HW 0 (Practice Mode)

Canvas assignment link for submission and due date.

Objective:

- familiarize with the use of basic functions in python packages
- familiarize with the use of python notebook: compile all cells to show results

Assessment:

- successful run of the Markdown and Python notebook cells.
- succesfull submission on git link by the due date.

Keep the following in mind for **all** notebooks you develop:

1. Structure your notebook. Use headings with meaningful levels in Markdown cells, and explain the questions each piece of code is to answer or the reason it is there.
2. Make sure your notebook can always be rerun from top to bottom.
3. **DO NOT** erase notebook cells provided.

Setup

This section loads the relevant Python modules and does any configuration needed for the notebook to work.

Lets import python packages we will use in this homework:

- numpy - scientific computing package
- pandas - python data analysis package
- seaborn - statistical data visualization package

```
import numpy as np
import pandas as pd
import seaborn as sns
```

Introduction to Pandas

In this chapter you will use pandas commands

Q1: Read the data file using Pandas. **Note** When we run your experiment to test for correctness, we assume that the day.csv is in the ../data/ folder relative to your HW1.ipynb.

1. **Download the Capital Bike Share data set** from https://archive.ics.uci.edu/ml/datasets/bike+sharing+dataset. Click 'Data Folder', download the zip file, and extract the `day.csv` file.
- get used to downloading data files and saving them to correct hierarchy.
- big part of projct and source versioning practice

1. Read the Data File: use Pandas read_csv[] function to read the file into `bikes` dataframe.
   - Our data file does not have column headers, so we need to specify the names. [read_csv]: https://pandas.pydata.org/pandas-docs/stable/reference/api/pandas.read_csv.html

A1 Replace the ? mark with your answer in the python cell below.

```
bikes = pd.read_csv("../HW/data/day.csv")
```

Q2: Use `head` to show the first few rows of the table:

- brief preview is a safety check you are exploring the correct data frame

A2 Replace the ? mark with your answer

```
bikes.head(5)
```

```
   instant      dteday  season  yr  mnth  holiday  weekday  workingday
\
0        1  2011-01-01       1   0     1        0        6           0

1        2  2011-01-02       1   0     1        0        0           0

2        3  2011-01-03       1   0     1        0        1           1

3        4  2011-01-04       1   0     1        0        2           1

4        5  2011-01-05       1   0     1        0        3           1


   weathersit      temp     atemp       hum  windspeed  casual
registered  \
0           2  0.344167  0.363625  0.805833   0.160446     331
654
1           2  0.363478  0.353739  0.696087   0.248539     131
670
2           1  0.196364  0.189405  0.437273   0.248309     120
1229
3           1  0.200000  0.212122  0.590435   0.160296     108
1454
4           1  0.226957  0.229270  0.436957   0.186900      82
1518

    cnt
0   985
1   801
2  1349
3  1562
4  1600
```

Q3: Use `info` to show a description of the columns, along with the shape and memory use of the data frame:

- `.info()` or `.head()` can be called in the same cell as data load
- we separate them out in this notebook so that we can discuss them in the markdown cells, but we can combine them in the future.

A3 Replace the ? mark with your answer in the python cell below

```
bikes.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 731 entries, 0 to 730
Data columns (total 16 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   instant     731 non-null    int64  
 1   dteday      731 non-null    object 
 2   season      731 non-null    int64  
 3   yr          731 non-null    int64  
 4   mnth        731 non-null    int64  
 5   holiday     731 non-null    int64  
 6   weekday     731 non-null    int64  
 7   workingday  731 non-null    int64  
 8   weathersit  731 non-null    int64  
 9   temp        731 non-null    float64
 10  atemp       731 non-null    float64
 11  hum         731 non-null    float64
 12  windspeed   731 non-null    float64
 13  casual      731 non-null    int64  
 14  registered  731 non-null    int64  
 15  cnt         731 non-null    int64  
dtypes: float64(4), int64(11), object(1)
memory usage: 91.5+ KB
```

Q4: Pandas provide a very useful function for exploring statistical properties of dataframe, and allow us to see data composition for numerical columns. Use pandas build-in function and show statistical information for columns.

