Lab 1 - College Football Salary Recommendation

July 24, 2022

1 LAB 1 - Marley Akonnor

Research Question: How can we recommend the best salary (totalpay or schoolpay – your choice) for our next head football coach?

##Import Required Packages

[150]:

```
#Import appropriate libraries for analysis
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error,mean_absolute_error,r2_score
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
import statsmodels.api as sm
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.formula.api as smf
%matplotlib inline
```

##Import and cleaning of the datasets:

[89]:

```
#Import the coaches dataset
coaches_df = pd.read_csv('/Users/m/Documents/M.S Syracuse Data Science/Courses/
↪IST 718 -  Big Data Analytics/Labs/Coaches9.csv')
coaches_df.head()
```

[89]:

```
                    School Conference              Coach    SchoolPay  \
0                Air Force   Mt. West       Troy Calhoun       885000
1                    Akron        MAC       Terry Bowden     $411,000
2                  Alabama        SEC         Nick Saban   $8,307,000
3  Alabama at Birmingham      C-USA         Bill Clark     $900,000
4        Appalachian State   Sun Belt  Scott Satterfield     $712,500

     TotalPay       Bonus  BonusPaid AssistantPay        Buyout
0      885000      247000         --           $0            --
1    $412,500    $225,000    $50,000           $0      $688,500
2  $8,307,000  $1,100,000   $500,000           $0   $33,600,000
3    $900,000    $950,000   $165,471           $0    $3,847,500
```

```
4    $712,500     $295,000   $145,000           $0    $2,160,417
```

[90]:

```
#Clean the dataset by removing superfluous columns
coaches_df = coaches_df.drop(columns =['Bonus', 'Buyout', 'AssistantPay'])
```

[91]:

```
#Continues data cleaning:
#Utilize a function by Allen Flores to expedite data cleaning.
#This function removes commas, dollar signs, and extra spaces. Use this␣
 ↪function on the appropriate columns

def convert2num(data_column):
    col = data_column.str.replace(',','')
    col = col.str.replace('$','')
    col = col.str.replace(" ","")
    col = col.str.replace("--","0")
    col = col.fillna(0)
    col = col.astype(float)
    return col

coaches_df['SchoolPay'] = convert2num(coaches_df['SchoolPay'])
coaches_df['TotalPay'] = convert2num(coaches_df['TotalPay'])
coaches_df['BonusPaid'] = convert2num(coaches_df['BonusPaid'])

coaches_df.head()
```

```
<ipython-input-91-33db4cb2753b>:7: FutureWarning: The default value of regex
will change from True to False in a future version. In addition, single
character regular expressions will*not* be treated as literal strings when
regex=True.
  col = col.str.replace('$','')
```

[91]:

```
                  School Conference              Coach  SchoolPay   TotalPay  \
0              Air Force   Mt. West       Troy Calhoun   885000.0   885000.0
1                  Akron        MAC       Terry Bowden   411000.0   412500.0
2                Alabama        SEC         Nick Saban  8307000.0  8307000.0
3  Alabama at Birmingham      C-USA         Bill Clark   900000.0   900000.0
4      Appalachian State   Sun Belt  Scott Satterfield   712500.0   712500.0

   BonusPaid
0        0.0
1    50000.0
2   500000.0
3   165471.0
4   145000.0
```

[92]:

```
#Import the stadium dataset
#Use the converter function on the Capacity column
#Change the "College" column name to "School" in preparation for the merge
```

```
stadium_df = pd.read_csv('/Users/m/Documents/M.S Syracuse Data Science/Courses/
 ↪IST 718 -  Big Data Analytics/Labs/Stadium_Size.csv')
stadium_df['Capacity'] = convert2num(stadium_df['Capacity'])
stadium_df.rename(columns={'College':'School'}, inplace=True)
stadium_df.head(5)
```

```
<ipython-input-91-33db4cb2753b>:7: FutureWarning: The default value of regex
will change from True to False in a future version. In addition, single
character regular expressions will*not* be treated as literal strings when
regex=True.
  col = col.str.replace('$','')
```

[92]:

```
            Stadium      School Conference  Capacity  Opened
0  Michigan Stadium    Michigan    Big Ten  107601.0    1927
1    Beaver Stadium  Penn State    Big Ten  106572.0    1960
2      Ohio Stadium  Ohio State    Big Ten  104944.0    1922
3        Kyle Field   Texas A&M        SEC  102733.0    1904
4   Neyland Stadium   Tennessee        SEC  102521.0    1921
```

[93]:

```
#Import the revenue dataset
#Use the converter function on the "Revenue" and "Expenses" column
#Rename "RK" to "Rank" for clarity
revenue_df = pd.read_csv('/Users/m/Documents/M.S Syracuse Data Science/Courses/
 ↪IST 718 -  Big Data Analytics/Labs/revenue.csv')
revenue_df['Revenue'] = convert2num(revenue_df['Revenue'])
revenue_df['Expenses'] = convert2num(revenue_df['Expenses'])
revenue_df.rename(columns={'RK':'Rank'}, inplace=True)
revenue_df.head(5)
```

```
<ipython-input-91-33db4cb2753b>:7: FutureWarning: The default value of regex
will change from True to False in a future version. In addition, single
character regular expressions will*not* be treated as literal strings when
regex=True.
  col = col.str.replace('$','')
```

[93]:

```
   Rank      School Conference      Revenue     Expenses
0     1       Texas     Big 12  223879781.0  204234897.0
1     2   Texas A&M        SEC  212748002.0  169012456.0
2     3  Ohio State    Big Ten  210548239.0  220572956.0
3     4    Michigan    Big Ten  197820410.0  190952175.0
4     5     Georgia        SEC  174042482.0  143299554.0
```

[94]:

```
#Import the Graduation Rates dataset
#Use the converter function on the "gsr" and "fgr" column
#Change the "school" column name to "School" in preparation for the merge
gradrate_df = pd.read_csv('/Users/m/Documents/M.S Syracuse Data Science/Courses/
 ↪IST 718 -  Big Data Analytics/Labs/grad_rates.csv')
gradrate_df.rename(columns={'school':'School'}, inplace=True)
gradrate_df.head(10)
```

