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Laboratory 21: "Towards Hypothesis Testing"

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ENGR 1330 Laboratory 21 - In-Lab

Hypothesis Testing

Hypothesis tests are methods to quantify if two groups of data are similar or different. In this lab we will just get started using mostly exploratory data analysis and histograms, and will explore the concept in increasing detail over the next few labs.

First import some necessary packages:

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

Next lets get a database to work with, in this case the database is simply two collections of numerical values.

In [2]:
```
######### CODE TO AUTOMATICALLY DOWNLOAD THE DATABASE #################
#! pip install requests #install packages into local environment
import requests # import needed modules to interact with the internet
# make the connection to the remote file (actually its implementing "bash curl -O http:
remote_url = 'http://54.243.252.9/engr-1330-webroot/8-Labs/Lab21/Lab21_data.csv' # a cs
response = requests.get(remote_url) # Gets the file contents puts into an object
output = open('Lab21_data.csv', 'wb') # Prepare a destination, local
output.write(response.content) # write contents of object to named local file
output.close() # close the connection
```

In [3]:
```
mydata = pd.read_csv("Lab21_data.csv")
mydata
```

Out[3]:

	Set1	Set2
0	46.688625	512.459480
1	44.825192	480.551364
2	71.453564	560.502112
3	30.360172	503.885912
4	47.657087	458.124749
...	...	...
95	60.040915	462.122309

	Set1	Set2
96	21.527991	509.909507
97	59.523999	572.309957
98	38.173070	562.580099
99	39.671168	497.784981

100 rows × 2 columns

Question 1

What are the names of the two series in "mydata"?

The two names are Set1 and Set2.

Question 2

Describe the two data series, which has a larger mean value, which has a larger variance?

In [4]:
```
# put your answer here
import statistics
mydata.describe()
```

Out[4]:

	Set1	Set2
count	100.000000	100.000000
mean	48.566581	508.276381
std	15.861475	47.978391
min	13.660911	408.244489
25%	38.229562	470.288351
50%	49.369139	507.096010
75%	59.580899	541.199481
max	86.356515	629.497949

In [5]:
```
set1 = statistics.mean(mydata['Set1'])
set2 = statistics.mean(mydata['Set2'])
print('Set one mean is:', set1)
print('Set two mean is:', set2)
```

```
Set one mean is: 48.566581065754555
Set two mean is: 508.2763812929764
```

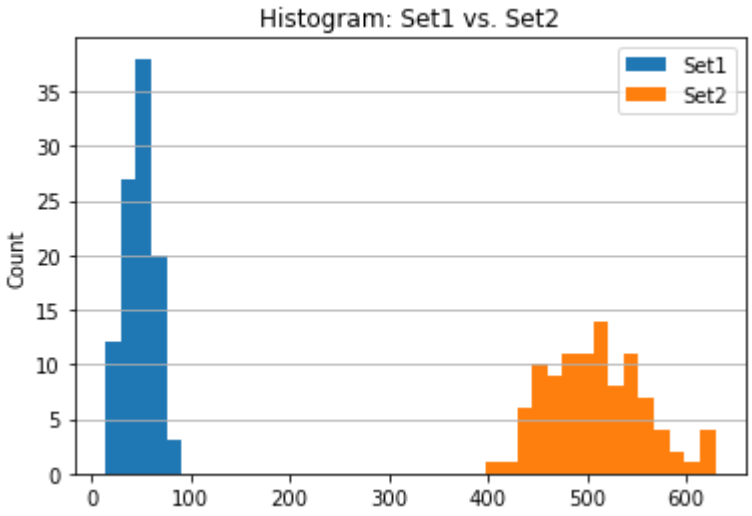
In [6]:
```
mydata.var()
```

Out[6]:
```
Set1     251.586400
Set2    2301.925985
dtype: float64
```

Set2 has a higher mean value, and set two also has a higher variance

Now lets prepare histograms of the two data series, an easy way to generate two histoprgams on the same plot is listed below

In [7]:
```
fig, ax = plt.subplots()
mydata.plot.hist(density=False, ax=ax, title='Histogram: Set1 vs. Set2', bins=40)
ax.set_ylabel('Count')
ax.grid(axis='y')
```



Question 3:

Are the two data series similar or not?

Describe (using words, and sentences, not the method) how the series are different.

No the two data series are not similar at all as they vary largely in their values and their spread.

