Homework 3

Due: Thursday Oct 5, at 11:59pm via Blackboard

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

plt.style.use('ggplot')
```

Problem 1: Peformance of Large vs. Small Companies

Companies vary greatly in size. This variation can hide how well a company is performing. Rather than looking at the raw profit numbers, analysts consider financial ratios that adjust for the size of the company. A popular ratio is the return on assets, defined as:

Return on Assets $= Net Income/Total Assets$

Net income is another name for profits, and the total assets of a company is the value of everything it owns that is used to produce profits. The return on assets indicates how much profit the company generates relative to the amount that it invested to make that profit. A company with losses rather than profits has a negative return on assets.

Data: The data set `Company.csv` gives the company name, total assets (in Millions \$), net income (in Millions \$), and the number of employees reported by 167 retailers in the United States.

In the following questions, you will be performing an **exploratory data analysis (EDA)** for the given companies data.

In [2]:
```
df_company = pd.read_csv('Company.csv')
df_company.shape
```

Out[2]:
```
(167, 4)
```

In [3]:
```
df_company.head()
```

Out[3]:

	Company Name	Total Assets (M$)	Net Income (M$)	# Employees
0	1-800-FLOWERS.COM	256	-4	2200
1	99 CENTS ONLY STORES	824	74	12000
2	A.C. MOORE ARTS & CRAFTS INC	237	-30	4710
3	ABERCROMBIE & FITCH -CL A	2948	150	85000
4	ADVANCE AUTO PARTS INC	3354	346	51017

1.1. (2 points) Compute and report (in a short paragraph of text) the following summary statistics for the `Net Income (M\$)` data (round your values to the nearest integer):

- Mean
- Median
- Standard Deviation
- Range
- IQR

Summary:

Based on the descriptive statistics of the data, in average, company obtains net income of $334 million. However, by seeing the minimum number, we can conclude that there are companies which get negative net income (net loss). In addition, by seeing the P75 and maximum number, it can be observed that there might be several companies which have exteremely outlier number of net income on the data distribution.

In [4]:
```
print('Mean:',  df_company['Net Income (M$)'].mean().astype('int64'))
print('Median:', df_company['Net Income (M$)'].quantile(0.5).astype('int64')
