Import Python Libraries

Libraries Used

Pandas

Data manipulation and analysis

MatPlotLib Pyplot

2D plotting

Numpy

Supports large, multi-dimensional arrays and matrix manipulation and high level mathematical functions on these arrays

Scipy Stats

Hypothesis testing

In [1]:

```
# Perform library imports
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import scipy.stats as stats
```

Import Data Dictionaries to Convert Codes to Descriptions

Sources

Non-Profit Data - NCSS Data Archive: https://nccs-data.urban.org/dd2.php?close=1&form=BMF+08/2016 (https://nccs-data.urban.org/dd2.php?close=1&form=BMF+08/2016)

Region Data - ...

Non-Profit Method

- Created text files in json format within Visual Studio for each Data Dictionary
- Saved files to Resources folder
- Used pandas library to read the files into dataframes

In [2]:

```
# Import Level1 Data Dictionary and display : NOTE - This is only a break out
 of Public Charities
file_Level1 = "./Resources/NCSSDataDictLevel1.txt"
dict_Level1 = pd.read_json(file_Level1)
dict_Level1
```

Out[2]:

	Description1
O	Other Nonprofits
PC	Public Charity
PF	Private Foundation
U	Unknown

Import IRS Business Master Files

Source

NCSS Data Archive https://nccs-data.urban.org/data.php?ds=bmf (https://nccs-data.urban.org/data.php?ds=bmf)

File

bmf.bm1812.csv

In [3]:

```
# specify file name
gov_data_file = "../../bookish-lamp/2018_BMF.csv"

# import file
gov_data = pd.read_csv(gov_data_file, low_memory=False)

# Display resulting dataframe header
gov_data.head()
```

Out[3]:

	EIN	SEC_NAME	FRCD	SUBSECCD	TAXPER	ASSETS	INCOME	NAME	ADDRE
0	19818	3514	60	3	NaN	NaN	NaN	PALMER SECOND BAPTIST CHURCH	10 THORNDI
1	29215	NaN	60	3	NaN	NaN	NaN	ST GEORGE CATHEDRAL	523 BROADW
2	260049	NaN	60	3	NaN	NaN	NaN	CORINTH BAPTIST CHURCH	PO BOX
3	490336	NaN	60	3	NaN	NaN	NaN	EASTSIDE BAPTIST CHURCH	PO BOX 2
4	587764	NaN	60	3	NaN	NaN	NaN	IGLESIA BETHESDA INC	1 ANDOVI

5 rows × 40 columns

Data Cleaning Phase

Review Raw Data and Eliminate Data not Required for Analysis and Junk Data

- IMPORTANT: Read data dictionary and determine if some rows should be eliminated in step 1
    - TAXPER ending tax period for financial data - do we know these are all the same? Do we care?
    - Out of Scope Flag - do we only want in scope data?
    - Reason why out of scope - do we care?
    - Filer: 99 filing w/in 2 years yes or no
    - ZFiler: 990 filing 0 dollars inc/assets w/in 2 years?
    - Etc.. need to review all codes and determine if some data should be removed by code (rows) first
- Remove unwanted columns - Do this step next to avoid deleting a row where one of the un-needed columns has invalid data and the columns needed have valid data
- Determine how many values in each column
- Remove NaN or missing values
- Removed unwanted rows (States that do not map to a region, Level1 O or U types)
- Other?

Questions

- Should we be using cTotRev and cAssets fields instead of ASSETS and INCOME? The c fields are NCCS Financial Information, the two used so far are from Basic Info. Are these the same?

