

MnV Walkthrough

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2018-08-13

Contents

Step 1	2
Step 2	2
Step 3	2
Step 4	3
Step 5	3
Step 6	4
Step 7	4
Step 8	5
Step 9	5
Step 10	7
Step 11	9
Step 12	9
Step 13	10
Step 14	10

Step 1

Login on the Airtable and click on the **Opportunities Log** tab. Select one of the entries under **Traditional Energy Model M&V** as seen in *Figure 1*.

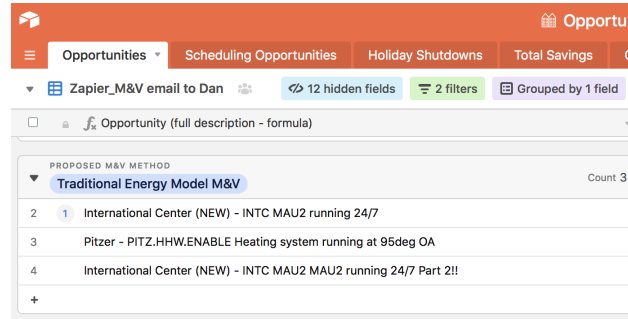


Figure 1: Traditional Energy Model MnV

Step 2

Scroll to the right of the columns until you find *Unique ID* as seen in *Figure 2*.

The screenshot shows the Airtable interface with the 'Unique ID' column circled in red. The view is grouped by 'PROPOSED M&V METHOD'. The 'Traditional Energy Model M&V' group is selected, showing a count of 3. The entries listed are:

PROPOSED M&V METHOD	Month	Proposed M&V Met...	Ready for M&V	Unique ID
(Empty)	Sum 7			Sum 148
1 Life Sciences - LSA-AHU4 OAT sensor failed at 49F	7	yes		148
(Empty)				
Traditional Energy Model M&V	Sum 28			Sum 401
2 International Center (NEW) - INTC MAU2 running 24/7	11	Traditional Energy Mod...	yes	89
3 Pitzer - PITZ.HHW.ENABLE Heating system running at 95deg OA	6	Traditional Energy Mod...	yes	154
4 International Center (NEW) - INTC MAU2 MAU2 running 24/7 Part 2!!	11	Traditional Energy Mod...	yes	158

Figure 2: Unique ID

Step 3

Go to the Jupyter notebook following the path / **UCD_ECO_coding** / **MnV-Tool/ ACE MnV** and make a duplicate of **DC MnV v14-New.ipynb** notebook. Rename it as **{Building Name}_{Unique ID}_{Commodity}** as seen in *Figure 3*.