print('Standard Deviation:',  round(df_company['Net Income (M$)'].std()))
print('Range:', int(df_company['Net Income (M$)'].max() - df_company['Net In
print('IQR:',  int(df_company['Net Income (M$)'].quantile(0.75) - df_company
```

```
Mean: 334
Median: 34
Standard Deviation: 1385
Range: 17899
IQR: 188
```

1.2. (2 points) Report the % of companies that inccured losses. For this question, you are expected to add a new categorical variable to the dataset (call it `Profit`) with two levels: `PROFIT` if the net income is above zero (net income >= 0) and `LOSS` if the net income is below zero (net income < 0).

In [5]:
```
df_company['Profit'] = ["Profit" if x >= 0 else "Loss" for x in df_company['
df_company.head()
```

Out[5]:

	Company Name	Total Assets (M$)	Net Income (M$)	# Employees	Profit
0	1-800-FLOWERS.COM	256	-4	2200	Loss
1	99 CENTS ONLY STORES	824	74	12000	Profit
2	A.C. MOORE ARTS & CRAFTS INC	237	-30	4710	Loss
3	ABERCROMBIE & FITCH -CL A	2948	150	85000	Profit
4	ADVANCE AUTO PARTS INC	3354	346	51017	Profit

In [6]:
```
df_company['Profit'].value_counts(normalize=True)
```

Out[6]:
```
Profit
Profit    0.766467
Loss      0.233533
Name: proportion, dtype: float64
```

1.3. (2 points) What is the shape of the distribution of the variable `Net Income (M$)`? For this question, you are expected to create **both** a histogram and a boxplot, and comment about the shape of the distribution and if there are any companies with an outlier net income.

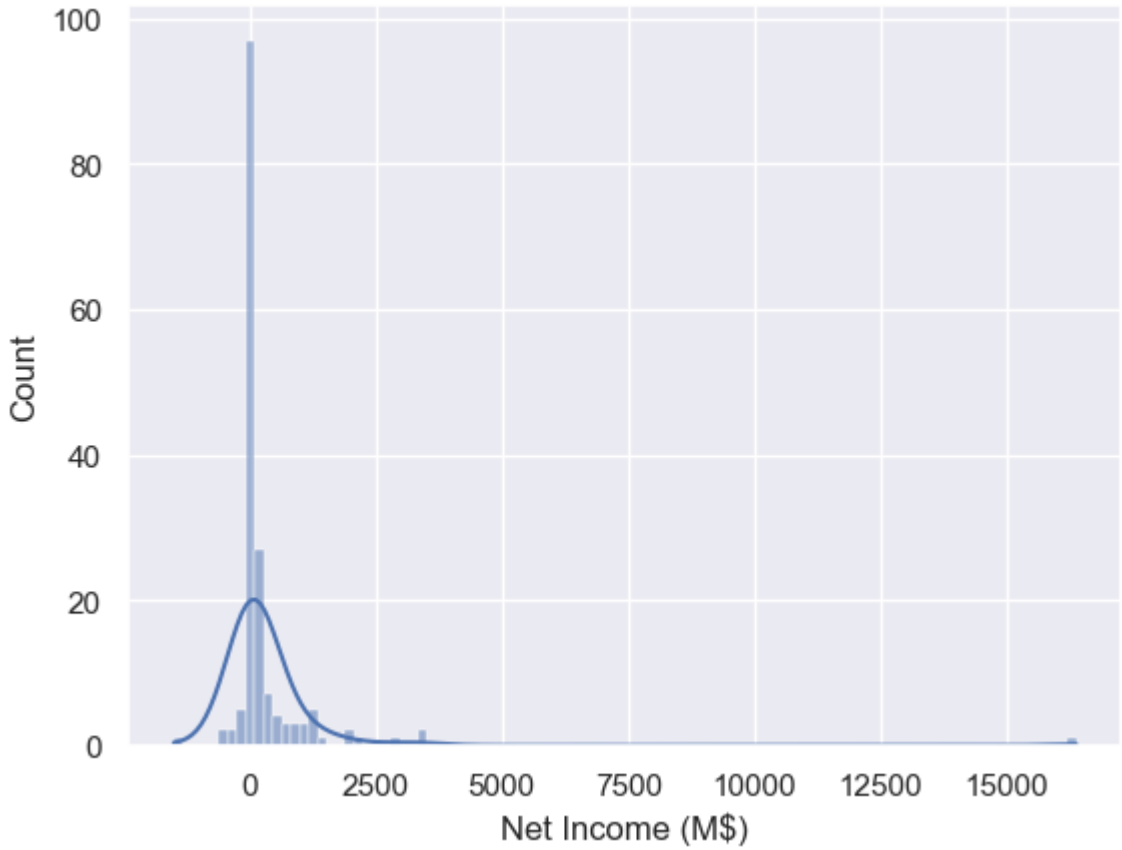
Summary:

Seeing the histogram and boxplot chart below, the shape of distribution for Net Income data in Company dataset is right-skewed distribution

In [7]:
```
import seaborn as sns
import matplotlib.pyplot as plt
```

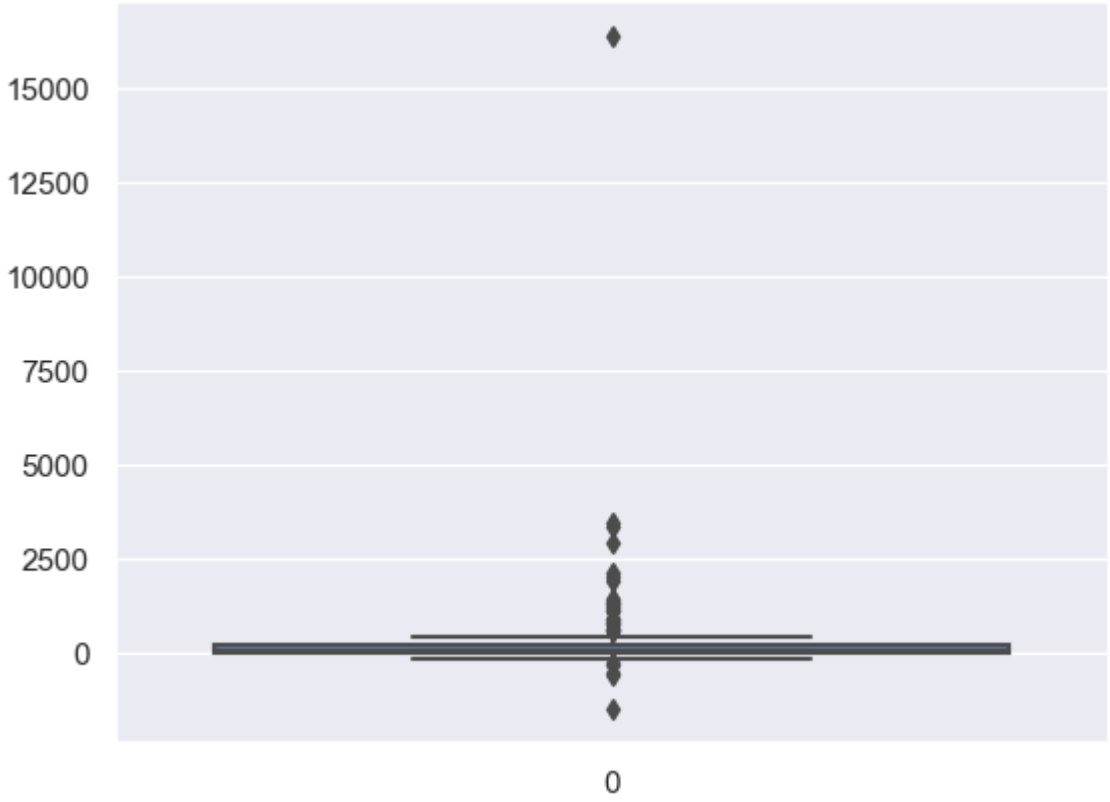
In [8]:
```
sns.set_theme()
sns.histplot(df_company['Net Income (M$)'], bins=100, kde = True)
```

Out[8]:
```
<Axes: xlabel='Net Income (M$)', ylabel='Count'>
```



In [9]:
```
sns.boxplot(df_company['Net Income (M$)'])
```

Out[9]:
```
<Axes: >
```



1.4. (2 points) A company that has more than 5000 employees is considered a large one, otherwise it is cosidered small. Create a new categroical variable (call it `Company Size`) with two levels: `LARGE` if the number of employees is greater than 5000 (employees > 5000), and `SMALL` otherwise (employees <=5000). What is the % of large and small companies in the dataset?