In [4]:
```
# Select only the columns of data we need for analysis
gov_data = gov_data[["EIN","ASSETS","INCOME","NAME","STATE","LEVEL1"]]
```

In [5]:
```
# check the number of data rows per column
gov_data.count()
```

Out[5]:
```
EIN       1499450
ASSETS    1223112
INCOME    1223112
NAME      1499450
STATE     1498426
LEVEL1    1499450
dtype: int64
```

In [6]:

```
# display the data read in
gov_data
```

Out[6]:

	EIN	ASSETS	INCOME	NAME	STATE	LEVEL1
0	19818	NaN	NaN	PALMER SECOND BAPTIST CHURCH	MA	PC
1	29215	NaN	NaN	ST GEORGE CATHEDRAL	MA	PC
2	260049	NaN	NaN	CORINTH BAPTIST CHURCH	FL	PC
3	490336	NaN	NaN	EASTSIDE BAPTIST CHURCH	FL	PC
4	587764	NaN	NaN	IGLESIA BETHESDA INC	MA	PC
...	...	...	...	...	...	...
1499445	996089401	670570.0	160467.0	TOYO SAKUMOTO CHARITABLE TR	HI	PF
1499446	996165005	0.0	0.0	INDEPENDENT ORDER OF ODD FELLOWS	CA	O
1499447	998010224	737906.0	177689.0	HAWAII FOUNDATION FOR THE BLIND	HI	PF
1499448	998997790	0.0	0.0	CHAMPAIGN COUNTY EXTENSION EDUCATION FOUNDATION	IL	PC
1499449	999009356	0.0	0.0	NATIONAL ASSOCIATION OF LETTER CARRIERS	HI	O

1499450 rows × 6 columns

In [7]:

```
# drop invalid rows and display
gov_data.dropna(axis=0, how='any', inplace=True)
gov_data
```

Out[7]:

	EIN	ASSETS	INCOME	NAME	STATE	LEVEL1
18	10002847	0.0	0.0	HULLS COVE NEIGHBORHOOD ASSOCIATION	ME	PC
19	10011694	0.0	0.0	MASSACHUSETTS MODERATORS ASSOCIATION	MA	PC
20	10015091	52489.0	107989.0	HANOVER SOCCER CLUB INC	NJ	PC
21	10017496	233819.0	180773.0	AGAMENTICUS YACHT CLUB OF YORK	ME	PC
22	10018555	0.0	0.0	ALPHA TAU OMEGA FRATERNITY	ME	O
...	...	...	...	...	...	...
1499445	996089401	670570.0	160467.0	TOYO SAKUMOTO CHARITABLE TR	HI	PF
1499446	996165005	0.0	0.0	INDEPENDENT ORDER OF ODD FELLOWS	CA	O
1499447	998010224	737906.0	177689.0	HAWAII FOUNDATION FOR THE BLIND	HI	PF
1499448	998997790	0.0	0.0	CHAMPAIGN COUNTY EXTENSION EDUCATION FOUNDATION	IL	PC
1499449	999009356	0.0	0.0	NATIONAL ASSOCIATION OF LETTER CARRIERS	HI	O

1222273 rows × 6 columns

In [8]:

```
# Determine if rows are even yet
gov_data.count()
```

Out[8]:

```
EIN       1222273
ASSETS    1222273
INCOME    1222273
NAME      1222273
STATE     1222273
LEVEL1    1222273
dtype: int64
```

In [9]:

```
# identify the indices of rows we want to eliminate and display how many rows
 are found
indexNames = gov_data[gov_data["LEVEL1"]=="O"].index
len(indexNames)
```

Out[9]:

```
330856
```

In [10]:

```
# drop the rows identified and show the resulting dataframe
gov_data.drop(indexNames, inplace=True)
gov_data.head()
```

Out[10]:

	EIN	ASSETS	INCOME	NAME	STATE	LEVEL1
18	10002847	0.0	0.0	HULLS COVE NEIGHBORHOOD ASSOCIATION	ME	PC
19	10011694	0.0	0.0	MASSACHUSETTS MODERATORS ASSOCIATION	MA	PC
20	10015091	52489.0	107989.0	HANOVER SOCCER CLUB INC	NJ	PC
21	10017496	233819.0	180773.0	AGAMENTICUS YACHT CLUB OF YORK	ME	PC
33	10024155	0.0	0.0	BANGOR BAND	ME	PC