[94]:

```
      x                 School                           conf     sport state  \
0  2012      Abilene Christian           Southland Conference  Football    TX   
1  2012                  Akron        Mid-American Conference  Football    OH   
2  2012            Alabama A&M    Southwestern Athletic Conf.  Football    AL   
3  2012          Alabama State    Southwestern Athletic Conf.  Football    AL   
4  2012                Alabama        Southeastern Conference  Football    AL   
5  2012  Alabama at Birmingham                 Conference USA  Football    AL   
6  2012   University at Albany  Colonial Athletic Association  Football    NY   
7  2012           Alcorn State    Southwestern Athletic Conf.  Football    MS   
8  2012      Appalachian State            Sun Belt Conference  Football    NC   
9  2012          Arizona State              Pac-12 Conference  Football    AZ   

   gsr   fgr  Unnamed: 7
0   70  47.0         NaN
1   75  61.0         NaN
2   59  49.0         NaN
3   58  39.0         NaN
4   85  65.0         NaN
5   71  51.0         NaN
6   88  63.0         NaN
7   58  40.0         NaN
8   75  67.0         NaN
9   75  60.0         NaN
```

[95]:

```
#Merge the datafames together
#Begin by merging the Coaches data with the Stadium data and then merge Revenue␣
 ↪and the grauation rate
mergeUno = coaches_df.merge(stadium_df, on='School', how='left')
mergeDos = mergeUno.merge(revenue_df, on='School', how='left')
coaches_comp = mergeDos.merge(gradrate_df, on='School', how='left')
coaches_comp.head(10)
```

[95]:

```
                  School Conference_x              Coach  SchoolPay  \
0              Air Force     Mt. West       Troy Calhoun   885000.0   
1                  Akron          MAC       Terry Bowden   411000.0   
2                Alabama          SEC         Nick Saban  8307000.0   
3  Alabama at Birmingham        C-USA         Bill Clark   900000.0   
4      Appalachian State     Sun Belt  Scott Satterfield   712500.0   
5                Arizona       Pac-12       Kevin Sumlin  1600000.0   
6          Arizona State       Pac-12       Herm Edwards  2000000.0   
7          Arizona State       Pac-12       Herm Edwards  2000000.0   
8               Arkansas          SEC        Chad Morris  3500000.0   
9         Arkansas State     Sun Belt     Blake Anderson   825000.0   

    TotalPay  BonusPaid                  Stadium   Conference_y  Capacity  \
0   885000.0        0.0          Falcon Stadium  Mountain West   52237.0
1   412500.0    50000.0      InfoCision Stadium            MAC   30000.0
2  8307000.0   500000.0     Bryant Denny Stadium          SEC  101821.0
3   900000.0   165471.0                     NaN            NaN       NaN
4   712500.0   145000.0     Kidd Brewer Stadium       Sun Belt   24150.0
5  2000000.0        0.0         Arizona Stadium         Pac 12   56037.0
6  2000000.0        0.0       Sun Devil Stadium         Pac 12   56232.0
7  2000000.0        0.0       Sun Devil Stadium         Pac 12   56232.0
8  3500000.0        0.0       Razorback Stadium            SEC   72000.0
9   825000.0    25000.0  Centennial Bank Stadium      Sun Belt   30964.0

   Opened  …  Conference      Revenue     Expenses       x  \
0  1962.0  …    Mt. West   60009782.0   54192115.0  2012.0
1  2009.0  …         MAC   37194485.0   37275978.0  2012.0
2  1929.0  …         SEC  164090889.0  185317681.0  2012.0
3     NaN  …       C-USA   36494381.0   35697117.0  2012.0
4  1962.0  …    Sun Belt   37996512.0   37773447.0  2012.0
5  1928.0  …      Pac-12  105091389.0  100565835.0  2012.0
6  1958.0  …      Pac-12  121698840.0  118404377.0  2012.0
7  1958.0  …      Pac-12  121698840.0  118404377.0  2012.0
8  1938.0  …         SEC  137497788.0  129620361.0  2012.0
9  2002.0  …    Sun Belt   35550592.0   35550592.0     NaN

                        conf     sport state   gsr   fgr  Unnamed: 7
0  Mountain West Conference  Football    CO  80.0   NaN         NaN
1   Mid-American Conference  Football    OH  75.0  61.0         NaN
2   Southeastern Conference  Football    AL  85.0  65.0         NaN
3            Conference USA  Football    AL  71.0  51.0         NaN
4       Sun Belt Conference  Football    NC  75.0  67.0         NaN
5         Pac-12 Conference  Football    AZ  76.0  58.0         NaN
6         Pac-12 Conference  Football    AZ  75.0  60.0         NaN
7       Sun Belt Conference  Football    AR  80.0  62.0         NaN
8   Southeastern Conference  Football    AR  67.0  47.0         NaN
9                       NaN       NaN   NaN   NaN   NaN         NaN

[10 rows x 21 columns]
```

[96]:

```
#Next remove extraneous columns
coaches_comp = coaches_comp.drop(['Stadium','Conference_y', 'Opened',␣
 ↪'Conference', 'x', 'conf', 'sport', 'Unnamed: 7'], axis=1)

#Rename conference
coaches_comp.rename(columns={'Conference_x':'Conference'}, inplace=True)
coaches_comp.head(10)
```

[96]:

```
                  School Conference            Coach  SchoolPay   TotalPay  \
0              Air Force   Mt. West     Troy Calhoun   885000.0   885000.0
```

```
1                  Akron         MAC         Terry Bowden   411000.0   412500.0
2                Alabama         SEC           Nick Saban  8307000.0  8307000.0
3  Alabama at Birmingham       C-USA           Bill Clark   900000.0   900000.0
4      Appalachian State    Sun Belt    Scott Satterfield   712500.0   712500.0
5                Arizona      Pac-12         Kevin Sumlin  1600000.0  2000000.0
6          Arizona State      Pac-12         Herm Edwards  2000000.0  2000000.0
7          Arizona State      Pac-12         Herm Edwards  2000000.0  2000000.0
8               Arkansas         SEC          Chad Morris  3500000.0  3500000.0
9         Arkansas State    Sun Belt       Blake Anderson   825000.0   825000.0

   BonusPaid  Capacity  Rank      Revenue     Expenses state   gsr   fgr
0        0.0   52237.0  57.0   60009782.0   54192115.0    CO  80.0   NaN
1    50000.0   30000.0  84.0   37194485.0   37275978.0    OH  75.0  61.0
2   500000.0  101821.0   7.0  164090889.0  185317681.0    AL  85.0  65.0
3   165471.0       NaN  86.0   36494381.0   35697117.0    AL  71.0  51.0
4   145000.0   24150.0  81.0   37996512.0   37773447.0    NC  75.0  67.0
5        0.0   56037.0  38.0  105091389.0  100565835.0    AZ  76.0  58.0
6        0.0   56232.0  27.0  121698840.0  118404377.0    AZ  75.0  60.0
7        0.0   56232.0  27.0  121698840.0  118404377.0    AR  80.0  62.0
8        0.0   72000.0  20.0  137497788.0  129620361.0    AR  67.0  47.0
9    25000.0   30964.0  92.0   35550592.0   35550592.0   NaN   NaN   NaN
```