In [10]:
```
df_company['Company Size'] = ["Large" if x > 5000 else "Small" for x in df_c
df_company.head()
```

Out[10]:

	Company Name	Total Assets (M$)	Net Income (M$)	# Employees	Profit	Company Size
0	1-800-FLOWERS.COM	256	-4	2200	Loss	Small
1	99 CENTS ONLY STORES	824	74	12000	Profit	Large
2	A.C. MOORE ARTS & CRAFTS INC	237	-30	4710	Loss	Small
3	ABERCROMBIE & FITCH - CL A	2948	150	85000	Profit	Large
4	ADVANCE AUTO PARTS INC	3354	346	51017	Profit	Large

In [11]:
```
df_company['Company Size'].value_counts(normalize=True)
```

Out[11]:
```
Company Size
Large    0.688623
Small    0.311377
Name: proportion, dtype: float64
```

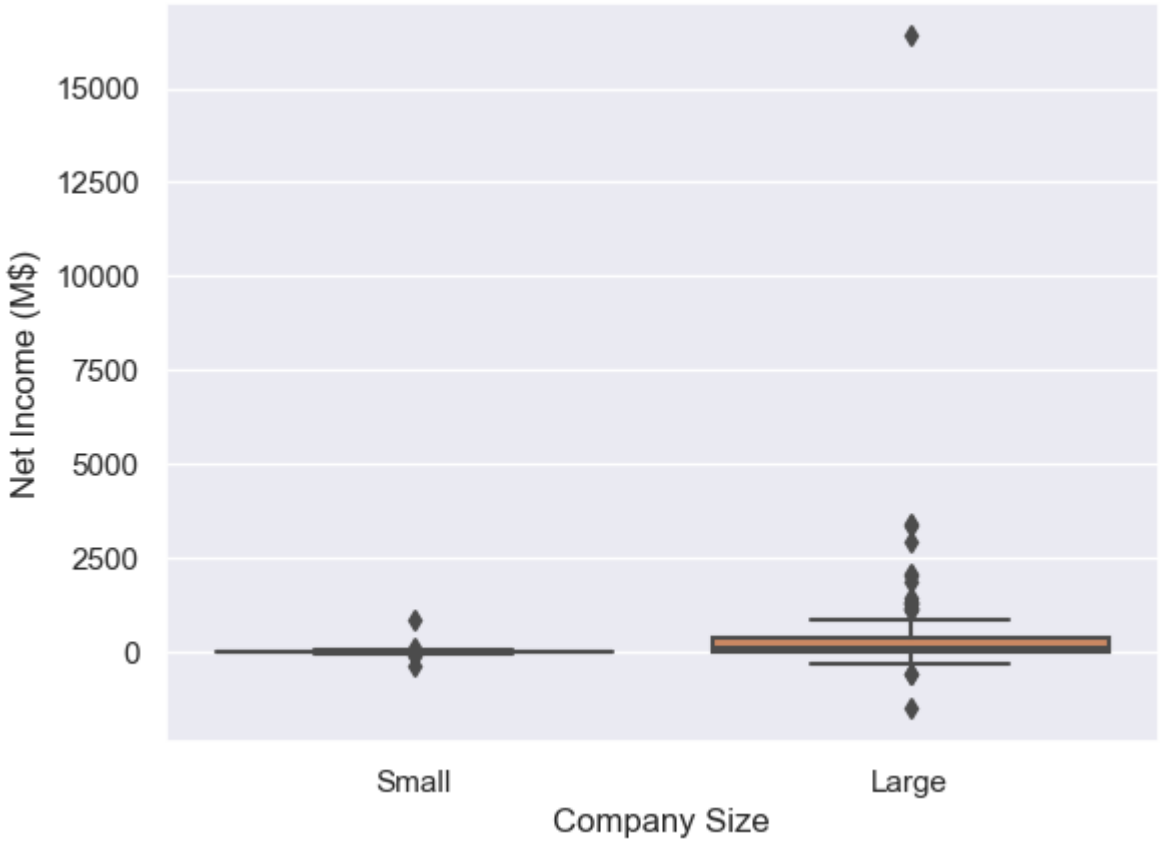
1.5. (2 points) Create a side-by-side boxplot to compare the distribtution of `Net Income (M$)` for both Large and Small companies. What does this graph tell you about the net income for both types of companies?

Summary:

First highlighted point is that there is an extreme outlier data in large company one which make the chart difficult to be compared. So, I try to remove that outlier and having new observation. In the new observation, it seems that large-sized companies obtain more net income than the small-sized ones by seeing the stats location on the boxplot such as median, Q1, and Q3 data.

In [12]:
```
sns.boxplot(data=df_company, y="Net Income (M$)", x='Company Size')
```

Out[12]:
```
<Axes: xlabel='Company Size', ylabel='Net Income (M$)'>
```



1.6. (3 points) A better way to assess the performance of companies is to look at their `Return on Assets` instead of looking only at net income. The return on assets indicates how much profit the company generates relative to the amount that it invested to make profits.

- Create a new numerical variable (call it `Return on Assets`) based on the formula: **Return on Assets = Net Income/Total Assets**.
- What is the shape of the distribution of the variable `Return on Assets`? For this question, you are expected to create **both** a histogram and a boxplot, and comment

about the shape of the distribution and if there are any companies with an outlier return on assets value.

- Create a side-by-side boxplot to compare the distribtution of `Return on Assets` for both Large and Small companies. What does this graph tell you about the return on assets for both types of companies?