In [11]:

```
# identify the indices of rows we want to eliminate and display how many rows
indexNames = gov_data[gov_data["LEVEL1"]=="U"].index
len(indexNames)
```

Out[11]:

```
9
```

In [12]:

```
# drop the rows identified and show the resulting dataframe
gov_data.drop(indexNames, inplace=True)
gov_data.head()
```

Out[12]:

	EIN	ASSETS	INCOME	NAME	STATE	LEVEL1
18	10002847	0.0	0.0	HULLS COVE NEIGHBORHOOD ASSOCIATION	ME	PC
19	10011694	0.0	0.0	MASSACHUSETTS MODERATORS ASSOCIATION	MA	PC
20	10015091	52489.0	107989.0	HANOVER SOCCER CLUB INC	NJ	PC
21	10017496	233819.0	180773.0	AGAMENTICUS YACHT CLUB OF YORK	ME	PC
33	10024155	0.0	0.0	BANGOR BAND	ME	PC

In [13]:

```
# Determine the remaining count of rows and ensure our data set is full (no un
even row counts)
gov_data.count()
```

Out[13]:

```
EIN       891408
ASSETS    891408
INCOME    891408
NAME      891408
STATE     891408
LEVEL1    891408
dtype: int64
```

Review Basic Statistics of the Remaining Data

- Run basic statistics on the numeric columns

In [14]:
```
gov_data.describe()
```

Out[14]:

	EIN	ASSETS	INCOME
count	8.914080e+05	8.914080e+05	8.914080e+05
mean	4.501007e+08	5.560271e+06	3.733421e+06
std	2.390812e+08	1.752903e+08	1.782037e+08
min	1.000285e+07	0.000000e+00	-3.050449e+07
25%	2.631331e+08	0.000000e+00	0.000000e+00
50%	4.527022e+08	3.790000e+03	4.860000e+03
75%	5.825405e+08	2.846955e+05	1.976800e+05
max	9.989978e+08	5.207875e+10	7.235283e+10

Create a copy of our dataset at the State Level

In [15]:
```
# Create a copy of our data at the State Level
state_level1 = gov_data.copy()
state_level1
```

Out[15]:

	EIN	ASSETS	INCOME	NAME	STATE	LEVEL1
18	10002847	0.0	0.0	HULLS COVE NEIGHBORHOOD ASSOCIATION	ME	PC
19	10011694	0.0	0.0	MASSACHUSETTS MODERATORS ASSOCIATION	MA	PC
20	10015091	52489.0	107989.0	HANOVER SOCCER CLUB INC	NJ	PC
21	10017496	233819.0	180773.0	AGAMENTICUS YACHT CLUB OF YORK	ME	PC
33	10024155	0.0	0.0	BANGOR BAND	ME	PC
...	...	...	...	...	...	...
1499443	996087839	10109.0	22000.0	KEIKI KOHOLA PROJECT	FL	PF
1499444	996088748	377564.0	64829.0	UNOYO KOJIMA TRUST	HI	PF
1499445	996089401	670570.0	160467.0	TOYO SAKUMOTO CHARITABLE TR	HI	PF
1499447	998010224	737906.0	177689.0	HAWAII FOUNDATION FOR THE BLIND	HI	PF
1499448	998997790	0.0	0.0	CHAMPAIGN COUNTY EXTENSION EDUCATION FOUNDATION	IL	PC

891408 rows × 6 columns

Apply Region Data to the dataset

*

In [ ]:
```
```

Map Level 1 Labels (demo) and Save gov_data file (cleaned)

In [16]:
```
x_labels1 = gov_data["LEVEL1"].map(dict_Level1["Description1"])
x_labels1

gov_data.to_csv(index=False, path_or_buf="./Output/gov_data.csv")
```