Now lets generate two more series using the descriptive statistics from "Set1" and "Set2"

In [8]:
```
set1_s = np.random.normal(np.array(mydata['Set1']).mean(), np.array(mydata['Set1']).std
set2_s = np.random.normal(np.array(mydata['Set2']).mean(), np.array(mydata['Set2']).std
```

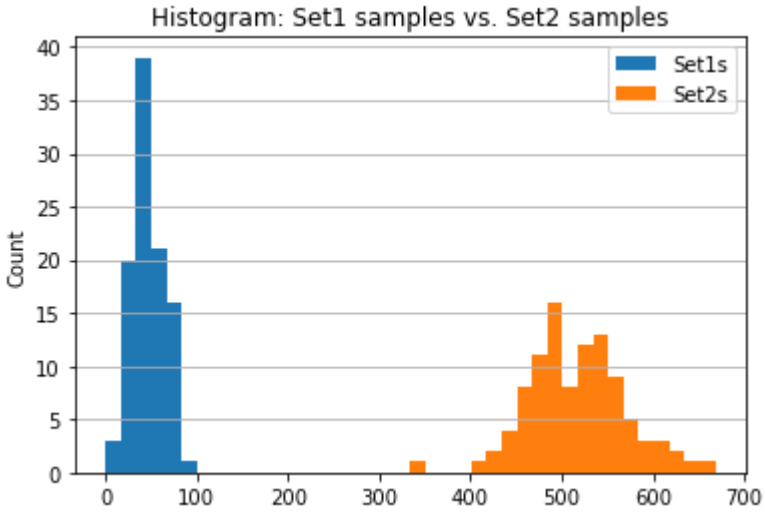
Put these into a new dataframe

In [9]:
```
mydata_d = pd.DataFrame({'Set1s':set1_s,'Set2s':set2_s}) # make into a dataframe _d ==
```

Now lets prepare histograms of the two data series, an easy way to generate two histograms on the same plot is listed below

In [10]:
```
fig, ax = plt.subplots()
mydata_d.plot.hist(density=False, ax=ax, title='Histogram: Set1 samples vs. Set2 sample
```

```
ax.set_ylabel('Count')
ax.grid(axis='y')
```



Question 4:

Are the two new data series similar or not?

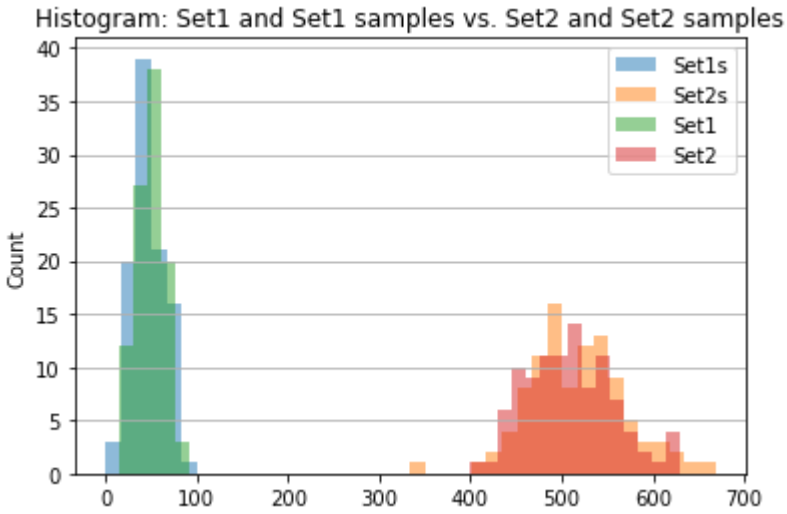
Describe (using words, and sentences, not the method) how the series are different.

The two new data sets are very similar and that can be clearly seen from the graph.

SET1 AND SET1S LOOK TIGHTLY PACKED TOGETHER. SET2 AND SET2S HAVE A WIDER SPREAD AROUND THE SAME AREA.

Now lets examine all 4 data series. First a histogram of all 4 on the same graph

In [11]:
```
fig, ax = plt.subplots()
mydata_d.plot.hist(density=False, ax=ax, title='Histogram: Set1 and Set1 samples vs. Se
mydata.plot.hist(density=False, ax=ax, bins=40,alpha=0.5)

ax.set_ylabel('Count')
ax.grid(axis='y')
```



