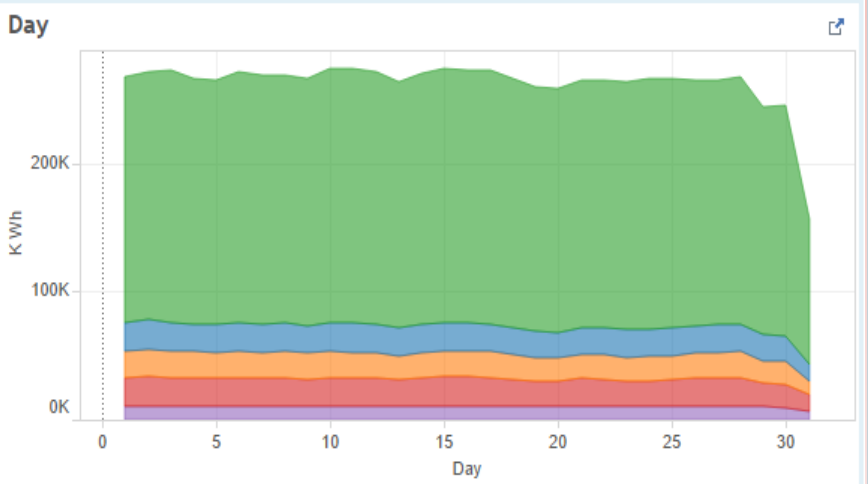
```
###Dudley BPD

setwd("C:/Users/Mushtaq/Downloads/ADS/COB Interval data 2014/CY2014 COB Interval data 1")
BPDdudley<-read.csv("COB-BPD.DUDLEY SQ.2014.csv",header=T)
summary(is.na(BPDdudley))
BPDdudleyTime<-BPDdudley[,c(5:292)]
BPDdudleyTranspose<-t(BPDdudleyTime)
head(BPDdudleyTranspose)
a<-0

for(i in seq(from=1,to=ncol(BPDdudleyTranspose),by=3)){
  b<-i
  c<-i+2
  a<-rbind(a,BPDdudleyTranspose[,b:c])

}
a=a[-1,]
write.csv(a,file="mushtaq31.csv")
xyz<-read.csv("mushtaq31.csv",header=FALSE)
head(xyz)
xyz=xyz[-1,]
colnames(xyz)<-c("Time","KWh","powerfactor","KVARh")
head(xyz)

library(stringr)
out<-str_split_fixed(xyz$Time,".",2)
nrow(xyz)
nrow(out)
head(xyz)
xyz<-cbind(xyz,out)
xyz<-xyz[,-5]
head(xyz)
colnames(xyz)<-c("Time","KWh","powerfactor","KVARh","time")
```

```r
#Now back to main file
BPDdudleyAccount<-BPDdudley[,c(1:2)]
head(BPDdudleyAccount)


#ExpandRows
newDat<-BPDdudleyAccount[c(10),]

a<-0
for(i in seq(from=1,to=nrow(BPDdudleyAccount),by=3))
{
  b<-i
  a<-rbind(a,expandRows(BPDdudleyAccount[c(b),],288,count.is.col = FALSE))
}
head(a)
a=a[-1,]


#Splitting date
datetxt<-a[,c(2)]
datetxt<-as.character(datetxt)
datetxt<-as.Date(datetxt,"%m/%d/%Y")

class(datetxt)
df <- data.frame(month = as.numeric(format(datetxt, format = "%m")),
                 day = as.numeric(format(datetxt, format = "%d")),
                 year = as.numeric(format(datetxt, format = "%Y")))
head(df)

#Column binding
nrow(a)
nrow(xyz)
finalBPDdudley<-cbind(a,df)
finalBPDdudley<-cbind(finalBPDdudley,xyz)
head(final)
write.csv(finalBPDdudley,file="finalBPDdudley.csv")

##
```