[97]:

```
#Get an understanding of what types are in the dataset for classification,␣
 ↪linear or logistic regression
coaches_comp.dtypes
```

[97]:

```
School          object
Conference      object
Coach           object
SchoolPay      float64
TotalPay       float64
BonusPaid      float64
Capacity       float64
Rank           float64
Revenue        float64
Expenses       float64
state           object
gsr            float64
fgr            float64
dtype: object
```

[98]:

```
#Convert "Conference" and "Rank" to categorical
coaches_comp['Conference'] = coaches_comp.Conference.astype('category')
coaches_comp['Rank'] = coaches_comp.Rank.astype('category')
```

##Check for missing values:

[99]:

```
#Check for null values in the dataframe
null_check = coaches_comp.isnull().values.any()
tot_null = coaches_comp.isnull().sum()
print(null_check)
print(tot_null)
```

```
True
School         0
Conference     0
Coach          0
SchoolPay      0
TotalPay       0
BonusPaid      0
Capacity      15
Rank          20
Revenue       20
Expenses      20
state          5
gsr            5
fgr            7
dtype: int64
```

[100]:

```
#Colleges missing TotalPay
coaches_comp.loc[coaches_comp['TotalPay'] == 0]
```

[100]:

```
                 School Conference            Coach  SchoolPay  TotalPay  \
13               Baylor     Big 12      Matt Rhule        0.0       0.0
17        Brigham Young       Ind.   Kalani Sitake        0.0       0.0
92                 Rice      C-USA  Mike Bloomgren        0.0       0.0
100  Southern Methodist        AAC     Sonny Dykes        0.0       0.0

     BonusPaid  Capacity Rank  Revenue  Expenses state   gsr   fgr
13         0.0   45140.0  NaN      NaN       NaN    TX  90.0  61.0
17         0.0       NaN  NaN      NaN       NaN    UT  64.0  43.0
92         0.0   47000.0  NaN      NaN       NaN    TX  87.0  80.0
100        0.0       NaN  NaN      NaN       NaN    TX  72.0  63.0
```

[101]:

```
#Colleges missing Stadium Capacity
coaches_comp[coaches_comp['Capacity'].isna()]
```

[101]:

```
                     School Conference            Coach  SchoolPay   TotalPay  \
3    Alabama at Birmingham      C-USA       Bill Clark   900000.0   900000.0
17           Brigham Young       Ind.    Kalani Sitake        0.0        0.0
22               Charlotte      C-USA     Brad Lambert   625000.0   625000.0
51                 Liberty       Ind.      Turner Gill   947281.0   947281.0
59           Massachusetts       Ind.     Mark Whipple   500000.0   500000.0
61             Miami (Fla.)        ACC      Mark Richt  4058061.0  4058061.0
62             Miami (Ohio)        MAC    Chuck Martin   524826.0   524826.0
```

```
73         Nevada-Las Vegas   Mt. West     Tony Sanchez   600000.0   600000.0
77     North Carolina State        ACC      Dave Doeren  3000000.0  3000000.0
99      Southern California     Pac-12      Clay Helton  2625965.0  2625965.0
100      Southern Methodist        AAC      Sonny Dykes        0.0        0.0
101    Southern Mississippi      C-USA       Jay Hopson   500000.0   500000.0
107          Texas Christian     Big 12  Gary Patterson  4840717.0  4840717.0
110            Texas-El Paso      C-USA      Dana Dimel   700000.0   700000.0
111        Texas-San Antonio      C-USA    Frank Wilson  1100000.0  1100000.0

     BonusPaid  Capacity   Rank     Revenue    Expenses state   gsr   fgr
3     165471.0       NaN   86.0  36494381.0  35697117.0    AL  71.0  51.0
17         0.0       NaN    NaN         NaN         NaN    UT  64.0  43.0
22         0.0       NaN   76.0  40866430.0  38454232.0    NC  80.0   NaN
51         0.0       NaN    NaN         NaN         NaN    VA  67.0  65.0
59     20000.0       NaN   67.0  49461013.0  48445234.0    MA  68.0  51.0
61         0.0       NaN    NaN         NaN         NaN    FL  81.0  50.0
62     12669.0       NaN   79.0  39644248.0  38650630.0    OH  89.0  77.0
73         0.0       NaN   64.0  50784275.0  50445250.0    NV  63.0  60.0
77    275000.0       NaN   47.0  92724548.0  90100025.0    NC  71.0  54.0
99         0.0       NaN    NaN         NaN         NaN    CA  82.0  62.0
100        0.0       NaN    NaN         NaN         NaN    TX  72.0  63.0
101    15000.0       NaN  125.0  25687189.0  25687189.0    MS  72.0  58.0
107        0.0       NaN    NaN         NaN         NaN    TX  67.0  52.0
110        0.0       NaN   99.0  33481654.0  32980563.0    TX  85.0  67.0
111    17500.0       NaN   97.0  33657739.0  32278508.0    TX  81.0  59.0
```

[102]:

```
#Colleges missing Revenue
coaches_comp[coaches_comp['Revenue'].isna()]
```