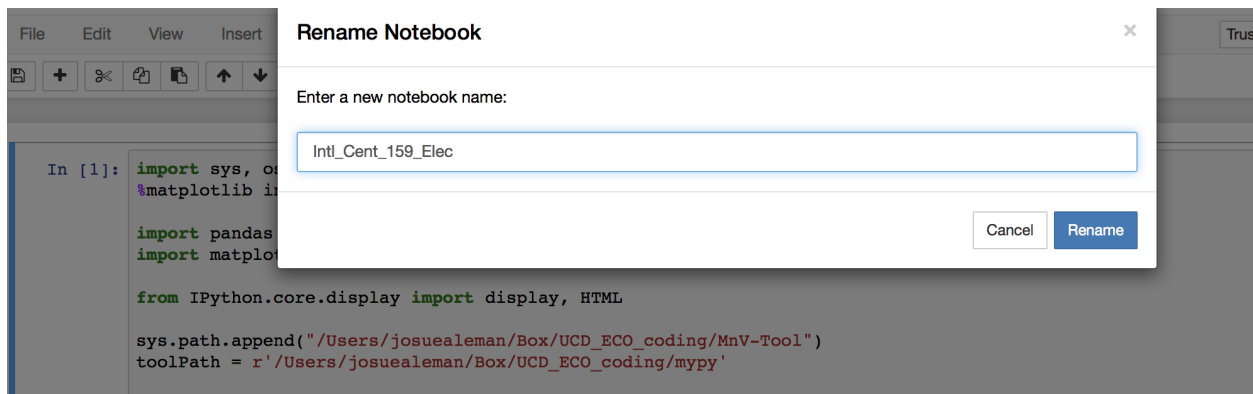


Figure 3: Notebook for Opportunity

Step 4

Ensure that the path to mypy folder and the MnV tool are correct (As seen in *Figure 4*) before running the cell. Once both paths have been added hit **Cmd + [Return]** for Mac or **Ctrl + [Enter]** for Windows to run the cell.

```
In [1]: import sys, os
import matplotlib inline

import pandas as pd
import matplotlib.pyplot as plt

from IPython.core.display import display, HTML

sys.path.append("/Users/josuealeman/Box/UCD_ECO_coding/MnV-Tool")
toolPath = r'/Users/josuealeman/Box/UCD_ECO_coding/mypy'
sys.path.append(toolPath)

#print(sys.path)
#lib_path = os.path.abspath(os.path.join('.', '..')) # relative path of the source code in Box Folder
#sys.path.append(lib_path)
import mnv14 as mnv

#display(HTML("<style>.container { width:90% !important; }</style>"))

pd.set_option('display.max_rows', 50)
pd.set_option('display.max_columns', 50)
pd.set_option('display.width', 500)

print(mnv.version)
```

Path to mnv14 (points to the path in the code)

Path to mypy folder (points to the path in the code)

Printed Version indicates succes! (points to the output 'Version 1.4')

Version 1.4 (circled in the output)

FutureWarning: The pandas.core.datetools module is deprecated and will be removed in a future version. Please use the pandas.tseries module instead.

Figure 4: Notebook for Opportunity

Step 5

Go to the **Pi Data Loading** cell and ensure you search for the correct building and keep *demand_kbtu* to search for the right tag. Wild cards (*) are valid to help search for the tags. Once you have that field correct run the cell (see step 4 on how to run cell). The tags available will be printed out under the cell as seen in *Figure 5*.

PI Data Loading

```
In [2]: from PI_client import pi_client
pi = pi_client()

tags = pi.search_by_point('*international*demand_kbtu')[0]
#tags += pi.search_by_point('*shields*kbtu*')[0]

print(tags)

[u'International_Center_Electricity_Demand_kBtu', u'International_Center_Gas_Demand_kBtu']
```

Bldg

Figure 5: Notebook for Opportunity

Step 6

Go back to the **Opportunities Log** and look for the column *Date issue resolved* and save that date as it will be useful in determining how much data to extract from PI as seen in *Figure 6*.

Opportunities

Scheduling Opportunities

Holiday Shutdowns

Total Savings

Commodity Rates

Cam

Zapier_M&V email to Dan

12 hidden fields

2 filters

Grouped by 1 field

Sort

Color

Opportunity (full description - formula)

31

Date issue resolved

PROPOSED M&V METHOD

(Empty)

Count 1

1

Life Sciences - LSA.AHU4 OAT sensor failed at 49F

8/4/2017

+

PROPOSED M&V METHOD

Traditional Energy Model M&V

Count 3

2

1 International Center (NEW) - INTC MAU2 running 24/7

11/7/2017

3

Pitzer - PITZ.HHW.ENABLE Heating system running at 95deg OA

6/21/2017

International Center (NEW) - INTC MAU2 MAU2 running 24/7 Part 2!!

11/30/2017

Figure 6: Notebook for Opportunity

Step 7

In the notebook, go to the cell called **Pull tags** and select a start date that is at least one year before the *Date issue resolved*. To keep the end date to today's date use the "*". The parameter *interval* should be "1 hour" and the parameter *calculation* should be "calculated" for these models. Run the cell and ensure that you have the right amount of Responses as seen in *Figure 7*.

Pull tags

```
In [4]: startDate = '2016-01-01'
endDate = '*'
interval = '1 hour' #Can be "minute" "hour" "day"
calculation = 'calculated' # Redundant?

data = pi.get_stream_by_point(tags, start=startDate, end=endDate, interval=interval, calculation=calculation)
```

<Response [200]>
<Response [200]>

One "<Response [200]>" per tag

Figure 7: Pulling Data From PI

Step 8

To get a glimpse of the data run the `data.head()` cell, this will display the first five rows of the data. As seen in *Figure 8* each column is a tag and each row index is the timestamp.