In [13]:
```
df_company.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 167 entries, 0 to 166
Data columns (total 6 columns):
 #   Column             Non-Null Count  Dtype 
---  ------             --------------  ----- 
 0   Company Name       167 non-null    object
 1   Total Assets (M$)  167 non-null    int64 
 2   Net Income (M$)    167 non-null    int64 
 3   # Employees        167 non-null    int64 
 4   Profit             167 non-null    object
 5   Company Size       167 non-null    object
dtypes: int64(3), object(3)
memory usage: 8.0+ KB
```

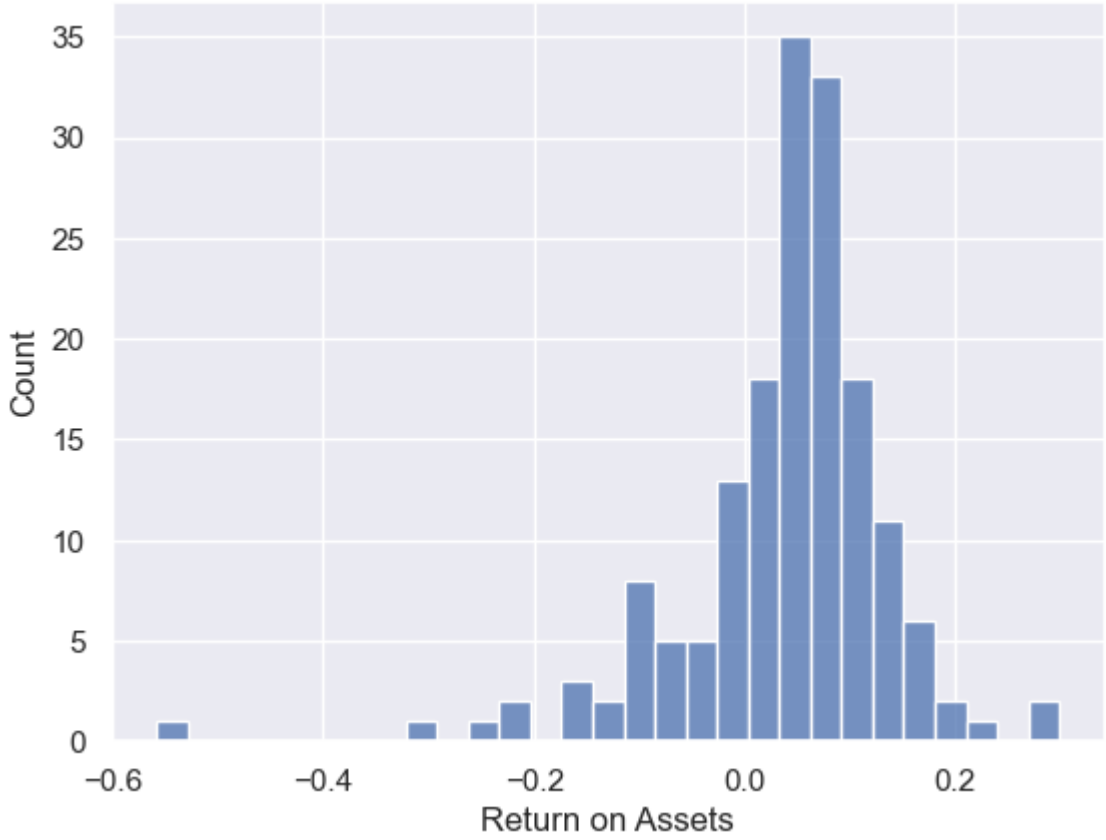
In [14]:
```
df_company['Return on Assets'] = df_company['Net Income (M$)']/df_company['T
df_company.head()
```

Out[14]:

	Company Name	Total Assets (M$)	Net Income (M$)	# Employees	Profit	Company Size	Return on Assets
0	1-800-FLOWERS.COM	256	-4	2200	Loss	Small	-0.015625
1	99 CENTS ONLY STORES	824	74	12000	Profit	Large	0.089806
2	A.C. MOORE ARTS & CRAFTS INC	237	-30	4710	Loss	Small	-0.126582
3	ABERCROMBIE & FITCH -CL A	2948	150	85000	Profit	Large	0.050882
4	ADVANCE AUTO PARTS INC	3354	346	51017	Profit	Large	0.103160

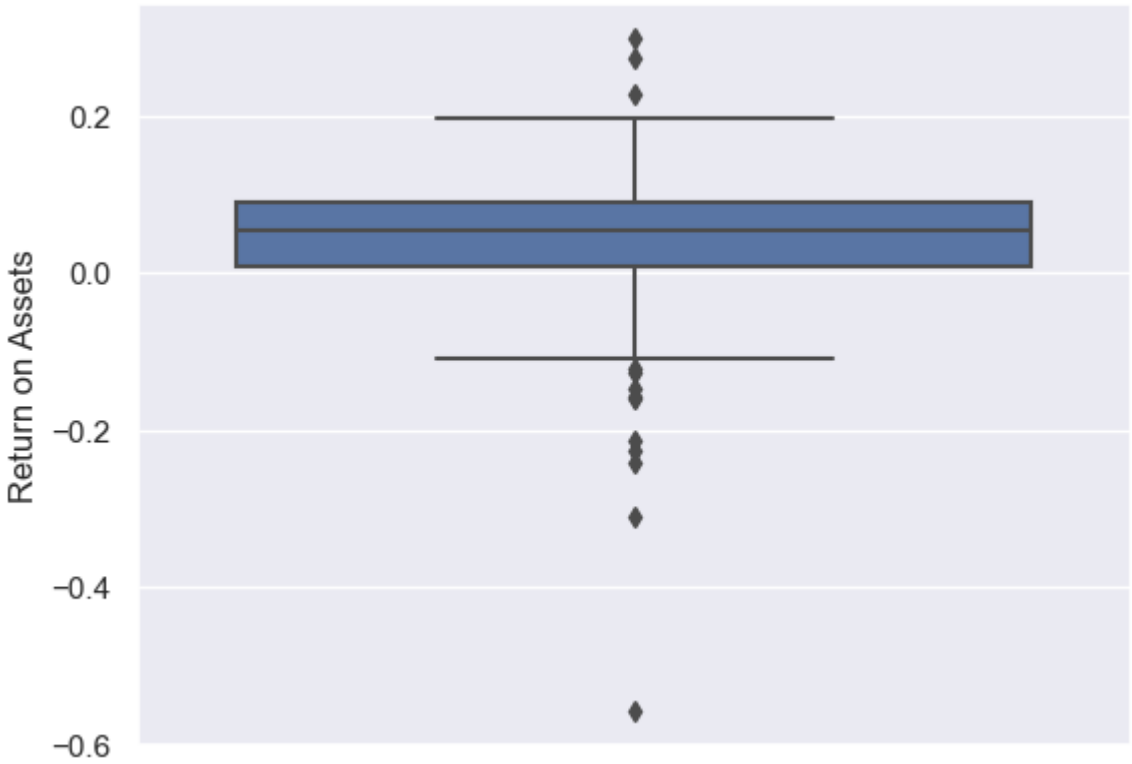
In [15]:
```
sns.histplot(df_company['Return on Assets'])
```

Out[15]:
```
<Axes: xlabel='Return on Assets', ylabel='Count'>
```



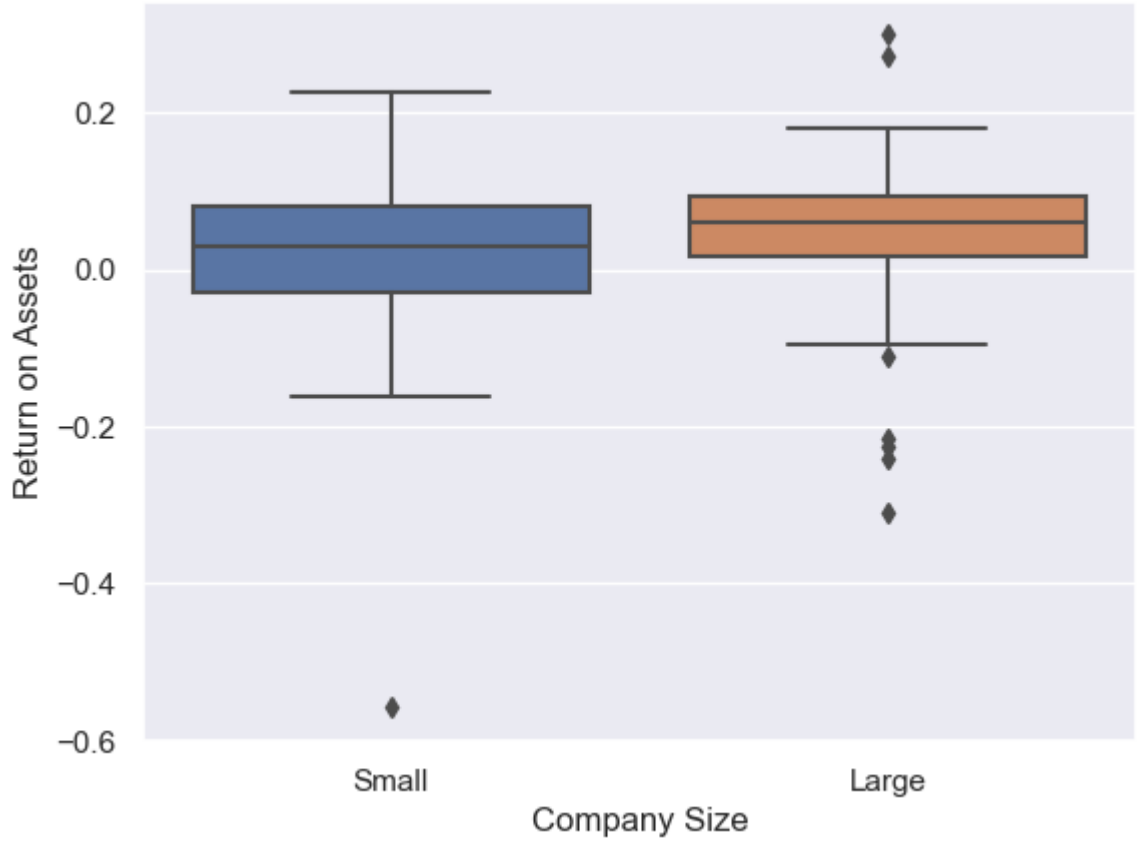
In [16]:
```
sns.boxplot(df_company, y = 'Return on Assets')
```

Out[16]:
```
<Axes: ylabel='Return on Assets'>
```



In [17]:
```
sns.boxplot(df_company, x = 'Company Size', y = 'Return on Assets')
```

Out[17]:
```
<Axes: xlabel='Company Size', ylabel='Return on Assets'>