[102]:

```
                  School Conference              Coach  SchoolPay   TotalPay  \
10                  Army       Ind.        Jeff Monken   932521.0   932521.0
13                Baylor     Big 12        Matt Rhule        0.0        0.0
15        Boston College        ACC      Steve Addazio  2514859.0  2514859.0
17          Brigham Young       Ind.      Kalani Sitake        0.0        0.0
29                  Duke        ACC    David Cutcliffe  2540928.0  2540928.0
51               Liberty       Ind.        Turner Gill   947281.0   947281.0
61           Miami (Fla.)        ACC         Mark Richt  4058061.0  4058061.0
70                  Navy        AAC    Ken Niumatalolo  2163000.0  2163000.0
80           Northwestern    Big Ten     Pat Fitzgerald  3619775.0  3619775.0
81            Notre Dame       Ind.        Brian Kelly  2129638.0  2129638.0
90            Pittsburgh        ACC       Pat Narduzzi  3017718.0  3017718.0
92                  Rice      C-USA     Mike Bloomgren        0.0        0.0
99   Southern California     Pac-12        Clay Helton  2625965.0  2625965.0
100   Southern Methodist        AAC        Sonny Dykes        0.0        0.0
102             Stanford     Pac-12         David Shaw  4311543.0  4311543.0
107      Texas Christian     Big 12     Gary Patterson  4840717.0  4840717.0
114               Tulane        AAC       Willie Fritz  1629000.0  1629000.0
```

```
115             Tulsa        AAC  Philip Montgomery  1518177.0  1518177.0
119        Vanderbilt        SEC        Derek Mason  2812523.0  2812523.0
122       Wake Forest        ACC       Dave Clawson  1831580.0  1831580.0

     BonusPaid  Capacity Rank  Revenue  Expenses state    gsr   fgr
10         0.0   38000.0  NaN      NaN       NaN   NaN    NaN   NaN
13         0.0   45140.0  NaN      NaN       NaN    TX   90.0  61.0
15         0.0   44500.0  NaN      NaN       NaN    MA   90.0  81.0
17         0.0       NaN  NaN      NaN       NaN    UT   64.0  43.0
29         0.0   40004.0  NaN      NaN       NaN    NC   96.0  90.0
51         0.0       NaN  NaN      NaN       NaN    VA   67.0  65.0
61         0.0       NaN  NaN      NaN       NaN    FL   81.0  50.0
70         0.0   34000.0  NaN      NaN       NaN   NaN    NaN   NaN
80         0.0   47130.0  NaN      NaN       NaN    IL  100.0  93.0
81         0.0   77622.0  NaN      NaN       NaN    IN   92.0  84.0
90         0.0   65500.0  NaN      NaN       NaN    PA   78.0  47.0
92         0.0   47000.0  NaN      NaN       NaN    TX   87.0  80.0
99         0.0       NaN  NaN      NaN       NaN    CA   82.0  62.0
100        0.0       NaN  NaN      NaN       NaN    TX   72.0  63.0
102        0.0   50000.0  NaN      NaN       NaN    CA   91.0  88.0
107        0.0       NaN  NaN      NaN       NaN    TX   67.0  52.0
114        0.0   30000.0  NaN      NaN       NaN    LA   89.0  73.0
115        0.0   35542.0  NaN      NaN       NaN    OK   78.0  72.0
119        0.0   40550.0  NaN      NaN       NaN    TN   95.0  81.0
122        0.0   31500.0  NaN      NaN       NaN    NC   86.0  73.0
```

[103]:

```
#Colleges missing Expenses
coaches_comp[coaches_comp['Expenses'].isna()]
```

[103]:

```
                  School Conference               Coach  SchoolPay   TotalPay  \
10                  Army       Ind.         Jeff Monken   932521.0   932521.0
13                Baylor     Big 12          Matt Rhule        0.0        0.0
15        Boston College        ACC       Steve Addazio  2514859.0  2514859.0
17          Brigham Young      Ind.       Kalani Sitake        0.0        0.0
29                  Duke        ACC    David Cutcliffe  2540928.0  2540928.0
51               Liberty       Ind.         Turner Gill   947281.0   947281.0
61          Miami (Fla.)        ACC          Mark Richt  4058061.0  4058061.0
70                  Navy        AAC     Ken Niumatalolo  2163000.0  2163000.0
80           Northwestern    Big Ten      Pat Fitzgerald  3619775.0  3619775.0
81            Notre Dame       Ind.         Brian Kelly  2129638.0  2129638.0
90            Pittsburgh        ACC        Pat Narduzzi  3017718.0  3017718.0
92                  Rice      C-USA      Mike Bloomgren        0.0        0.0
99   Southern California     Pac-12         Clay Helton  2625965.0  2625965.0
100   Southern Methodist        AAC         Sonny Dykes        0.0        0.0
102             Stanford     Pac-12          David Shaw  4311543.0  4311543.0
107       Texas Christian     Big 12      Gary Patterson  4840717.0  4840717.0
114               Tulane        AAC        Willie Fritz  1629000.0  1629000.0
```

```
115                Tulsa        AAC  Philip Montgomery  1518177.0  1518177.0
119           Vanderbilt        SEC        Derek Mason  2812523.0  2812523.0
122          Wake Forest        ACC       Dave Clawson  1831580.0  1831580.0

     BonusPaid  Capacity Rank  Revenue  Expenses state    gsr   fgr
10         0.0   38000.0  NaN      NaN       NaN   NaN    NaN   NaN
13         0.0   45140.0  NaN      NaN       NaN    TX   90.0  61.0
15         0.0   44500.0  NaN      NaN       NaN    MA   90.0  81.0
17         0.0       NaN  NaN      NaN       NaN    UT   64.0  43.0
29         0.0   40004.0  NaN      NaN       NaN    NC   96.0  90.0
51         0.0       NaN  NaN      NaN       NaN    VA   67.0  65.0
61         0.0       NaN  NaN      NaN       NaN    FL   81.0  50.0
70         0.0   34000.0  NaN      NaN       NaN   NaN    NaN   NaN
80         0.0   47130.0  NaN      NaN       NaN    IL  100.0  93.0
81         0.0   77622.0  NaN      NaN       NaN    IN   92.0  84.0
90         0.0   65500.0  NaN      NaN       NaN    PA   78.0  47.0
92         0.0   47000.0  NaN      NaN       NaN    TX   87.0  80.0
99         0.0       NaN  NaN      NaN       NaN    CA   82.0  62.0
100        0.0       NaN  NaN      NaN       NaN    TX   72.0  63.0
102        0.0   50000.0  NaN      NaN       NaN    CA   91.0  88.0
107        0.0       NaN  NaN      NaN       NaN    TX   67.0  52.0
114        0.0   30000.0  NaN      NaN       NaN    LA   89.0  73.0
115        0.0   35542.0  NaN      NaN       NaN    OK   78.0  72.0
119        0.0   40550.0  NaN      NaN       NaN    TN   95.0  81.0
122        0.0   31500.0  NaN      NaN       NaN    NC   86.0  73.0
```

[104]:

```
#Colleges missing Federal Graduation Rate
coaches_comp[coaches_comp['fgr'].isna()]
```