Calculate Statistics by Region: Public Charity vs Private Foundation

- Calculate count, median, mean, min, max, sem

In [17]:
```
# Create a dataframe that contains statistics about Income and Assets by State
and Public Charity vs Private Foundation
state_level1 = state_level1.groupby(["STATE", "LEVEL1"], as_index=False).aggre
gate(
    {
        "INCOME":["mean", "sem", "count", "min", "max", "median"],
        "ASSETS":["mean", "sem", "count", "min", "max", "median"]
    }
)
# Display the resulting dataframe
state_level1
```

Out[17]:

	STATE	LEVEL1	INCOME						AS
			mean	sem	count	min	max	median	
0	AA	PC	0.000000e+00	NaN	1	0.0	0.000000e+00	0.0	0.0
1	AE	PC	7.268707e+05	6.340133e+05	21	0.0	1.329001e+07	0.0	4.5
2	AK	PC	1.829941e+06	4.558748e+05	2788	0.0	8.759308e+08	23.0	2.6
3	AK	PF	3.081849e+06	1.315174e+06	110	0.0	1.320134e+08	101937.5	1.0
4	AL	PC	1.275886e+06	2.325689e+05	10542	0.0	1.868716e+09	0.0	1.9
...	...	...	...	...	...	...	...	...	
112	WI	PF	1.612918e+06	2.897912e+05	2375	-6126.0	6.120344e+08	150243.0	4.2
113	WV	PC	2.150192e+06	4.157335e+05	5007	0.0	1.160407e+09	0.0	2.8
114	WV	PF	8.708717e+05	1.505691e+05	353	-30617.0	2.874431e+07	100762.0	2.8
115	WY	PC	6.374540e+05	1.370712e+05	2399	0.0	2.690173e+08	0.0	1.3
116	WY	PF	1.783573e+06	4.317716e+05	286	0.0	9.130250e+07	138517.5	4.1

117 rows × 14 columns

Remove any invalid rows (missing data or NaN)

In [18]:

```
# Remove invalid rows and display
state_level1.dropna(axis=0, how='any', inplace=True)
state_level1
```

Out[18]:

	STATE	LEVEL1	INCOME						AS
			mean	sem	count	min	max	median	
1	AE	PC	7.268707e+05	6.340133e+05	21	0.0	1.329001e+07	0.0	4.5
2	AK	PC	1.829941e+06	4.558748e+05	2788	0.0	8.759308e+08	23.0	2.6
3	AK	PF	3.081849e+06	1.315174e+06	110	0.0	1.320134e+08	101937.5	1.0
4	AL	PC	1.275886e+06	2.325689e+05	10542	0.0	1.868716e+09	0.0	1.9
5	AL	PF	9.482565e+05	1.277176e+05	1094	0.0	8.172473e+07	102247.5	2.5
...	...	...	...	...	...	...	...	...	
112	WI	PF	1.612918e+06	2.897912e+05	2375	-6126.0	6.120344e+08	150243.0	4.2
113	WV	PC	2.150192e+06	4.157335e+05	5007	0.0	1.160407e+09	0.0	2.8
114	WV	PF	8.708717e+05	1.505691e+05	353	-30617.0	2.874431e+07	100762.0	2.8
115	WY	PC	6.374540e+05	1.370712e+05	2399	0.0	2.690173e+08	0.0	1.3
116	WY	PF	1.783573e+06	4.317716e+05	286	0.0	9.130250e+07	138517.5	4.1

112 rows × 14 columns

Create Two Dataframes by Region: Public Charities, Private Foundations

In [19]:

```python
# Create a dataframe for Public Charities
state_PC = state_level1[state_level1["LEVEL1"] == "PC"]
state_PC = state_PC.set_index("STATE")
state_PC.head()
```

Out[19]:

	LEVEL1	INCOME						ASSETS
		mean	sem	count	min	max	median	mean
STATE								
AE	PC	7.268707e+05	634013.321381	21	0.0	1.329001e+07	0.0	4.598413e+05
AK	PC	1.829941e+06	455874.810920	2788	0.0	8.759308e+08	23.0	2.672440e+06
AL	PC	1.275886e+06	232568.933587	10542	0.0	1.868716e+09	0.0	1.963709e+06
AP	PC	2.762500e+04	11390.143450	20	0.0	1.552230e+05	0.0	1.085865e+04
AR	PC	1.876654e+06	284764.630994	6770	0.0	1.106865e+09	0.0	2.701117e+06