```



1.7. (1 point) Which company has the least return on assets?

SCHOOL SPECIALTY INC is the company which has the least return on assets

In [18]:
```
df_company.sort_values(by = 'Return on Assets').head(1)
```

Out[18]:

	Company Name	Total Assets (M$)	Net Income (M$)	# Employees	Profit	Company Size	Return on Assets
123	SCHOOL SPECIALTY INC	638	-356	1919	Loss	Small	-0.557994

Problem 2: Data Analytics Jobs in the USA

Soon you will start getting ready to explore the job market for data analyst/data scientist positions (internship and full time). In this case study, we will assess the job market in the USA, and in particular, we are interested to learn which business sectors and companies are looking to hire data analysts in different US states. This should get you started with your internship search for Summer 2022.

The data set (`DataAnalyst.csv`) is available for download from blackboard. It is scrapped and cleaned from GlassDoor using this web scrapper. We will learn how to scrap data from the web in the second half of the semester.

The dataset has a sample of 2,253 job listings. The following table describes some of the variables necessary to answer the questions in this quiz:

Variables	Explanation
`Job Title`	listing's job title
`Job Description`	listing's job description
`Rating`	the company's rating on Glassdoor
`Company Name`	the listing company's name
`City`	city location of the company
`State`	state location of the company
`Size`	number of employees in the company
`Founded`	the year the company was founded
`Type of ownership`	is the company private, public, non-profit, etc.?