[104]:

```
              School Conference              Coach  SchoolPay   TotalPay  \
0          Air Force   Mt. West       Troy Calhoun   885000.0   885000.0
9     Arkansas State   Sun Belt     Blake Anderson   825000.0   825000.0
10              Army       Ind.        Jeff Monken   932521.0   932521.0
22         Charlotte      C-USA       Brad Lambert   625000.0   625000.0
26          Colorado     Pac-12     Mike MacIntyre  2878500.0  2878500.0
54  Louisiana-Monroe   Sun Belt        Matt Viator   390000.0   390000.0
70              Navy        AAC    Ken Niumatalolo  2163000.0  2163000.0

    BonusPaid  Capacity   Rank     Revenue    Expenses state   gsr  fgr
0         0.0   52237.0   57.0  60009782.0  54192115.0    CO  80.0  NaN
9     25000.0   30964.0   92.0  35550592.0  35550592.0   NaN   NaN  NaN
10        0.0   38000.0    NaN         NaN         NaN   NaN   NaN  NaN
22        0.0       NaN   76.0  40866430.0  38454232.0    NC  80.0  NaN
26   297000.0   53750.0   46.0  94935198.0  98413284.0   NaN   NaN  NaN
54        0.0   30427.0  178.0  15568952.0  16927856.0   NaN   NaN  NaN
70        0.0   34000.0    NaN         NaN         NaN   NaN   NaN  NaN
```

[105]:
```
#Colleges missing Graduate Success Rate
coaches_comp[coaches_comp['gsr'].isna()]
```

[105]:
```
               School Conference            Coach  SchoolPay   TotalPay  \
9      Arkansas State   Sun Belt   Blake Anderson   825000.0   825000.0
10               Army       Ind.      Jeff Monken   932521.0   932521.0
26           Colorado     Pac-12   Mike MacIntyre  2878500.0  2878500.0
54   Louisiana-Monroe   Sun Belt      Matt Viator   390000.0   390000.0
70               Navy        AAC  Ken Niumatalolo  2163000.0  2163000.0

    BonusPaid  Capacity   Rank     Revenue    Expenses state  gsr  fgr
9     25000.0   30964.0   92.0  35550592.0  35550592.0   NaN  NaN  NaN
10        0.0   38000.0    NaN         NaN         NaN   NaN  NaN  NaN
26   297000.0   53750.0   46.0  94935198.0  98413284.0   NaN  NaN  NaN
54        0.0   30427.0  178.0  15568952.0  16927856.0   NaN  NaN  NaN
70        0.0   34000.0    NaN         NaN         NaN   NaN  NaN  NaN
```

[124]:
```
#Do a final clean of the coaches complete dataset
# Drop all schools with 0 TotalPay
coaches_comp = coaches_comp.drop(coaches_comp.index[coaches_comp.TotalPay == 0])
# Drop GSR null
coaches_comp = coaches_comp.dropna(axis=0, subset=['gsr'])
# Drop missing Stadium Capacity
coaches_comp = coaches_comp.dropna(axis=0, subset=['Capacity'])
# Drop missing Revenue
coaches_comp = coaches_comp.dropna(axis=0, subset=['Expenses'])
# Drop missing Expenses
coaches_comp = coaches_comp.dropna(axis=0, subset=['Revenue'])
print('The number of observations in the data set is:',len(coaches_comp))
```

```
The number of observations in the data set is: 98
```

##Data Exploration:

[125]:
```
#Summarize the data
coaches_comp.describe()
```

[125]:
```
          SchoolPay      TotalPay     BonusPaid       Capacity       Revenue  \
count  9.800000e+01  9.800000e+01  9.800000e+01      98.000000  9.800000e+01
mean   2.543377e+06  2.552000e+06  1.258214e+05   53311.846939  8.881076e+07
std    1.993359e+06  1.998053e+06  2.311458e+05   24422.421562  5.132700e+07
min    4.000000e+05  4.000000e+05  0.000000e+00   15000.000000  2.494847e+07
25%    8.036280e+05  8.068875e+05  0.000000e+00   30371.250000  3.812054e+07
50%    1.950004e+06  2.000000e+06  5.000000e+04   51521.000000  8.665144e+07
75%    3.778438e+06  3.778438e+06  1.297500e+05   66139.000000  1.277516e+08
max    8.307000e+06  8.307000e+06  1.350000e+06  107601.000000  2.238798e+08

           Expenses        gsr        fgr
```

```
count  9.800000e+01  98.00000  97.000000
mean   8.680718e+07  78.22449  61.474227
std    4.879808e+07   8.34134   9.905904
min    2.491091e+07  54.00000  31.000000
25%    3.854889e+07  73.00000  55.000000
50%    8.298962e+07  78.00000  62.000000
75%    1.265413e+08  85.00000  69.000000
max    2.205730e+08  95.00000  84.000000
```

[126]:

```
#Feature Exploration
df1 = coaches_comp[['SchoolPay', 'BonusPaid', 'Capacity', 'Revenue']]
df1.head(5)
```

[126]:

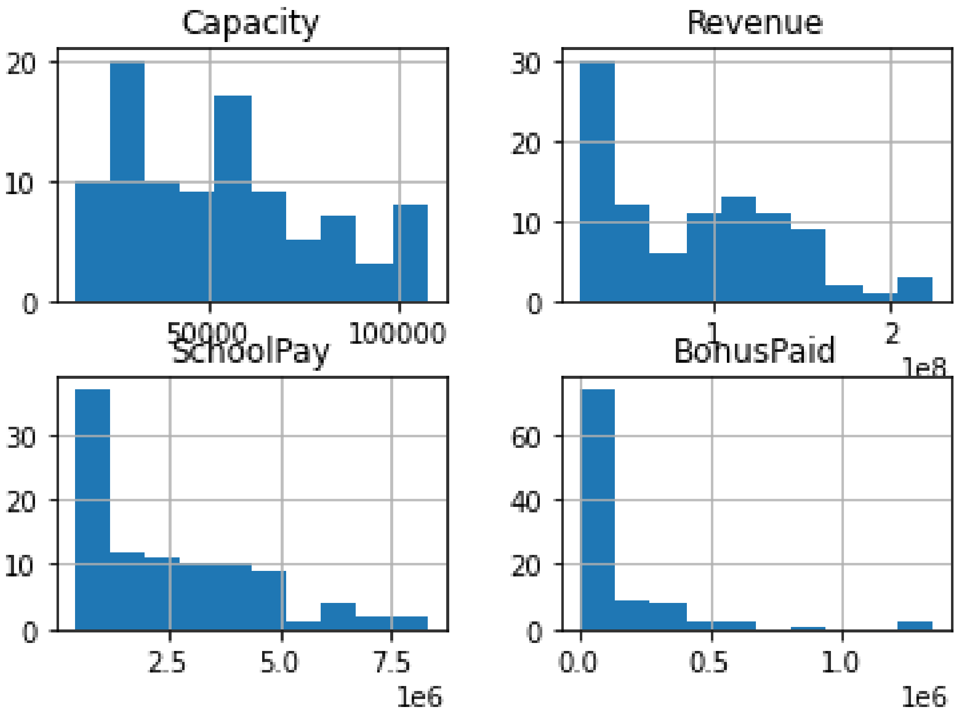
```
   SchoolPay  BonusPaid  Capacity      Revenue
0   885000.0        0.0   52237.0   60009782.0
1   411000.0    50000.0   30000.0   37194485.0
2  8307000.0   500000.0  101821.0  164090889.0
4   712500.0   145000.0   24150.0   37996512.0
5  1600000.0        0.0   56037.0  105091389.0
```