A4: Replace the ? mark with your answer in the python cell below

```
bikes.describe()
```

```
          instant      season          yr        mnth     holiday  \
count  731.000000  731.000000  731.000000  731.000000  731.000000   
mean   366.000000    2.496580    0.500684    6.519836    0.028728   
std    211.165812    1.110807    0.500342    3.451913    0.167155   

          weekday  
count  731.000000  
mean     2.997264  
std      2.004787  
```

```
2.004787
min      1.000000    1.000000    0.000000    1.000000    0.000000
0.000000
25%    183.500000    2.000000    0.000000    4.000000    0.000000
1.000000
50%    366.000000    3.000000    1.000000    7.000000    0.000000
3.000000
75%    548.500000    3.000000    1.000000   10.000000    0.000000
5.000000
max    731.000000    4.000000    1.000000   12.000000    1.000000
6.000000

       workingday  weathersit        temp       atemp         hum
windspeed  \
count  731.000000  731.000000  731.000000  731.000000  731.000000
731.000000
mean     0.683995    1.395349    0.495385    0.474354    0.627894
0.190486
std      0.465233    0.544894    0.183051    0.162961    0.142429
0.077498
min      0.000000    1.000000    0.059130    0.079070    0.000000
0.022392
25%      0.000000    1.000000    0.337083    0.337842    0.520000
0.134950
50%      1.000000    1.000000    0.498333    0.486733    0.626667
0.180975
75%      1.000000    2.000000    0.655417    0.608602    0.730209
0.233214
max      1.000000    3.000000    0.861667    0.840896    0.972500
0.507463

            casual   registered          cnt
count   731.000000   731.000000   731.000000
mean    848.176471  3656.172367  4504.348837
std     686.622488  1560.256377  1937.211452
min       2.000000    20.000000    22.000000
25%     315.500000  2497.000000  3152.000000
50%     713.000000  3662.000000  4548.000000
75%    1096.000000  4776.500000  5956.000000
max    3410.000000  6946.000000  8714.000000
```

Q5: Use pandas functions for filtering the dataframe rows based on some column values. Find out number of rows where the value of the **temp** column is more than the average value of **temp** for the dataset.

Steps:

1. Find out the mean value of the temp column
2. Filter the rows where temp is grater than the mean value
3. Get the number of rows in the filtered dataframe.

A5: Replace the ? mark with your answer in python cell below

```
mean_value = bikes[ 'temp' ].mean()
filtered_dataframe = bikes[ bikes.temp>mean_value ]
row_count = filtered_dataframe.shape[ 0 ] # or len( filtered_dataframe
)

print(row_count)
```

```
367
```

Numpy

We now use Numpy for doing some mathematical calculation on the dataset.

Q6: Now, use numpy for working with below tasks

1. At first convert the dataframe into a numpy array
2. Print the shape of the numpy n-dimensional array
3. select and print rows from *100 to 105*

A6: Replace the ? mark with your answer

```
num_array = bikes.to_numpy() # convert the dataframe
print( num_array.shape ) #print the shape
print( num_array[100:106] ) # print rows from 100 to 105
```

```
(731, 16)
[[101 '2011-04-11' 2 0 4 0 1 1 2 0.595652 0.565217 0.716956 0.324474
855
  2493 3348]
 [102 '2011-04-12' 2 0 4 0 2 1 2 0.5025 0.493054 0.739167 0.274879 257
  1777 2034]
 [103 '2011-04-13' 2 0 4 0 3 1 2 0.4125 0.417283 0.819167 0.250617 209
  1953 2162]
 [104 '2011-04-14' 2 0 4 0 4 1 1 0.4675 0.462742 0.540417 0.1107 529
2738
  3267]
 [105 '2011-04-15' 2 0 4 1 5 0 1 0.446667 0.441913 0.67125 0.226375
642
  2484 3126]
 [106 '2011-04-16' 2 0 4 0 6 0 3 0.430833 0.425492 0.888333 0.340808
121
  674 795]]
```

Q7: Lets put it all together

1. Create a new numpy array selecting column number 10 - 13.
2. Sort the numpy array in ascending order based on the 2nd column of our new numpy array.