In [20]:

```python
# Create a dataframe for Private Foundations
state_PF = state_level1[state_level1["LEVEL1"] == "PF"]
state_PF = state_PF.set_index("STATE")
state_PF.head()
```

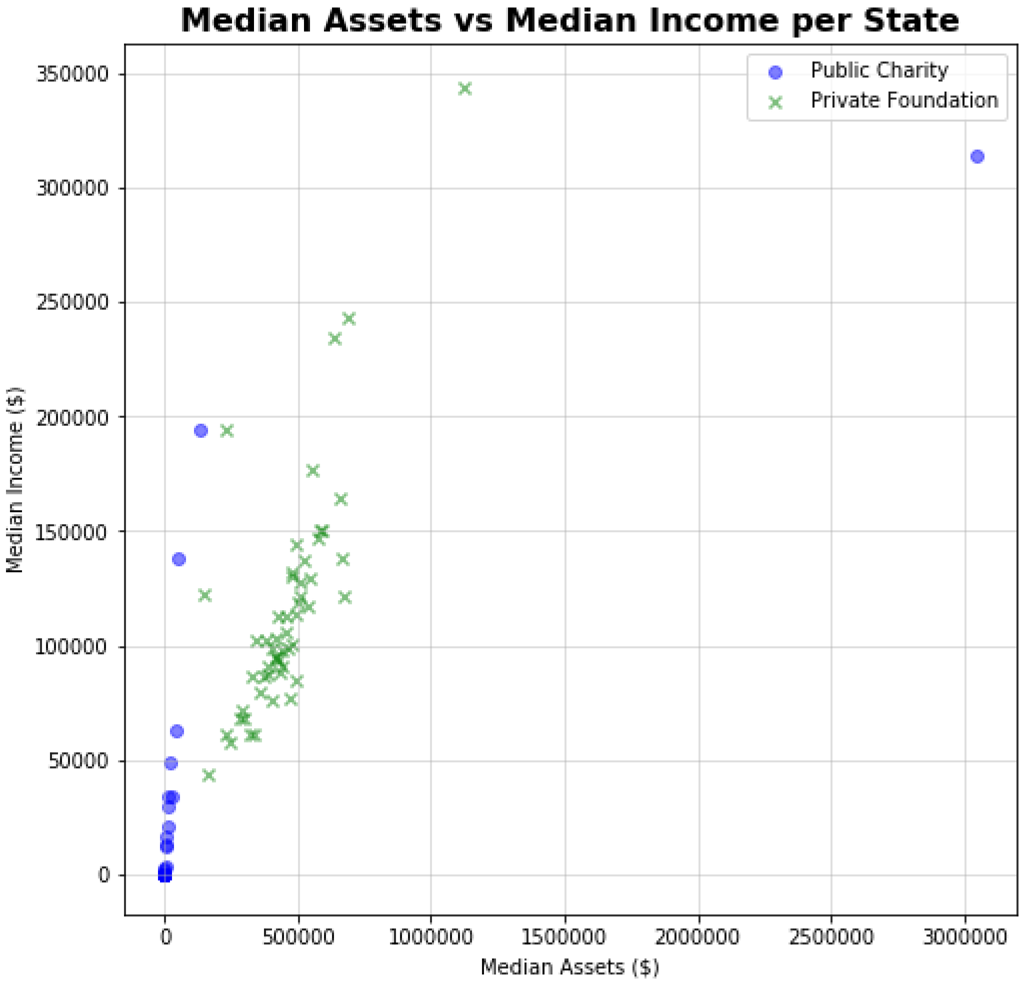
Out[20]:

	LEVEL1	INCOME						ASSETS
		mean	sem	count	min	max	median	mean
STATE								
AK	PF	3.081849e+06	1.315174e+06	110	0.0	1.320134e+08	101937.5	1.02992
AL	PF	9.482565e+05	1.277176e+05	1094	0.0	8.172473e+07	102247.5	2.54463
AR	PF	8.221813e+06	5.319360e+06	445	-96310.0	2.328780e+09	68188.0	1.45118
AZ	PF	1.269739e+06	2.103552e+05	1072	0.0	1.556742e+08	79397.5	4.11723
CA	PF	4.119017e+06	4.322736e+05	9922	-771027.0	1.805736e+09	102806.0	1.29069

In [21]:

```
# Plot Median Income vs Median Assets per State
plt.figure(figsize=(8,8))
plt.scatter(state_PC["ASSETS"]["median"], state_PC["INCOME"]["median"], c="b",
marker='o', alpha=0.5, label="Public Charity")
plt.scatter(state_PF["ASSETS"]["median"], state_PF["INCOME"]["median"], c="g",
marker='x', alpha=0.5, label="Private Foundation")
plt.title(f'Median Assets vs Median Income per State', size=16, weight='bold')
plt.xlabel('Median Assets ($)')
plt.ylabel('Median Income ($)')
plt.grid(alpha=0.5)
plt.legend(loc="best")

# Save the image
plt.savefig("./Images/MedianAssetsvsMedianIncomebyState.png")
plt.show()
```



Check Null Hypothesis

1) All states have the same number of Non-Profit Organizations (Public Charities & Private Foundations Total)

2) Median Income is the same for Public Charities and Private Foundations by State

3) Median Assets is the same for Public Charities and Private Foundations by State

4) Non-Profit count is the same for Public Charities and Private Foundations by State

Create a function for repetitive testing

This function will do the following with two populations of data:

- Create a scatter plot
- Create a histogram
- Run a Student t-test with unequal variance
- Run an ANOVA

In [22]:

```
# Function to plot two populations
def displayData(index1, index2, population1, population2, label1, label2, title, xlabel, ylabel):

    # set the figure size
    plt.figure(figsize=(20,8))

    # Scatter Plot of Data
    plt.subplot(2,1,1)
    plt.scatter(index1, population1, marker='o', color='b', label=label1)
    plt.scatter(index2, population2, marker='x', color='g', label=label2)
    plt.title(title,color='k', size=14, weight='bold')
    plt.xlabel(xlabel)
    plt.ylabel(ylabel)
    plt.legend(loc="best")
    plt.grid(alpha=0.5)

    # Historgram Plot of Data
    plt.subplot(2, 1, 2)
    plt.hist(population1, 10, density=True, alpha=0.7, color='b', label=label1)
    plt.hist(population2, 10, density=True, alpha=0.7, color='g', label=label2)
    plt.axvline(population1.mean(), color='b', linestyle='dashed', linewidth=2)
    plt.axvline(population2.mean(), color='g', linestyle='dashed', linewidth=2)
    plt.xlabel(ylabel)
    plt.ylabel("Frequency")
    plt.legend(loc="best")
    plt.grid(alpha=0.5)

    # Save the Figure
    plt.savefig("./Images/" + title.replace(" ", "") + ".png")

    # Student t-test
    print('\033[1m' + "Student t-test with unequal variance" + '\033[0m')
    print(stats.ttest_ind(population1, population2, equal_var=False))

    # ANOVA test
    print('\033[1m' + '\nANOVA test' + '\033[0m')
    print(stats.f_oneway(population1, population2))

    return
```

Null Hypothesis 1: All states have the same number of Non-Profit Organizations

Where

Non-Profit in scope = Public Charities & Private Foundations

In [23]:
```
# Test with a Chi-square
stats.chisquare(gov_data["STATE"].value_counts())
```

Out[23]:
```
Power_divergenceResult(statistic=1298643.0452923914, pvalue=0.0)
```