`Industry`	primary business activity
`Sector`	economic sector classification for the company
`Revenue`	company's income generated from business operations
`Competitors`	the company's list of competitors
`Min_Salary`	the minimum salary listing for the position
`Max_Salary`	the maximum salary listing for the position

In this homework, we assume that the sample of 2,253 job listings is a representative of the population of job listings in the USA.

2.1 (1 point) What are the top 4 sectors with the highest count of job listings?

In [19]:
```
df_data_analyst = pd.read_csv('DataAnalyst.csv')
df_data_analyst.head()
```

Out[19]:

	Job Title	Job Description	Rating	Company Name	City	State	Size	Found
0	Data Analyst, Center on Immigration and Justic...	Are you eager to roll up your sleeves and harn...	3.2	Vera Institute of Justice	New York	NY	201 to 500 employees	196
1	Quality Data Analyst	Overview\n\nProvides analytical and technical ...	3.8	Visiting Nurse Service of New York	New York	NY	10000+ employees	189
2	Senior Data Analyst, Insights & Analytics Team...	We're looking for a Senior Data Analyst who ha...	3.4	Squarespace	New York	NY	1001 to 5000 employees	200
3	Data Analyst	Requisition NumberRR-0001939\nRemote:Yes\nWe c...	4.1	Celerity	New York	NY	201 to 500 employees	200
4	Reporting Data Analyst	ABOUT FANDUEL GROUP\n\nFanDuel Group is a worl...	3.9	FanDuel	New York	NY	501 to 1000 employees	200

In [20]:
```
df_data_analyst['Sector'].value_counts().head(4)
```

Out[20]:
```
Sector
Information Technology    570
Business Services         524
Finance                   169
Health Care               151
Name: count, dtype: int64
```

2.2. (1 point) Suppose that you want to focus your job search in the following sectors (Information Technology, Business Services, Finance, Health Care). Create a subset of the given dataset that include only these 4 sectors with their data (include all variables).

Name the subset dataframe `mydata` .

In [21]:
```
mydata = df_data_analyst[(df_data_analyst['Sector'] == 'Information Technolo
mydata.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1414 entries, 1 to 2252
Data columns (total 15 columns):
 #   Column              Non-Null Count  Dtype  
---  ------              --------------  -----  
 0   Job Title           1414 non-null   object 
 1   Job Description     1414 non-null   object 
 2   Rating              1386 non-null   float64
 3   Company Name        1414 non-null   object 
 4   City                1414 non-null   object 
 5   State               1414 non-null   object 
 6   Size                1414 non-null   object 
 7   Founded             1200 non-null   float64
 8   Type of ownership   1414 non-null   object 
 9   Industry            1414 non-null   object 
 10  Sector              1414 non-null   object 
 11  Revenue             1414 non-null   object 
 12  Competitors         380 non-null    object 
 13  Min_Salary          1414 non-null   int64  
 14  Max_Salary          1414 non-null   int64  
dtypes: float64(2), int64(2), object(11)
memory usage: 176.8+ KB
```

In [22]:
```
mydata['Sector'].unique()
```

Out[22]:
```
array(['Health Care', 'Information Technology', 'Finance',
       'Business Services'], dtype=object)
```

2.3 (2 points) You are given the range of salary for each job listing (minimum and maximum salary). Add a new variable to `mydata` to estimate the salary of the for each of the listing in the dataset. The estimate salary is the average of the given minimum and maximum salary.

Name the the new column `Est_Salary`.

What is the **average**, and **standard deviation** for the estimated salary among the 4 sectors listed in `mydata` dataframe?

In [23]:
```
mydata.loc[:, 'Est_Salary'] = (mydata.loc[:, 'Min_Salary']+mydata.loc[:, 'Ma
```

```
/var/folders/76/7ftvty753sx628h00l7k3dy80000gn/T/ipykernel_24943/332837099.