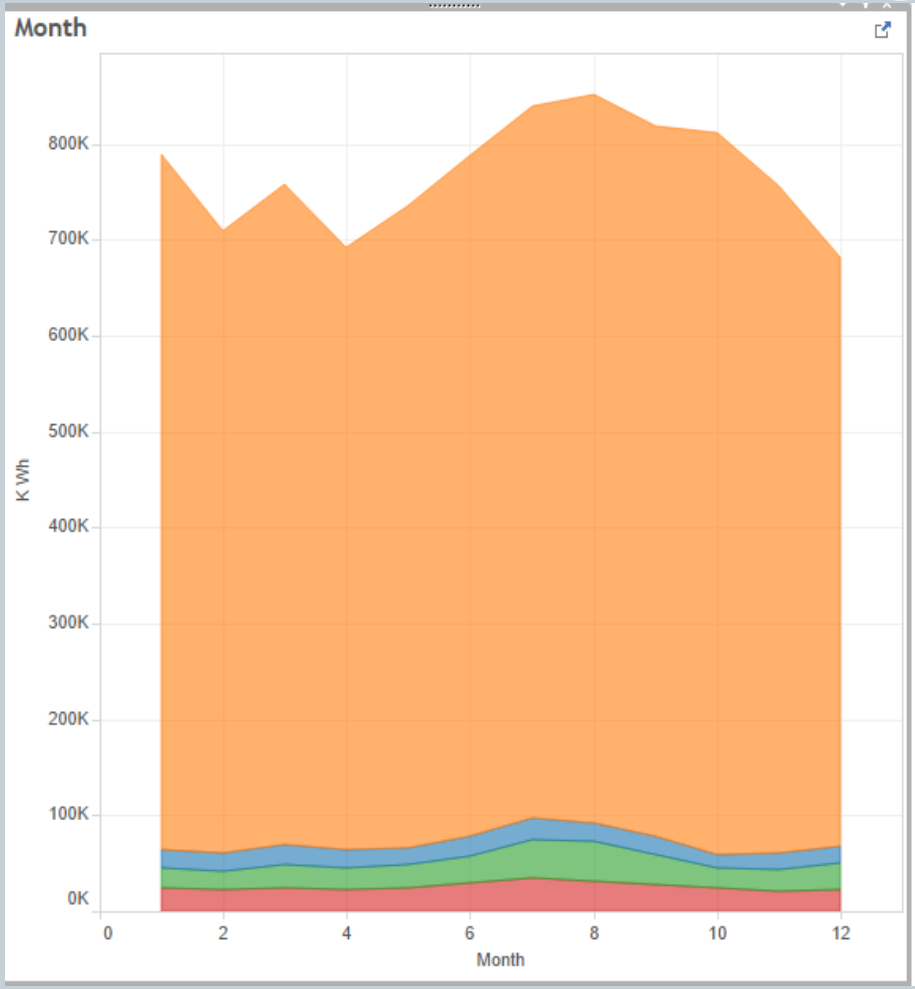
Exploratory Data Analysis – Power Consumption for Police Department

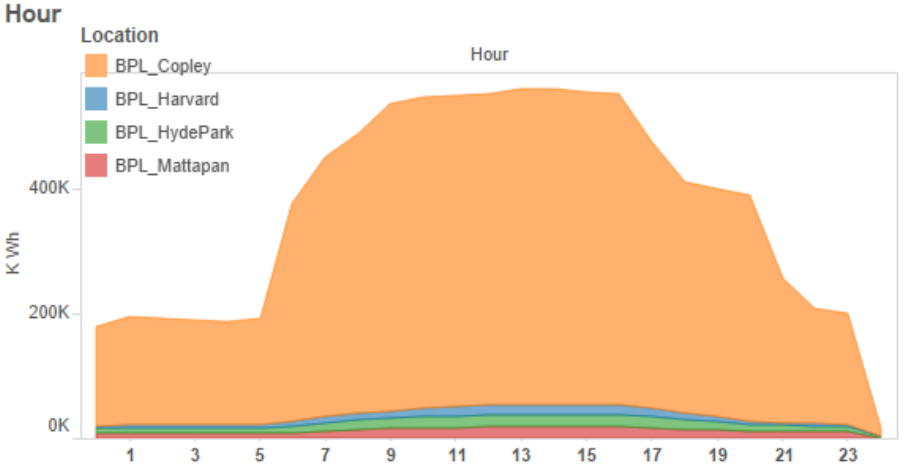


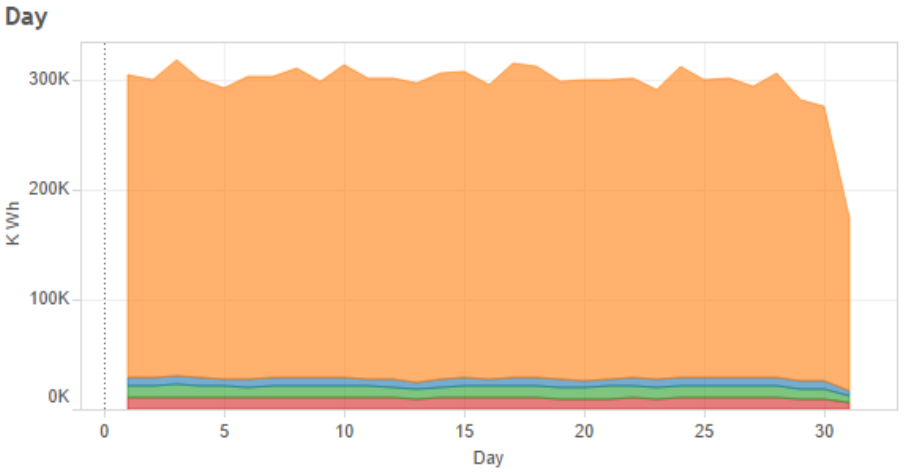




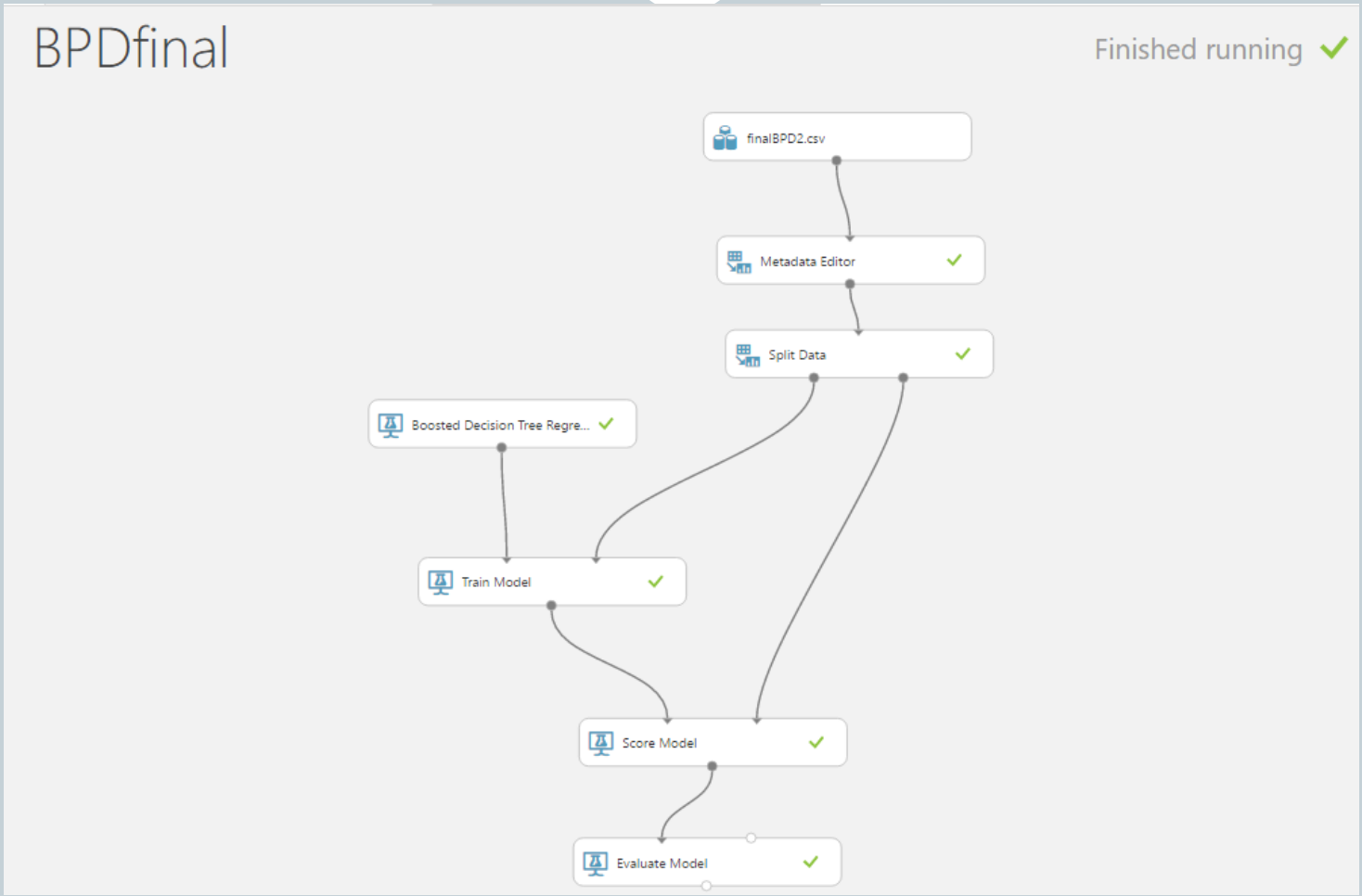
Exploratory Data Analysis – Power Consumption for Libraries



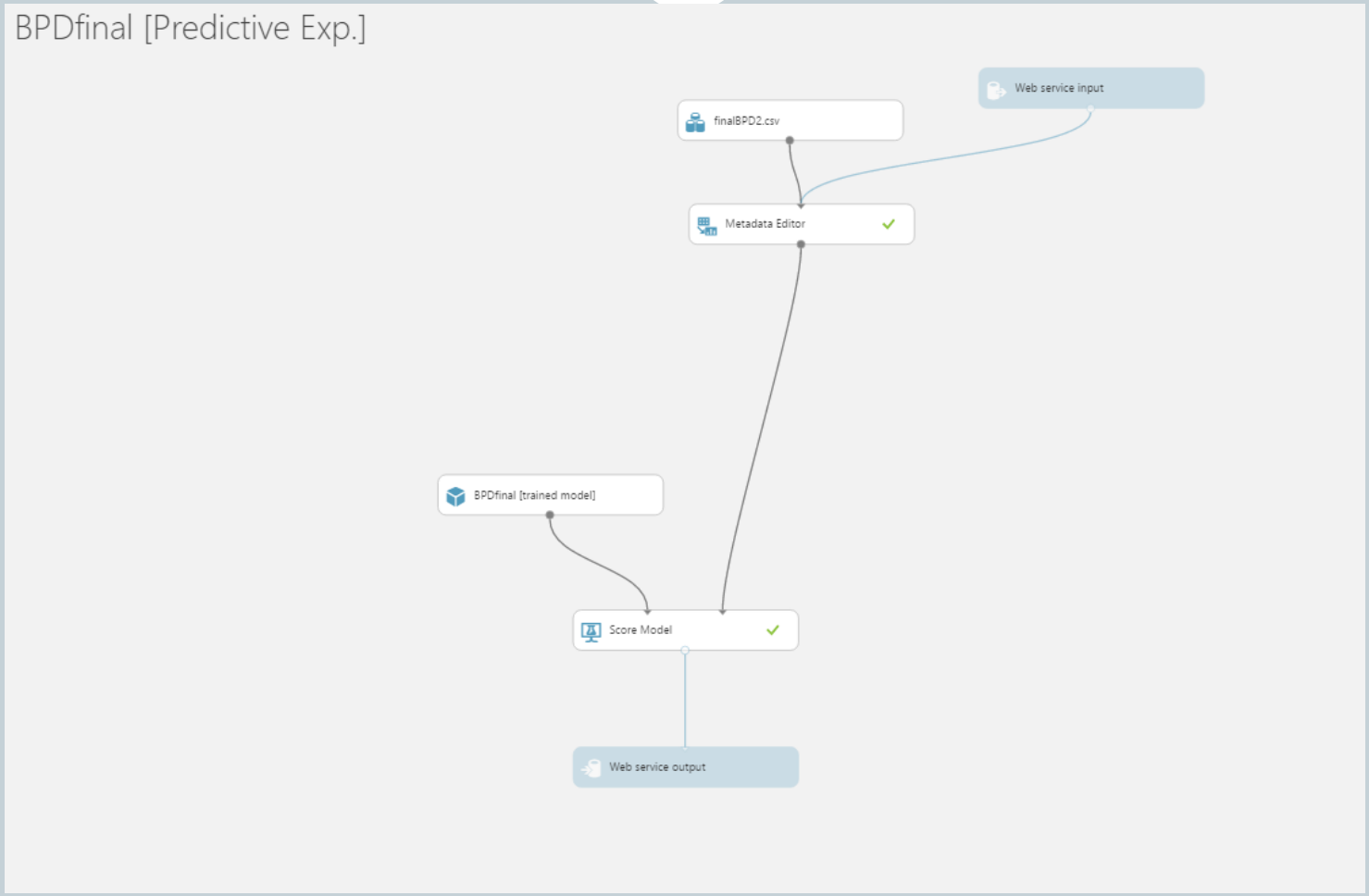




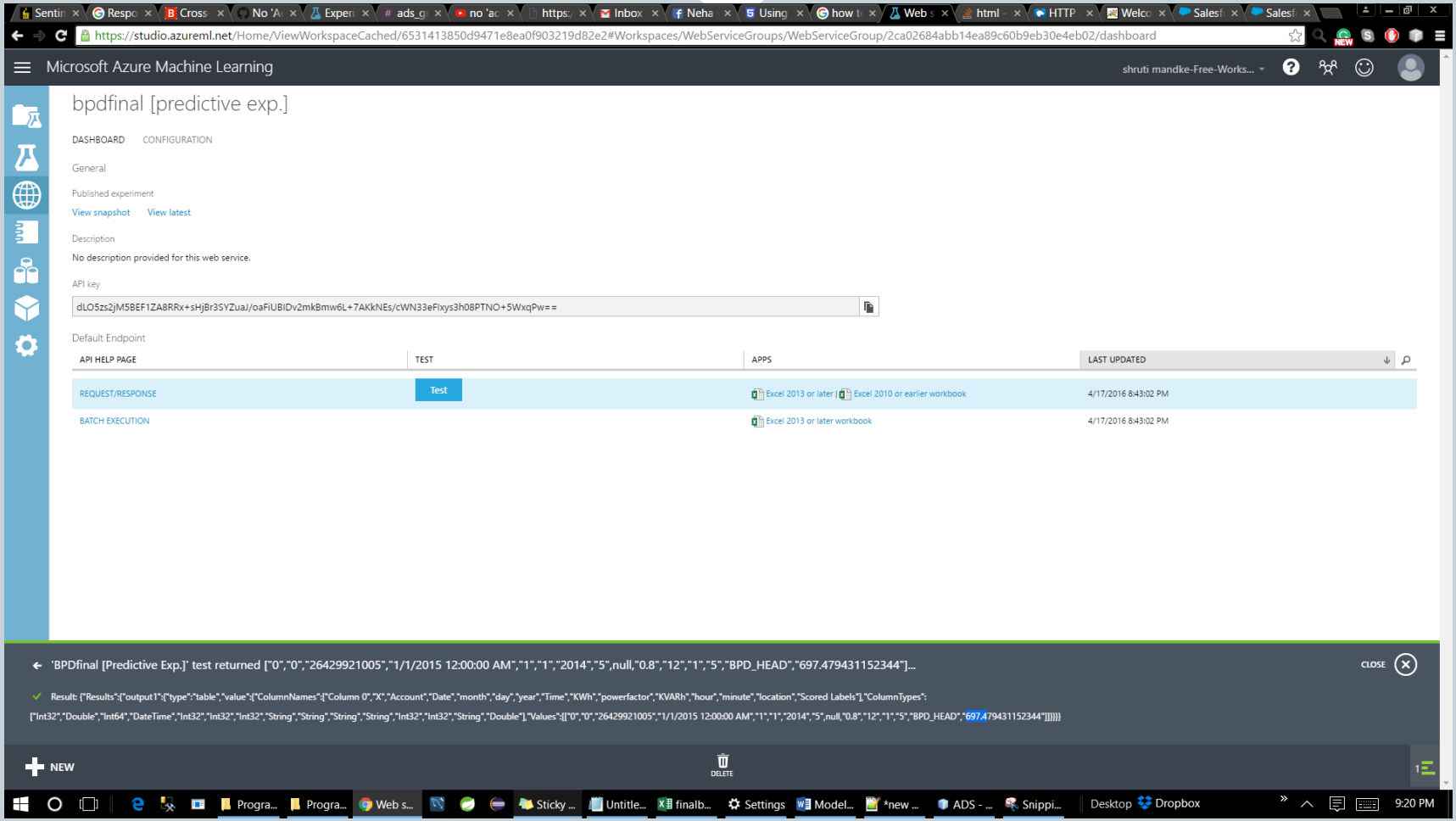
Boosted Decision Tree Regression for Boston Police Department at several places



Deployed Model



Predictive Experiment of Boosted Decision Tree Regression



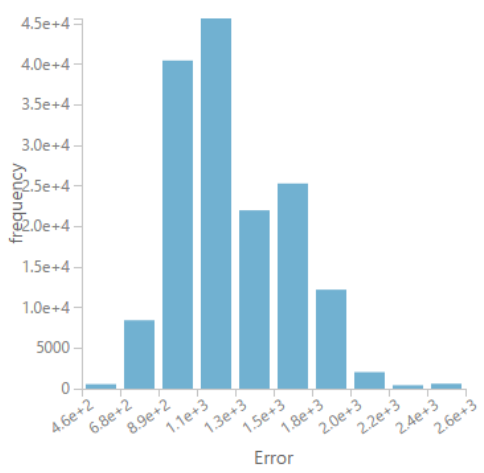
Evaluation Results of Boosted Decision Tree

BPDfinal › Evaluate Model › Evaluation results

Metrics

Mean Absolute Error	1306.434861
Root Mean Squared Error	1344.536808
Relative Absolute Error	9.642065
Relative Squared Error	69.345879
Coefficient of Determination	-68.345879

Error Histogram



Link for Tableau Public

- https://public.tableau.com/views/BPD-Boston-Day/Day?:embed=y&:display_count=yes&:showTabs=y
- https://public.tableau.com/views/BPL-Boston-dashboard/Dashboard1?:embed=y&:display_count=yes&:showTabs=y