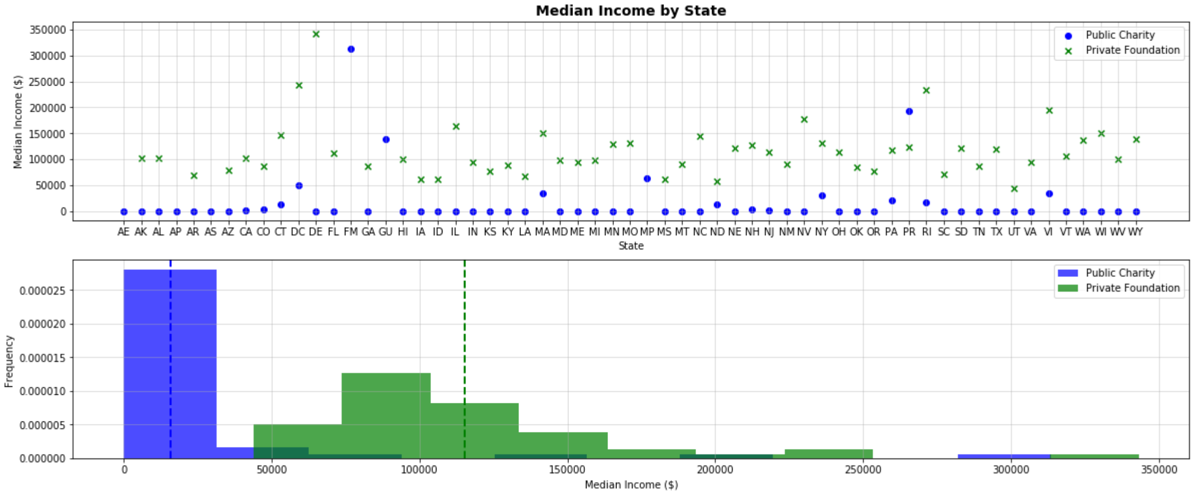
False: All states do not have the same number of Non-Profit Organizations.

Null Hypothesis 2: Median Income is the same for Public Charities and Private Foundations by State

In [24]:
```
# Using the dataframes by State and type of Non-Profit, run tests
displayData(state_PC.index, state_PF.index, state_PC["INCOME"]["median"], state_PF["INCOME"]["median"],
            "Public Charity", "Private Foundation", "Median Income by State", "State", "Median Income ($)")
```

```
Student t-test with unequal variance
Ttest_indResult(statistic=-10.28675374061529, pvalue=9.814713780131195e-18)

ANOVA test
F_onewayResult(statistic=105.89219949166548, pvalue=8.40558929233472e-18)
```



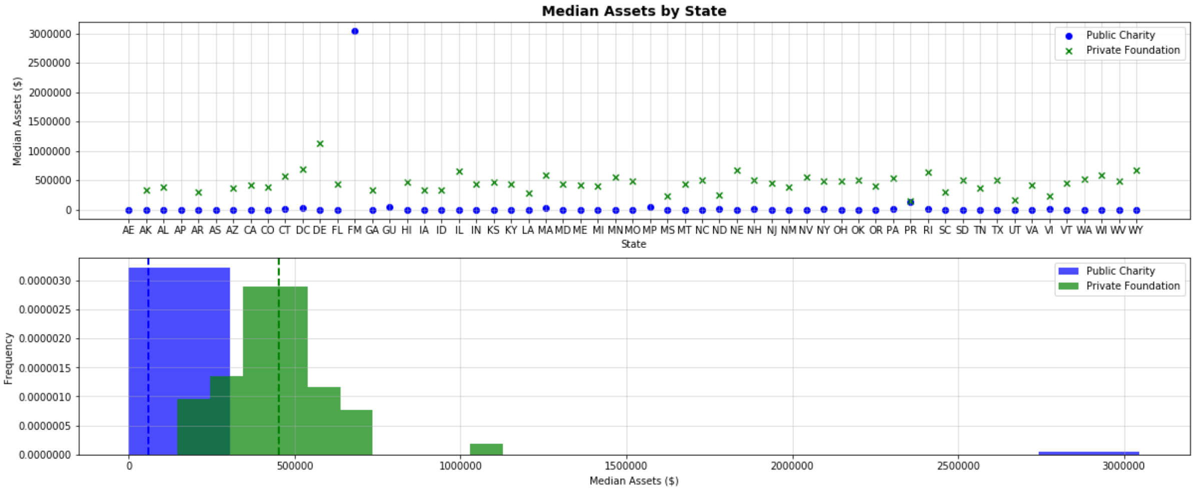
Null Hypothesis 3: Median Assets are the same for Public Charities and Private Foundations by State