In [5]:	data.head()			Column Name = Tag name
Out[5]:				
Index	International_Center_Electricity_Demand_kBtu	International_Center_Gas_Demand_kBtu		
2016-01-01 00:00:00	NaN	NaN		
2016-01-01 01:00:00	NaN	NaN		
2016-01-01 02:00:00	NaN	NaN		
2016-01-01 03:00:00	NaN	NaN		
2016-01-01 04:00:00	NaN	NaN		

Figure 8: Pulling Data From PI

Step 9

Go to the **Data Section** cell and ensure the parameters are correct. Under *column* type the column number you wish to run (remember that is 0 based meaning that the column numbers begin with 0). *IQRmult* should typically be in the range of **3 - 4** depending on how much we may need to exclude and consider outliers. *IQR*, *resampleRate*, *OATsource*, *OATname*, *sliceType*, and *midDate* should remain as the values already listed. Lastly, *dateRanges* should be ['Date Start Pre', 'Date End Pre', 'Date Start Post', 'Date End Post'] all in the format of **YYYY-MM-DD** shown in *Figure 9*. Run the cell to display the various plots shown in *Figure 10* and *Figure 11*. For a deeper understanding on the various plots please consult the data science team.

Data Section

```
In [7]: dataParams = {'column': 0,
                    'IQRmult': 3,
                    'IQR': 'y',
                    'resampleRate': 'D', # 'D' for daily 'H' for hourly
                    'OATsource': 'file', # 'self' or 'file'
                    'OATname': 'OAT', # Name of OAT column if OATsource is 'self' # only needed with sliceType : 'ranges'
                    'sliceType': 'ranges', # half, middate, ranges
                    'midDate': '2017-01-01', # only needed with sliceType : 'middate'
                    'dateRanges': ['2016-11-01', '2017-11-30', '2017-11-30', '2018-08-08'], # only needed with sliceType : 'rang

}

dk = mnv.data_keeper(data, dataParams)
dk.default_clean()

# Plots
dk._outlier_plot()
dk._resampled_plot(yrange=(-100, dk.modifiedData[dk.com].max()*1.1))
dk._pre_post_plot()
```

Figure 9: Data Section Cell

```
Q(75%): 281.96 Q(25%): 83.99
IQR value is 197.97
('IQRupper', 875.88, 'IQRlower', -509.93)
Ceiling adjusted by IQR - Now 875.88
OAT being loaded from master file
```

```
/anaconda2/lib/python2.7/site-packages/seaborn/categorical.py:462: FutureWarning: remove_na is deprecated and is a private function. Do not use.
```

```
box_data = remove_na(group_data)
```

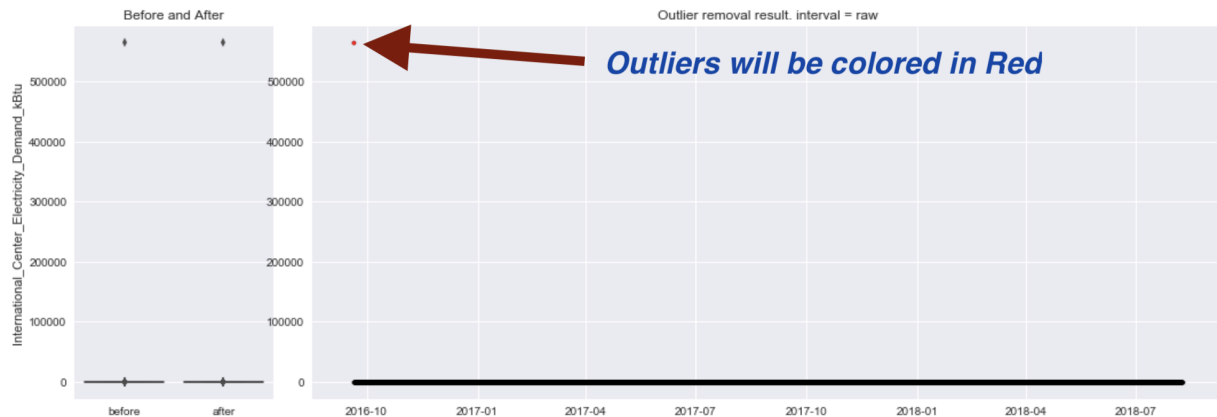


Figure 10: Results of Evaluation and Outlier Plot

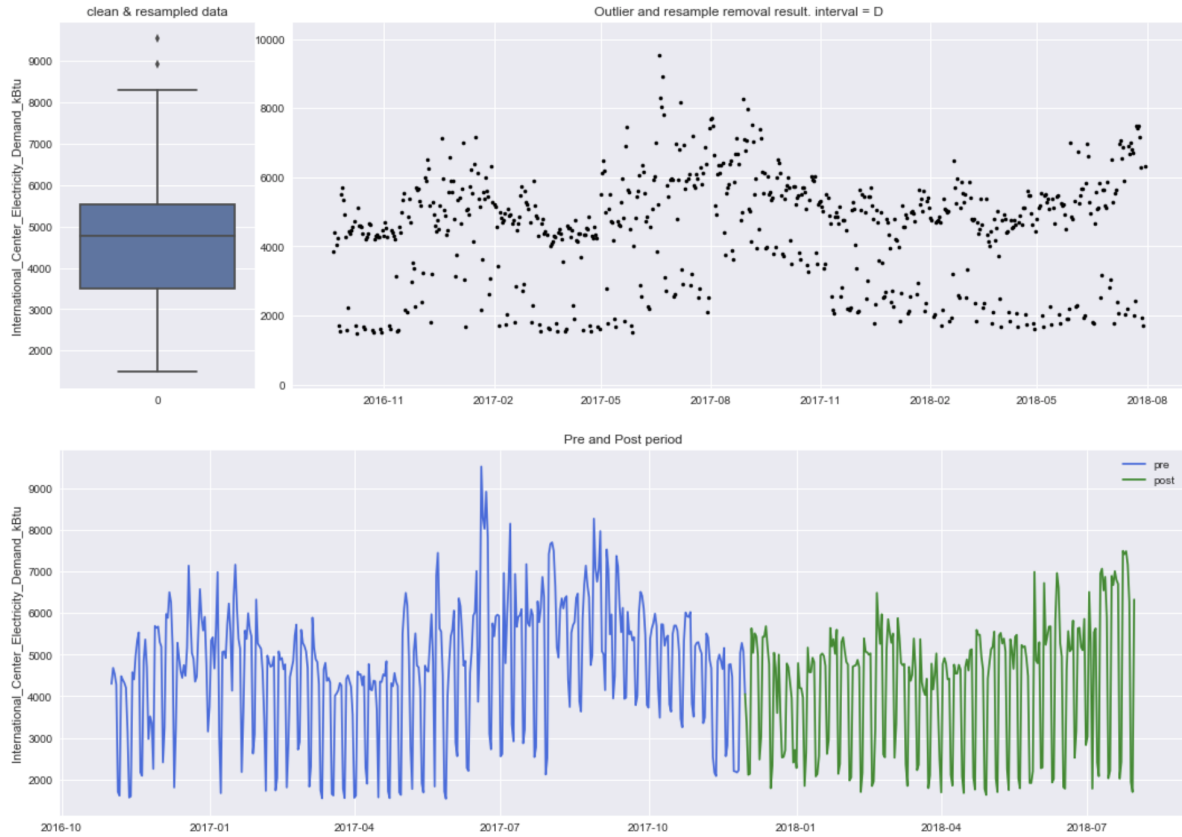



Figure 11: Outlier Resample and Pre and Post Period

Step 10

Once you have ensure that the data and plots look correct proceed to the **Many Linear Models** cell. The only parameter that will need to change is the *commodityRate*. To uncomment the right commodity rate, delete the “#” that is before the desired rate. Remember to only have one commodityRate uncommented, making sure the other rates have the “#” before it as shown in *Figure 12*. You may also select how many results you want to see by changing the *allmod.statsPool[0:5]* to a different range. To view more plots of the top results you may also change the *allmod.plot_pool(1)* to the number of plots you want to see. Once you have the right rate, run the cell which will output the summary of the models as seen in *Figure 13*. As a rule of thumb, a good model will have an **AR2** (Adjusted R^2) value that is **greater** than 0.75 and a **cvrmse** (Coefficient of Variation Root Mean Squared Error) value **less** than 0.3. If the top choice does not meet these requirements please consult the data science team for evaluation.

Many Linear Models

**Only ONE rate
uncommented!**



```
In [8]: modelParams = {'params': ['CDH', 'HDH', 'month', 'hour', 'weekday'],
                        'testTrainSplit': 'random',
                        'randomState': None,
                        'testSize': 0.2,
                        #'commodityRate': 0.0157, #CHW (kBtu)
                        'commodityRate': 0.0190504, #Elec(kBtu)
                        #'commodityRate': 0.0059172, #Steam(kBtu)
                        #'commodityRate': 0.0070000, #Gas (kBtu)
                        'paramPermuteList': ['', 'C(weekday)', 'C(month)']}

allmod = mnv.many_ols(dk.pre, dk.post, modelParams)

allmod.run_all_linear()
print(allmod.statsPool[0:5])
allmod.plot_pool(1)
modelParams['params'] = allmod.statsPool.iloc[0]['params']
```