py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  mydata.loc[:, 'Est_Salary'] = (mydata.loc[:, 'Min_Salary']+mydata.loc[:,
'Max_Salary'])/2
```

In [24]:
```
mydata[['Sector', 'Est_Salary']].groupby('Sector').describe().loc[:,(slice(N
```

Out[24]:

	Est_Salary	
	mean	std
Sector		
Business Services	72.135496	22.411196
Finance	67.644970	22.545747
Health Care	72.807947	26.554150
Information Technology	74.247368	25.520887

In [32]:
```
mydata[['Sector', 'Est_Salary']].groupby('Sector').describe()
```

Out[32]:

	Est_Salary							
	count	mean	std	min	25%	50%	75%	max
Sector								
Business Services	524.0	72.135496	22.411196	0.0	59.50	68.5	80.5	150.0
Finance	169.0	67.644970	22.545747	33.5	53.00	63.5	76.0	138.5
Health Care	151.0	72.807947	26.554150	33.5	53.75	68.0	87.0	150.0
Information Technology	570.0	74.247368	25.520887	33.5	59.00	70.0	85.0	150.0

In [25]:
```
mydata.head(3)
```

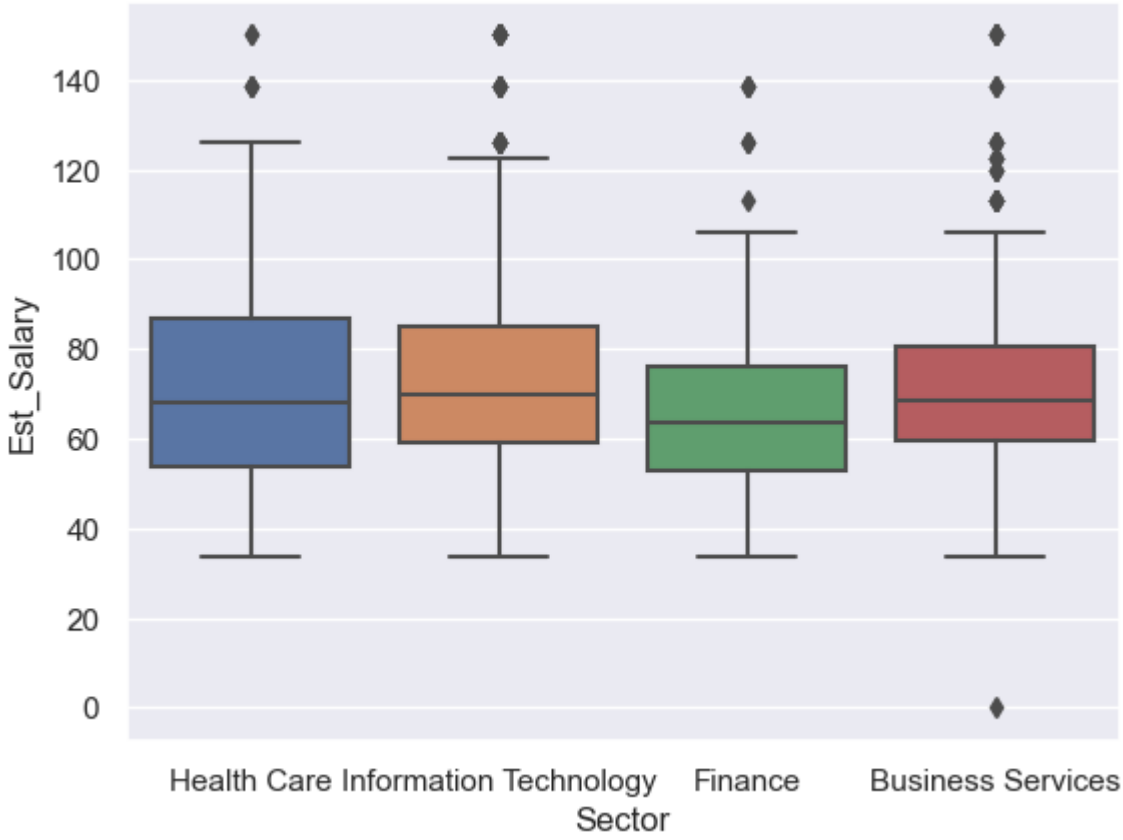
Out[25]:

	Job Title	Job Description	Rating	Company Name	City	State	Size	Founded
1	Quality Data Analyst	Overview\n\nProvides analytical and technical ...	3.8	Visiting Nurse Service of New York	New York	NY	10000+ employees	1893.(
2	Senior Data Analyst, Insights & Analytics Team...	We're looking for a Senior Data Analyst who ha...	3.4	Squarespace	New York	NY	1001 to 5000 employees	2003.(
3	Data Analyst	Requisition NumberRR-0001939\nRemote:Yes\nWe c...	4.1	Celerity	New York	NY	201 to 500 employees	2002.(

2.4 (2 points) Create a side-by-side boxplot to show the distribution of salaries among the four hiring sectors (listed in `mydata`). What does the boxplot tell you about the salaries in these industries for data analysts?

In [26]:
```
sns.boxplot(data = mydata, x = 'Sector', y = 'Est_Salary')
```

Out[26]:
```
<Axes: xlabel='Sector', ylabel='Est_Salary'>
```



Seeing the data distribution across these 4 industries especially on the median, it can concluded that the salaries for data analyst in the industries are quite comparable and competitive one another.

2.5 (2 points) List the company names (distinct) in the **Information Technology** sector has job postings with estimated salaries above 100K dollars?

In [27]:
```
mydata[(mydata['Sector'] == 'Information Technology') & (mydata['Est_Salary'
```

Out[27]:
```
array(['Criteo', 'Tekfortune Inc.', 'Staffigo Technical Services, LLC',
       '8K Miles Software Services, Inc.', 'VTS',
       'RMS Computer Corporation', 'Reliable Software Resources',
       'Oracle', 'Avani Technology Solutions', 'Primesoft',
       'Systemart LLC', 'TechProjects', 'Information Technology Partners',
       'TikTok', 'Synchronous Solutions, Inc', 'HR Pundits',
       'Softpath System LLC', 'Motorola Solutions', 'Capgemini', 'NVIDIA',
       'Risk Management Solutions (RMS)', 'LeanData', 'Alteryx',
       'L&T Infotech', 'IntraEdge', 'Joomag, Inc.', 'Moveworks', 'Ursus',
       'Nuro', 'TalentBurst, Inc.', 'BayOne Solutions', 'Logic Planet',
       'Netflix', 'Diverse Lynx', 'Adwait Algorithm', 'Netflix, Inc.',
       'Apple', 'Collabera', 'Crystal Equation', 'Frontend Arts',
       'Poshmark', 'Zolon Tech Solutions Inc.', 'Lodestone', 'SAP',
       'Calsoft Labs', 'Coinbase', 'Trifacta', 'Wilbur Labs',
       'User Testing', 'Priceonomics', 'BOLD', 'Flatiron Health',
       'Twitter', 'Evolver, Inc.', 'Lyft', 'Scale AI', 'Softova Inc',
       'LeadStack', 'TaskRabbit'], dtype=object)
```

2.6 (3 points) Use the dataset with the 4 sectors (`mydata`) to create a dot plot (lollipop plot) that shows the top 15 states with the highest average salaries.

Name the dataframe `top15states`

The resulting dataframe should have two columns (`State` *,* `Avg Salary` *), where* `Avg Salary` *is the mean salary in the corresponding* `State`

Use two different colors of your choice to distingusih between the states with avegrage salary larger than \$75K and thos with average salary less than \$75K.