[127]:

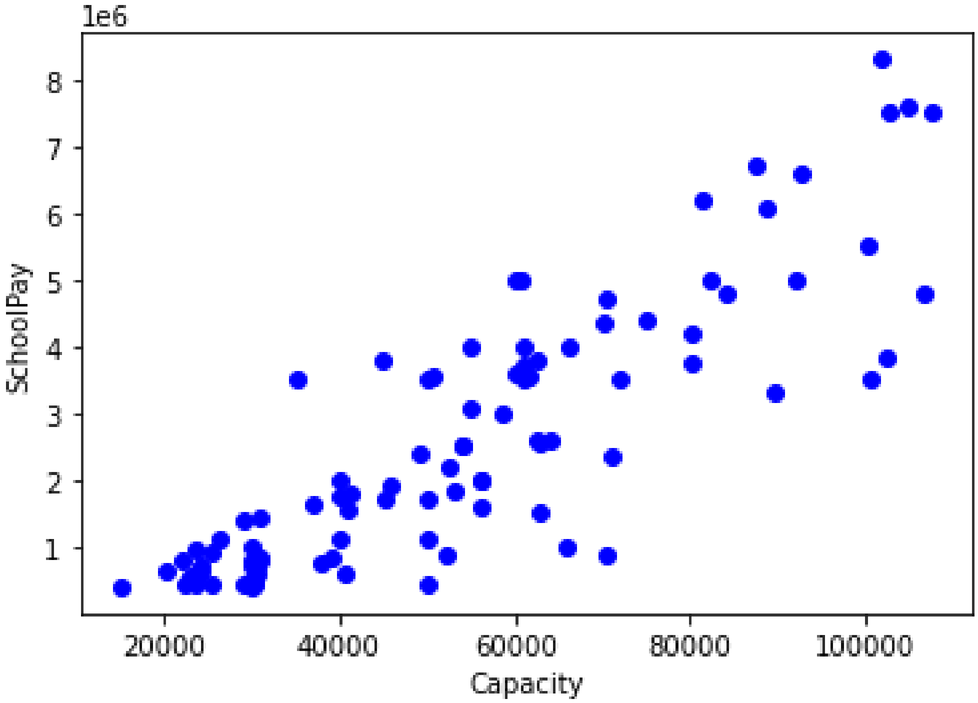
```
#Plotting the features
vis1 = df1[['Capacity', 'Revenue', 'SchoolPay', 'BonusPaid']]
vis1.hist()
```

[127]:

```
array([[<AxesSubplot:title={'center':'Capacity'}>,
        <AxesSubplot:title={'center':'Revenue'}>],
       [<AxesSubplot:title={'center':'SchoolPay'}>,
        <AxesSubplot:title={'center':'BonusPaid'}>]], dtype=object)
```

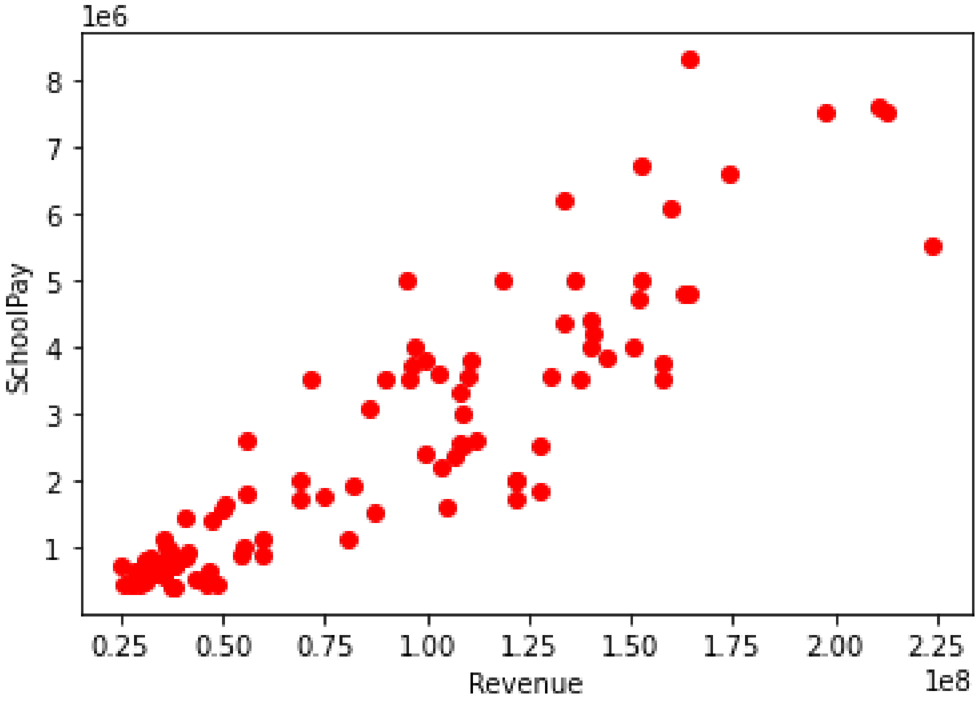


[128]:
```
#Plot "Capacity" against "SchoolPay" to see relationship
plt.scatter(df1.Capacity, df1.SchoolPay,  color='blue')
plt.xlabel("Capacity")
plt.ylabel("SchoolPay")
plt.show()
```