3. Print first 5 rows of the sorted numpy array

A7: Replace the ? mark with your answer in the cell below

```
new_array = num_array[:,10:14] #[row:row, col:col]

sorted_array = new_array[ np.argsort(new_array[:, 1]) ]

print( sorted_array[0:5, :] )
```

```
[[0.385668 0.0 0.261877 46]
 [0.391404 0.187917 0.507463 532]
 [0.426129 0.254167 0.274871 3252]
 [0.492425 0.275833 0.232596 2230]
 [0.315654 0.29 0.187192 531]]
```

Seaborn Plotting 1

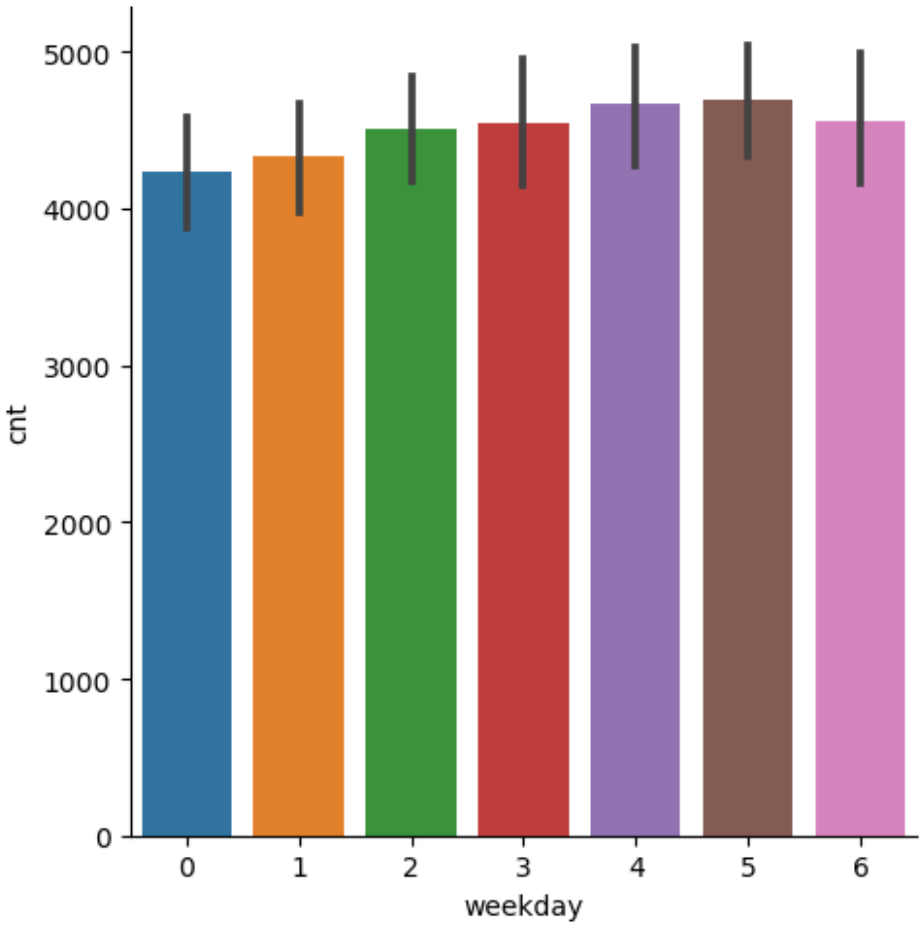
Seaborn package is used to plot the data. For every question in this chapter use the **bikes dataframe** for answering the questions.

Q8: Make a bar plot showing the mean number of riders (y-axis) per weekday (x-axis) using seaborn `catplot` method.

A8: Replace the ? mark with your answer

```
mean_riders = sns.catplot( x='weekday', y='cnt', data=bikes,
kind='bar' )
```

```
c:\Users\Isaac\anaconda3\Lib\site-packages\seaborn\axisgrid.py:118:
UserWarning: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```



Analysis

The X-axis labels are not very helpful as day 0 is not clear. This is a question about how the data is *coded*. We'll talk more about data encoding next week. Unfortunately, the data documentation doesn't actually say how weekdays are coded! But we can infer from the data in this case: first data point is January 1, 2011, which was a Saturday, coded as weekday 6; it then resets to 0 for the next day, and starts counting up. Often, we will not be able to infer the data encoding from the data itself - we need to consult the codebook or data set description. We got lucky this time. But looking at the data can help us make sense of the codebook.

Lesson here is to always look at your data.

Q9: Turn these weekday numbers into a *categorical* variable so Pandas knows how to label them. Hint: use pandas.Categorical.from_codes().

A9: Replace the ? mark with your answer in the python cell below

```
codes = pd.CategoricalDtype( categories=['Monday', 'Tuesday',
'Wednesday', 'Thursday', 'Friday', 'Saturday', 'Sunday'], ordered=True
)

bikes['day_names'] =
```

```
pd.Categorical.from_codes( codes=bikes['weekday'], dtype=codes )
bikes.head()
```

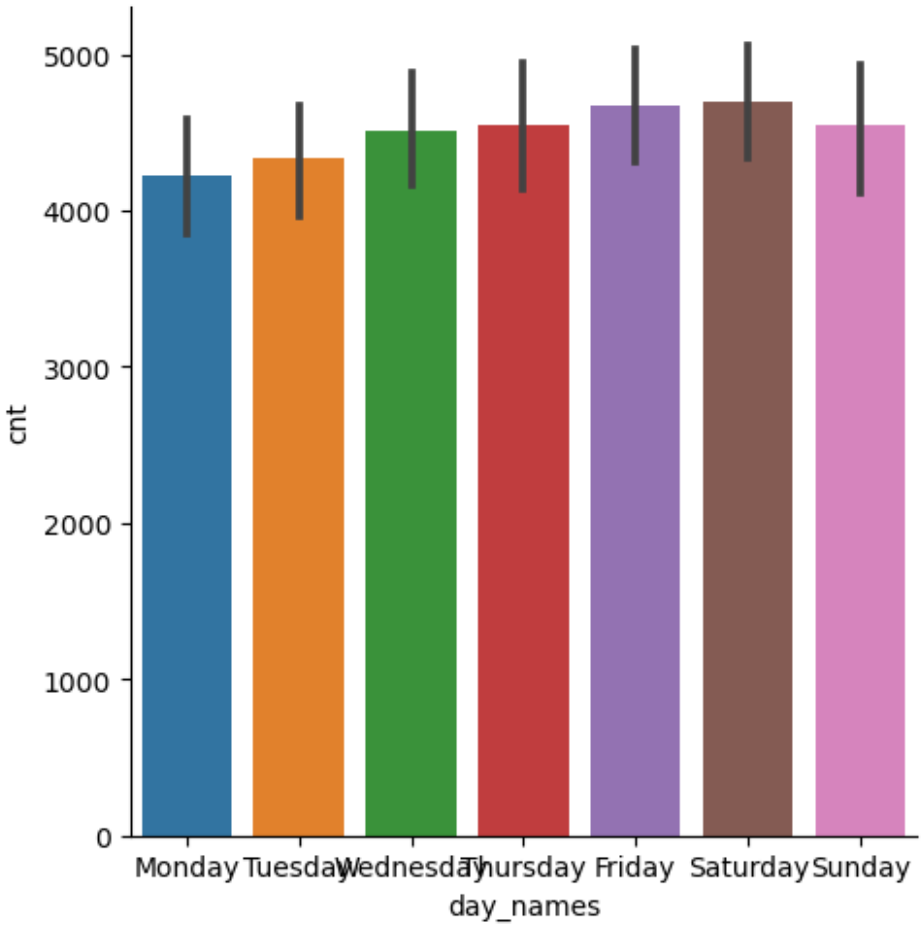
```
   instant      dteday  season  yr  mnth  holiday  weekday  workingday
\
0        1  2011-01-01       1   0     1        0        6           0

1        2  2011-01-02       1   0     1        0        0           0

2        3  2011-01-03       1   0     1        0        1           1

3        4  2011-01-04       1   0     1        0        2           1

4        5  2011-01-05       1   0     1        0        3           1


   weathersit      temp     atemp       hum  windspeed  casual
registered  \
0           2  0.344167  0.363625  0.805833   0.160446     331
654
1           2  0.363478  0.353739  0.696087   0.248539     131
670
2           1  0.196364  0.189405  0.437273   0.248309     120
1229
3           1  0.200000  0.212122  0.590435   0.160296     108
1454
4           1  0.226957  0.229270  0.436957   0.186900      82
1518

    cnt  day_names
0   985     Sunday
1   801     Monday
2  1349    Tuesday
3  1562  Wednesday
4  1600   Thursday
```

A10: Plot new data using seaborn `catplot`, where data=bikes, x-axis is `day_names` and y-axis is `cnt`

A10: Replace the ? mark with your answer in the python cell below

```
mean_riders = sns.catplot( x='day_names', y='cnt', data=bikes,
kind='bar' )
```

```
c:\Users\Isaac\anaconda3\Lib\site-packages\seaborn\axisgrid.py:118:
UserWarning: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```



You have now now plotted the average rides per day.
Note: When we do not tell `catplot` what to do with multiple points for the same value (in this case the weekday name), it computes the mean and a bootstrapped 95% confidence interval.

Seaborn Polotting 2: View Data over Time

Lets explore how did rides-per-day change over the course of the data set?

- This kind of data - a sequence of data points associated with times - is called a *time series*.

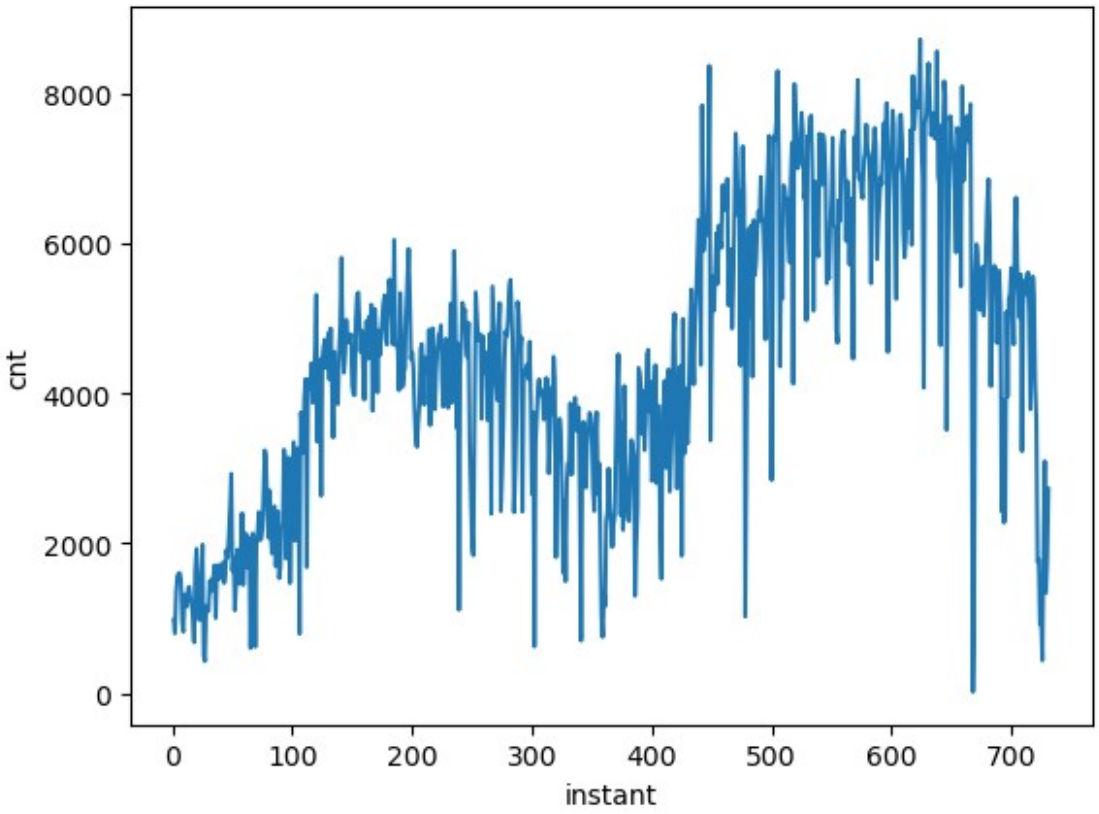
- This data set gives us an `instant` column that records the data number since the start of the data set

Q11: Use seaborn.lineplot() where data=bikes, x-axis is `instant` and y-axis is `cnt` value.

A11: Replace the ? mark with your answer in the python cell below

```
sns.lineplot( x='instant', y='cnt', data=bikes )
```

```
<Axes: xlabel='instant', ylabel='cnt'>
```



Lets view this graph for actual times on x-axis. The `dteday` column records the date. We can transform `dteday` column to the actual date comlumn using pandas.to_datetime() method on the column:

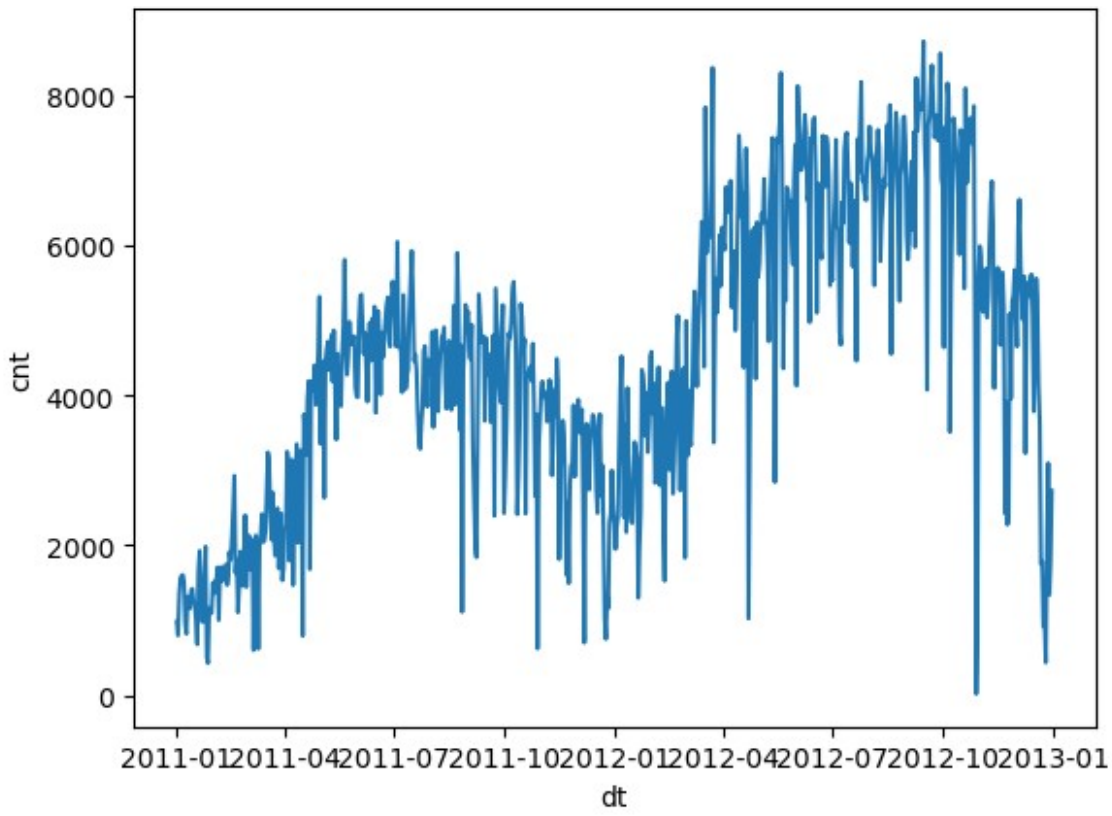
```
bikes['dt'] = pd.to_datetime(bikes['dteday'])
```

Q12: Now create a plot using seaborn.lineplot() where data=bikes, x-axis is `dt` and y-axis is `cnt` value.