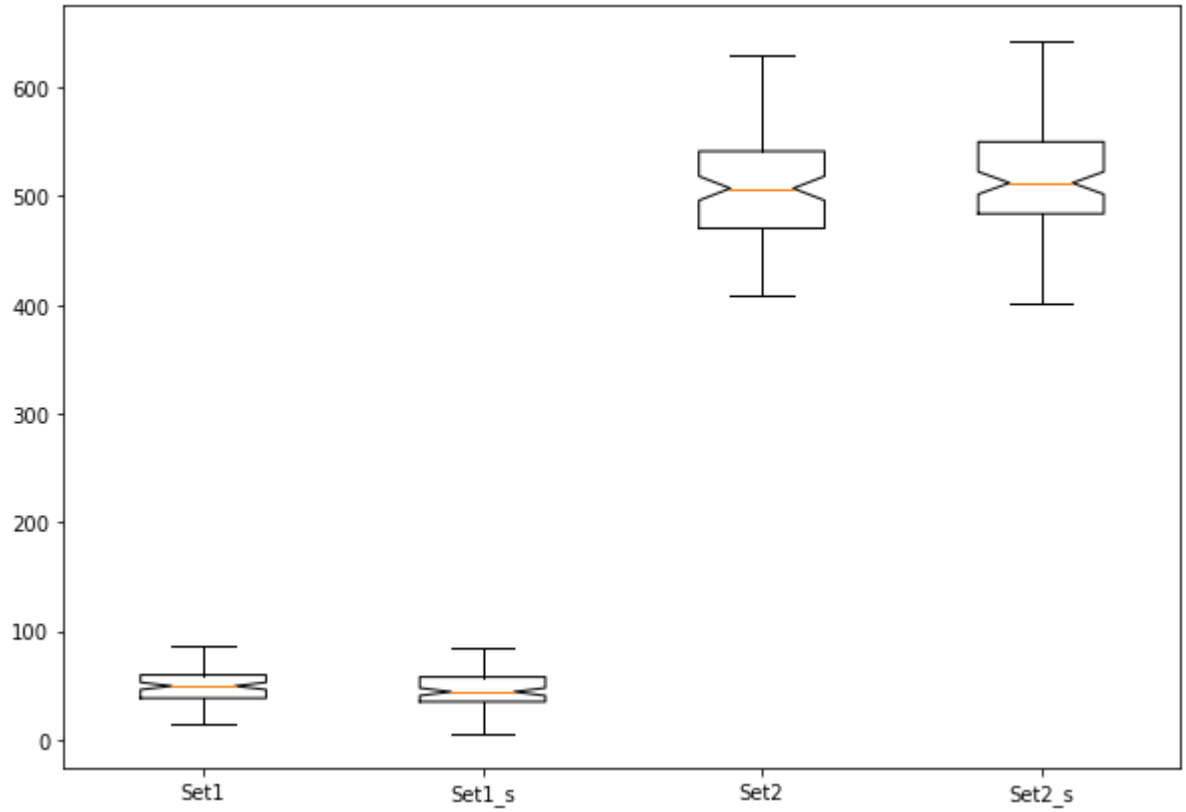
Question 5:

Are the series "Set1" and "Set1s" the same or different? How do they compare? What about series "Set2" and "Set2s"?

In [19]:
```
# The set1 and set1s are very similar but they are not exactly the same as set1 reaches

# Set2 and set2s are also very similar in which set2s reaches a higher total value. Sam
```

Another graphical tool is a set of boxplots

In [12]:
```
fig = plt.figure(figsize =(10, 7))

set1 =mydata['Set1']
set2 = mydata['Set2']

plt.boxplot ([set1, set1_s, set2, set2_s],1, '')
plt.xticks([1, 2, 3, 4], ['Set1', 'Set1_s', 'Set2', 'Set2_s'])
plt.show()
```



Question 6

Interpret the results of the boxplot. Are the Set2 "collections" different from the Set1 "collections"?

Set1 and set1s are extremely similar in their boxplots.

set2 and set2s are extremely similar in their boxplots as well.

however set 2 collections and set1 collections are extremely different.

Question 7

Suppose we are comparing the arithmetic means of the 4 collections. Are the mean values of "Set1" and "Set2" far apart?

How many "Set1" standard deviations is the "Set1" mean value from "Set2"? How about the converse (Set2 deviations)?

In [15]:
```
# The mean values of set1 and set2 are very far apart.
# The std of set1 was 15.8 and the mean for set 2 was 508.
(508 - 42) / 15 # set 1
```

Out[15]: 31.066666666666666

In [16]:
```
(508 - 42) / 48 # set 2
```

Out[16]: 9.708333333333334

Question 8

Visit SixSigma and after reading the Wiki, decide if the Set1 and Set2 collections are far enough apart to be considered "statistically" different. Repeat with Set1 and Set1s - are they far apart?

In [17]:
```
# Yes the two are statistically different
mydata_d.describe()
mydata.describe()
```

Out[17]:

	Set1	Set2
count	100.000000	100.000000
mean	48.566581	508.276381
std	15.861475	47.978391
min	13.660911	408.244489
25%	38.229562	470.288351
50%	49.369139	507.096010
75%	59.580899	541.199481
max	86.356515	629.497949

Exercise: What is the meaning of "statistically significant difference" ?

```
Statistically significant difference is when the data sets you are
comparing are over a certain standard devation apart from each other.
```

Make sure to cite any resources that you may use.

Statistically significant difference refers to a difference in values that leads the overall trend of the data to differ. This means it mathematically makes a major difference/impact on the sysytem.