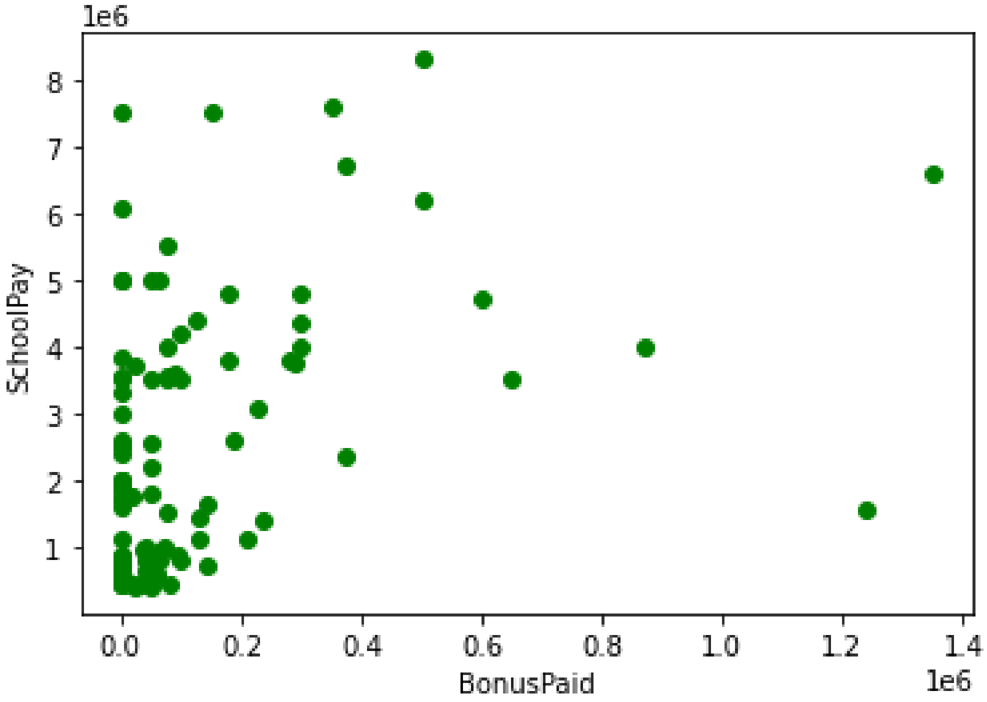
[129]:

```
#Plot "Revenue" against "SchoolPay" to see relationship
plt.scatter(df1.Revenue, df1.SchoolPay,  color='red')
plt.xlabel("Revenue")
plt.ylabel("SchoolPay")
plt.show()
```



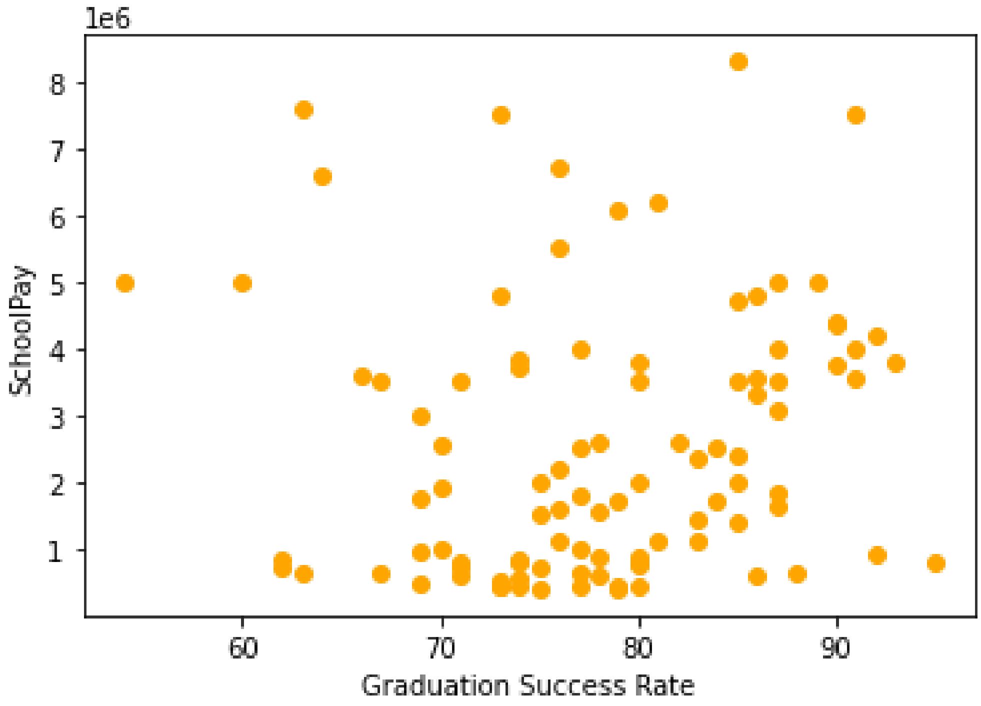
[130]:

```
#Plot "BonusPaid" against "SchoolPay" to see relationship
plt.scatter(df1.BonusPaid, df1.SchoolPay,  color='green')
plt.xlabel("BonusPaid")
plt.ylabel("SchoolPay")
plt.show()
```



[174]:

```
#Plot "gsr" against "SchoolPay" to see relationship
plt.scatter(coaches_comp.gsr, coaches_comp.SchoolPay,  color='orange')
plt.xlabel("Graduation Success Rate")
plt.ylabel("SchoolPay")
plt.show()
```



##Regression Models:

[132]:

```
#Create new df for first model
new_df = coaches_comp[['SchoolPay', 'BonusPaid', 'Capacity', 'Revenue',␣
 ↪'Expenses', 'gsr']]
```

[158]:

```
#Create new df2 for second model
new_df2 = coaches_comp[['SchoolPay', 'Capacity', 'Revenue', 'Expenses', 'gsr']]
```

[133]:

```
#Separate predictor variables in X
X=new_df[['BonusPaid', 'Capacity', 'Revenue', 'Expenses', 'gsr']]
```

[134]:

```
#Put variable for prediction in Y
Y=new_df['SchoolPay']
```

[135]:

```
X_train, X_test, y_train, y_test=train_test_split(X,Y,test_size=0.2)
```

[136]:

```
regr = LinearRegression()
regr.fit(X_train,y_train)
```

[136]:

```
LinearRegression()
```

[137]:

```
#Print the coefficients and intercept
print ('Coefficients: ', regr.coef_)
print ('Intercept: ',regr.intercept_)
```

```
Coefficients:  [ 1.04315387e+00  2.32735435e+01  2.02331230e-02  3.76234311e-03
 -2.39248569e+03]
Intercept:  -761878.3721777261
```

##Prediction

[138]:

```
y_pred=regr.predict(X_test)
mse = mean_squared_error(y_test, y_pred)
mae = mean_absolute_error(y_test, y_pred)
score=r2_score(y_test, y_pred)
#Display summary statistics for regression
print("Mean absolute error : " + str(mae))
print("Mean squared error : " + str(mse))
print("r2_score : " + str(score))
```

```
Mean absolute error : 565661.8126893027
Mean squared error : 589858918954.0946
r2_score : 0.8542541751117876
```

##Model 2 - Fit model for SchoolPay with Capacity, Revenue, Expenses, and GSR

[159]:

```
#A model predicting School pay based on stadium capacity, revenue, expenses,␣
 ↪and gsr
sp_model = str('SchoolPay ~ Capacity + Revenue + Expenses + gsr')

# fit the model to the training set
train_spmodel_fit = smf.ols(sp_model, data = new_df2).fit()

# summary of model fit to the training set
print(train_spmodel_fit.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:              SchoolPay   R-squared:                       0.818
Model:                            OLS   Adj. R-squared:                  0.810
Method:                 Least Squares   F-statistic:                     104.6
Date:                Sun, 24 Jul 2022   Prob (F-statistic):           1.49e-33
Time:                        19:28:00   Log-Likelihood:                -1476.6
No. Observations:                  98   AIC:                             2963.
Df Residuals:                      93   BIC:                             2976.
Df Model:                           4
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept  -1.158e+06   8.53e+05     -1.357      0.178   -2.85e+06    5.36e+05
Capacity      23.2531      8.543      2.722      0.008       6.287      40.219
Revenue        0.0183      0.011      1.630      0.107      -0.004       0.041
```

```
Expenses        0.0068       0.012       0.574       0.567      -0.017       0.030
gsr          3122.0315    1.07e+04       0.291       0.772   -1.82e+04    2.44e+04
==============================================================================
Omnibus:                        2.937   Durbin-Watson:                   1.867
Prob(Omnibus):                  0.230   Jarque-Bera (JB):                2.281
Skew:                           0.301   Prob(JB):                        0.320
Kurtosis:                       3.442   Cond. No.                     1.39e+09
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
[2] The condition number is large, 1.39e+09. This might indicate that there are
strong multicollinearity or other numerical problems.
```

##Recommended salaray for Syracuse football head coach

[147]:

```python
#Syracuse Coach Salary
syr_sal = coaches_comp[coaches_comp['School'] == 'Syracuse']
regr.predict(syr_sal[['BonusPaid', 'Capacity', 'Revenue', 'Expenses', 'gsr']])

pred_syr_sal = regr.predict(syr_sal[['BonusPaid', 'Capacity', 'Revenue',␣
 ↪'Expenses', 'gsr']])



# print amount
print("Syracuse Coach Pay should be $",(pred_syr_sal))
```

```
Syracuse Coach Pay should be $ [2512146.28444074]
```

[170]:

```python
big10_sal = coaches_comp[coaches_comp['Conference'] == 'Big Ten']
print(big10_sal)
```

```
             School Conference            Coach  SchoolPay   TotalPay  \
43         Illinois    Big Ten      Lovie Smith  5000000.0  5000000.0
44          Indiana    Big Ten        Tom Allen  1830000.0  1830000.0
45             Iowa    Big Ten     Kirk Ferentz  4700000.0  4700000.0
58         Maryland    Big Ten        DJ Durkin  2512000.0  2512000.0
63         Michigan    Big Ten     Jim Harbaugh  7504000.0  7504000.0
64   Michigan State    Big Ten   Mark Dantonio  4390417.0  4390417.0
66        Minnesota    Big Ten       P.J. Fleck  3550000.0  3550000.0
71         Nebraska    Big Ten      Scott Frost  5000000.0  5000000.0
83       Ohio State    Big Ten      Urban Meyer  7600000.0  7600000.0
89       Penn State    Big Ten  James Franklin  4800000.0  4800000.0
91           Purdue    Big Ten       Jeff Brohm  3800000.0  3800000.0
93          Rutgers    Big Ten        Chris Ash  2200000.0  2200000.0
128       Wisconsin    Big Ten     Paul Chryst  3750000.0  3750000.0

     BonusPaid  Capacity  Rank      Revenue     Expenses state   gsr   fgr
```

```
43      50000.0   60670.0  29.0  118565501.0  120168951.0    IL  87.0  73.0
44          0.0   52959.0  25.0  127832628.0  114822135.0    IN  87.0  70.0
45     600000.0   70585.0  14.0  151976026.0  146282275.0    IA  85.0  70.0
58          0.0   54000.0  33.0  108796303.0  108785924.0    MD  84.0  67.0
63     150000.0  107601.0   4.0  197820410.0  190952175.0    MI  91.0  72.0
64     125000.0   75005.0  18.0  140010865.0  135655740.0    MI  90.0  78.0
66          0.0   50805.0  24.0  130456454.0  129450256.0    MN  91.0  76.0
71          0.0   92000.0  21.0  136233460.0  124148206.0    NE  89.0  69.0
83     350000.0  104944.0   3.0  210548239.0  220572956.0    OH  63.0  45.0
89     300000.0  106572.0   6.0  164529326.0  160369805.0    PA  86.0  70.0
91     180000.0   62500.0  31.0  110844907.0  102026477.0    IN  80.0  64.0
93      50000.0   52454.0  39.0  103251280.0  103167344.0    NJ  76.0  55.0
128    290000.0   80321.0  11.0  157660107.0  154621828.0    WI  90.0  77.0
```

[172]:

```
big10_sal = coaches_comp[coaches_comp['Conference'] == 'Big Ten']
regr.predict(big10_sal[['BonusPaid', 'Capacity', 'Revenue', 'Expenses', 'gsr']])

pred_big10_sal = regr.predict(big12_sal[['BonusPaid', 'Capacity', 'Revenue',␣
 ↪'Expenses', 'gsr']])



# print amount
print("Big 10 coach Pay should be $",(pred_big10_sal))
```

```
Big 10 coach Pay should be $ [3345206.14525936 3280972.52211641 4928729.47937244
2904503.13512768
 6402087.36025005 4242064.77713212 3329395.5712759  4389872.90866691
 6984837.20114298 5757930.42580036 3315684.1929491  2806487.65777642
 4966363.53920055]
```

[ ]:

```

```