A12: Replace the ? mark with your answer

```
sns.lineplot( x='dt', y='cnt', data=bikes )
```

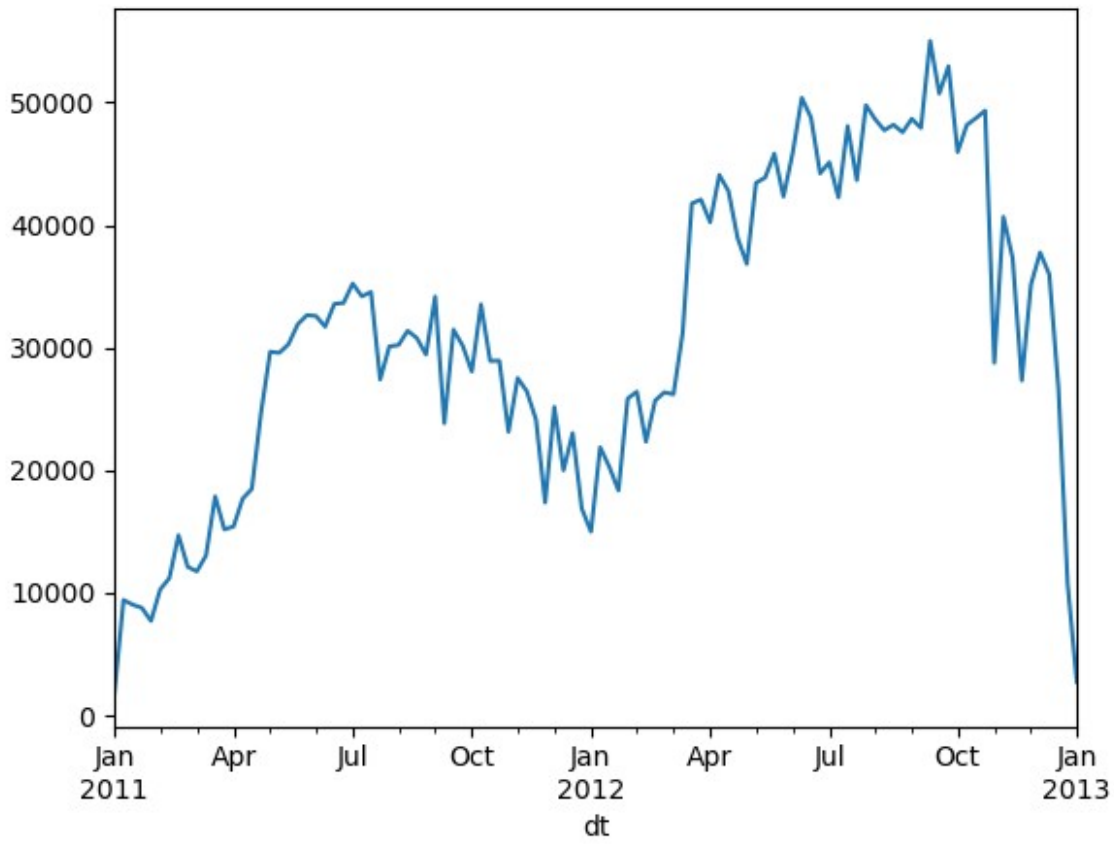
```
<Axes: xlabel='dt', ylabel='cnt'>
```



Next, plot the *weekly* rides by resampling. Right now, our `bikes` data is indexed by row number in the CSV file. We can change its index to another column, such as our `dt` column with the date, which then lets us do things like resample by week:

```
bikes.set_index('dt')['cnt'].resample('1W').sum().plot()
```

```
<Axes: xlabel='dt'>
```



What that code did, in one line, is:

1. Set the data frame's index to `dt` (`bikes.set_index('dt')`), returning a new DF
2. Select the count column (`['cnt']`), returning a series
3. Resample the series by week (`.resample('1W')`)
4. Combine measurements within each sample by summing them (`.sum()`)
5. Plotting the results using Pandas' defaults (`.plot()`)

Pandas default plotting functions are useful for quick plots to see what's in a data frame or series. They often are difficult to use to turn in to publication-ready charts.

Q13: Save the modified dataframe in csv format using pandas *to_csv()* function. Give the file name as **day_output**

A13: Replace the ? mark with your answer

```
bikes.to_csv( "day_output.csv" )
```

Submission Instructions

1. Run all cells in `ECpracticeSubmission.ipynb` and make sure there are no errors
2. Print `ECpracticeSubmission.ipynb` to pdf file
3. Create a Folder HW0 and Upload `ECpracticeSubmission.ipynb`, `ECpracticeSubmission.pdf` and `day_output.csv` files to your git repo allocated

for this course e.g: https://git.txstate.edu/NetID/netid before the deadline. Make Sure Instructor and TA has access for the repo.