In [28]:
```
mydata.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1414 entries, 1 to 2252
Data columns (total 16 columns):
 #   Column              Non-Null Count  Dtype  
---  ------              --------------  -----  
 0   Job Title           1414 non-null   object 
 1   Job Description     1414 non-null   object 
 2   Rating              1386 non-null   float64
 3   Company Name        1414 non-null   object 
 4   City                1414 non-null   object 
 5   State               1414 non-null   object 
 6   Size                1414 non-null   object 
 7   Founded             1200 non-null   float64
 8   Type of ownership   1414 non-null   object 
 9   Industry            1414 non-null   object 
 10  Sector              1414 non-null   object 
 11  Revenue             1414 non-null   object 
 12  Competitors         380 non-null    object 
 13  Min_Salary          1414 non-null   int64  
 14  Max_Salary          1414 non-null   int64  
 15  Est_Salary          1414 non-null   float64
dtypes: float64(3), int64(2), object(11)
memory usage: 187.8+ KB
```

In [29]:
```
top15states = mydata[['State', 'Est_Salary']].groupby('State').mean().sort_v
top15states
```

Out[29]:

State	Est_Salary
CA	90.986595
IL	78.027778
NJ	73.925000
CO	73.100000
NY	71.856195
AZ	70.771186
SC	70.250000
NC	67.849206
VA	65.074074
WA	62.545455
PA	60.801471
TX	59.454183
DE	59.166667
FL	52.000000
KS	51.500000

In [30]:
```
mycolors = ["orange" if x >= 75 else "skyblue" for x in top15states['Est_Sal
mycolors
```

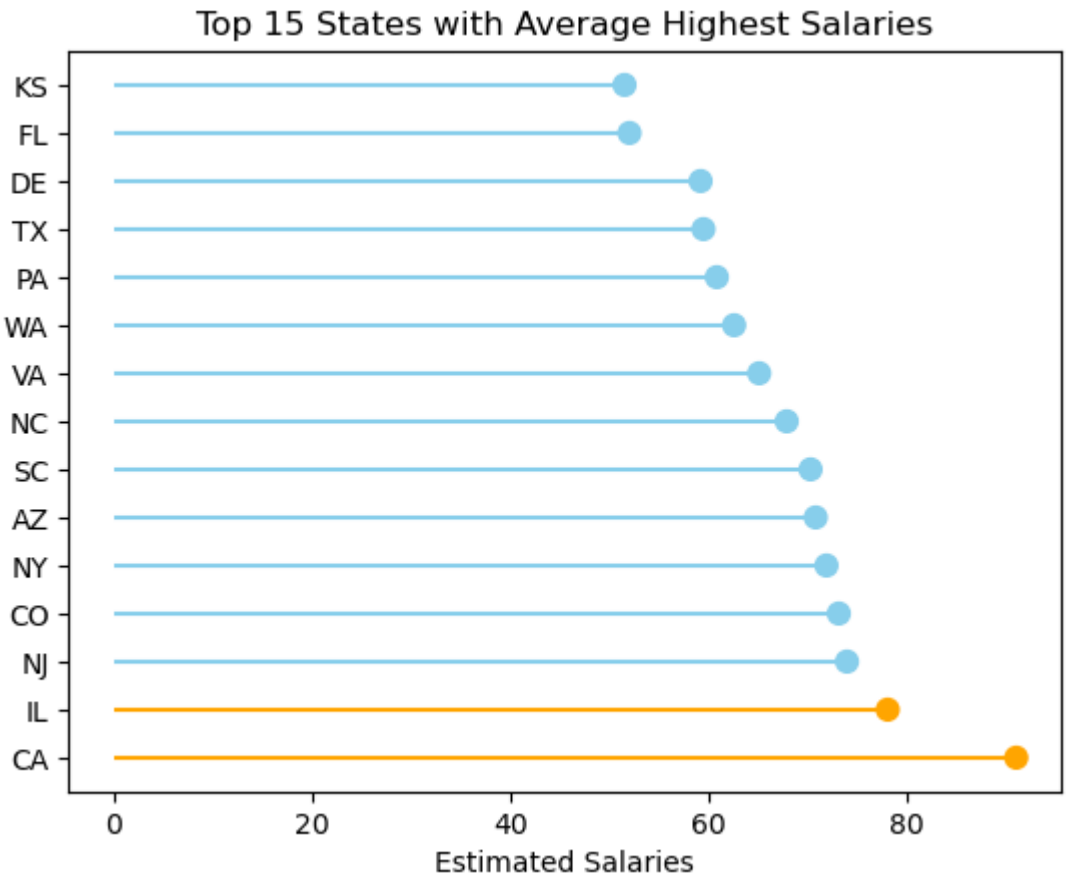
Out[30]:
```
['orange',
 'orange',
 'skyblue',
 'skyblue',
 'skyblue',
 'skyblue',
 'skyblue',
 'skyblue',
 'skyblue',
 'skyblue',
 'skyblue',
 'skyblue',
 'skyblue',
 'skyblue',
 'skyblue']
```

In [31]:
```
mycolors = ["orange" if x >= 75 else "skyblue" for x in top15states['Est_Sal

plt.style.use('default')

plt.hlines(y = top15states.index, xmin = 0, xmax = top15states, color=mycolo
plt.scatter(top15states, top15states.index, s = 60, color = mycolors)
plt.title('Top 15 States with Average Highest Salaries')
plt.xlabel('Estimated Salaries')

plt.show()
```


Top 15 States with Average Highest Salaries
KS
FL
DE
TX
PA
WA
VA
NC
SC
AZ
NY
CO
NJ
IL
CA
0
20
40
60
80
Estimated Salaries