Figure 12: Many Linear Models

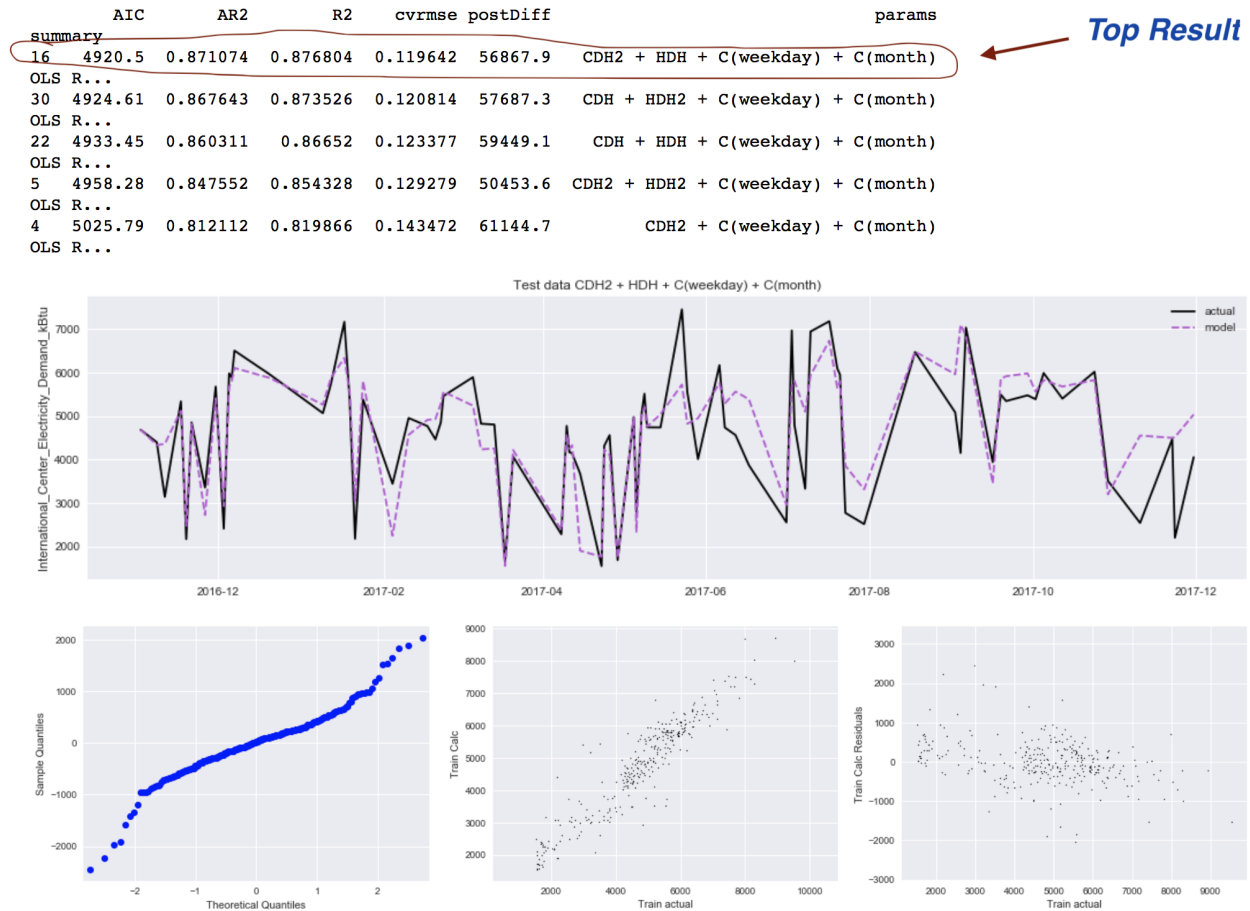


Figure 13: Many Linear Models Pt 2

Step 11

Run the **Single Linear Model** to run a *KFold* as a mean of ensuring that the predictions we are making in *Step 10* are accurate. Once again consult the data science team for further explanation on the plots and the data that is printed.

Step 12

Go to the **Savings** cell and run it. It will display the amount of savings that were made due to the fix in the opportunity as seen in *Figure 14*. The first plot displays the actual usage during the post period (black solid line) and the predicted usage if the fix had not been made (dotted purple line). The second plot shows the positive savings (black dots) and the potential loss (red dots). Lastly, the third plot shows the cumulative savings up to today's date.

Savings

```
In [10]: print(round(mod.postCumsum, 0))
print("Savings = $" +str(round(mod.postCumsum * mod.params.commodityRate,1)))
mod.savings_plot(yaxis='dollars')
```

```
59660.0
Savings = $1136.5
```

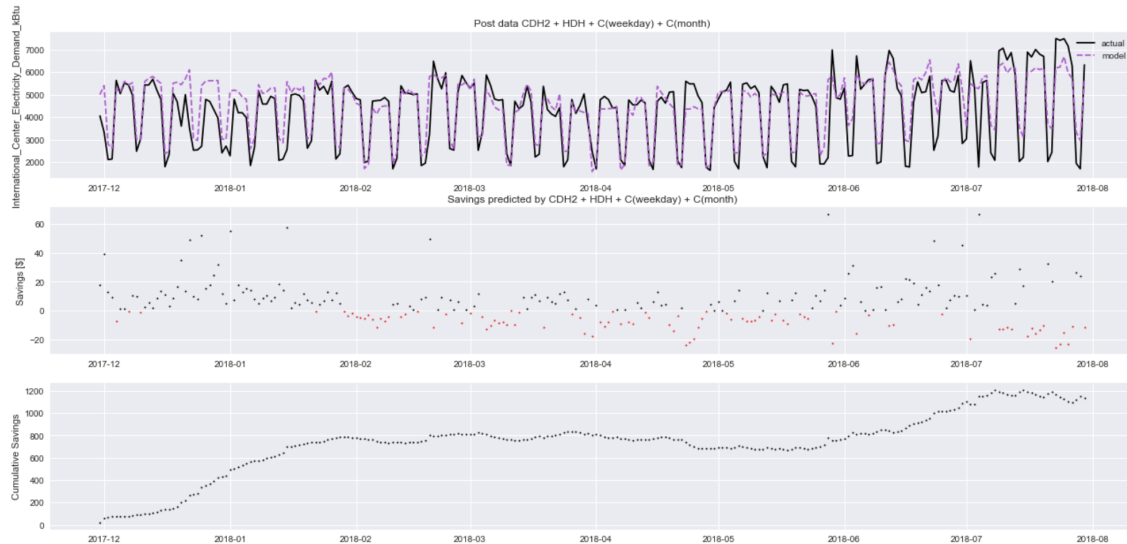


Figure 14: Savings Plots

Step 13

Run the cell which contains the “Estimated Annual Savings” to view how would be saved during the fiscal year due to the fix as seen in *Figure 15*.

```
In [11]: print("Estimated Annual Savings: %0.f" % round(mod.postCumsum/len(dk.post)*365,0))
```

```
Estimated Annual Savings: 89612
```

Figure 15: Estimated Annual Savings

Step 14

Go back to the **Opportunities Log** and copy the field entry name as displayed in *Figure 16*. Paste the copied entry into the *Total Savings* tab under **Opportunity & Commodity** column. Fill out the **Commodity & Unit**, **Commodity & Savings** and **Opportunity Item** columns as seen in *Figure 17*. Continue filling out the **Adjusted R-Squared**, **CVRMSE** columns (From the top AR2 result in the Many Linear Models shown in *Figure 13*). The **Start Date** column will contain the date of the Start Post Period and the **Date of Modeled Savings** column will contain the End Post Period date. The **Actual FY 17-18 Savings** column should have the number from the **Savings** cell in *Figure 14*. Lastly, the **Projected FY 17-18 Savings** column should have the number from the **Estimated Annual Savings** cell shown in *Figure 15*.

The screenshot shows the 'Opportunities' tab in a software interface. A modal window displays details for an opportunity titled 'International Center (NEW) - INTC MAU2 MAU2 running 24/7 Part 2!!'. The modal includes a 'PROPOSED M&V METHOD' section with a dropdown menu set to '(Empty)'. Below this, there is a list of items, with the first item being 'Life Sciences - LSA.AHU4 OAT sensor failed a'. The modal also features a 'DATE ISSUE RESOLVED' field with the date '11/30/2017' and an 'OPPORTUNITY (BRIEF DESCRIPTION)' field containing the text 'MAU2 running 24/7 Part 2!!'.

Figure 16: Opportunities Log

The screenshot shows the 'Total Savings' tab in a software interface. The table displays a list of opportunities and their associated savings. The table has columns for 'Opportunity & Commodity', 'Commodity & unit', 'Commodity & Savings Units', 'Rate', 'Building', and 'Opportunity Item'. The first row of data shows 'International Center (NEW) - INTC MAU2 MAU2 running ...' with a rate of '\$0.0191' and a building of 'International Center (NEW)'.

Opportunity & Commodity	Commodity & unit	Commodity & Savings Units	Rate	Building	Opportunity Item
International Center (NEW) - INTC MAU2 MAU2 running ...	Electricity kBTu	Electricity kBTu	\$0.0191	International Center (NEW)	International Center (NEW) - INTC MAU2 MAU2 ru...

Figure 17: Total Savings Tab

Opportunities	Scheduling Opportunities	Holiday Shutdowns	Total Savings	Commodity Rates	Campus Buildings	Import from UCD Bldg Profiles	Survey
Grid view	4 hidden fields	Filter	Group	Sort	Color		
Opportunity & Commodity	Adjusted R-Squared	CVRMSE	Model or Bin Sim	Start Date	Date of Modeled Sa...		
International Center (NEW) - INTC MAU2 MAU2 running87	.12	model	11/30/2017	8/8/2018		

Figure 18: AR2, CVRMSE, Start/End Post Period

Opportunities	Scheduling Opportunities	Holiday Shutdowns	Total Savings	Commodity Rates	Campus Buildings	Import from UCD Bldg Profiles	Survey - Lab	SHA
Grid view	4 hidden fields	Filter	Group	Sort	Color			
Opportunity & Commodity	Actual FY 17-18 Savings (kWh, TonH, k...	Projected Annual Savings (kWh, TonH, kLB...	Actual FY 17-18 \$ S...	Projected Annual \$...				
International Center (NEW) - INTC MAU2 MAU2 running ...	59660	89612	\$1,137	\$1,707				

Figure 19: Actual/Projected Savings