In [25]:

```python
# Using the dataframes by State and type of Non-Profit, run tests
displayData(state_PC.index, state_PF.index, state_PC["ASSETS"]["median"], state_PF["ASSETS"]["median"],
            "Public Charity", "Private Foundation", "Median Assets by State", "State", "Median Assets ($)")
```

```
Student t-test with unequal variance
Ttest_indResult(statistic=-7.075730950526343, pvalue=5.885042536354635e-10)

ANOVA test
F_onewayResult(statistic=46.26349437711653, pvalue=5.626218026605068e-10)
```



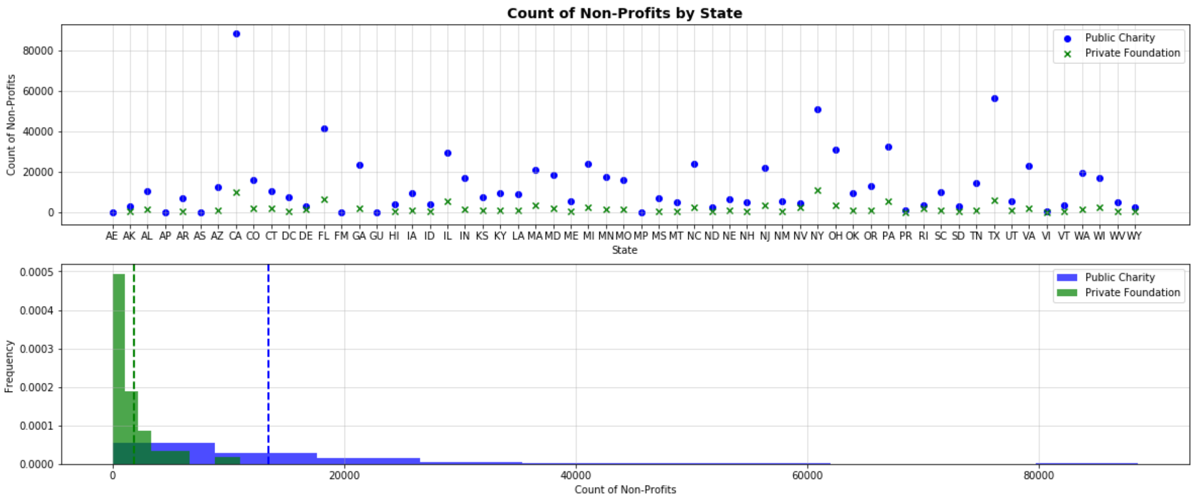
Null Hypothesis 4: Non-Profit count is the same for Public Charities and Private Foundations by State

In [26]:

```
# Using the dataframes by State and type of Non-Profit, run tests
displayData(state_PC.index, state_PF.index, state_PC["ASSETS"]["count"], state
_PF["ASSETS"]["count"],
            "Public Charity", "Private Foundation", "Count of Non-Profits by S
tate", "State", "Count of Non-Profits")
```

```
Student t-test with unequal variance
Ttest_indResult(statistic=5.582478726833098, pvalue=5.873129855273572e-07)

ANOVA test
F_onewayResult(statistic=28.093942790877055, pvalue=6.011338962566393e-07)
```



In [ ]: