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Purpose: Lab Week 3

Instructions

Step 1: Import necessary libraries

```
In [ ]:
```

```
import pandas as pd #data frame operations
import numpy as np #arrays and math functions
from scipy.stats import uniform #for training and test splits
import statsmodels.api as sm  # statistical models (including regression)
import statsmodels.formula.api as smf  # R-like model specification
import matplotlib.pyplot as plt #2D plotting
import seaborn as sns #seaborn for plotting
from sklearn.linear_model import LinearRegression
```

Step 2: Import dataset

```
In [ ]:
```

```
# read in Coaches data
coaches = pd.read_csv("Coaches9.csv")
```

Step 3: Data cleanup

```
In [ ]:
```

```
# shape and data types of the data
print("What are the dimensions of the dataset?\n",coaches.shape)
print("What are the datatypes for each variable?\n",coaches.dtypes)
# compute descriptive statistics
print(coaches.describe())
# % of missing.
for col in coaches.columns:
    pct_missing = np.mean(coaches[col].isnull())
    print("Are there any null values?\n",'{} - {}%'.format(col, round(pct_missing*100)))
```

```
What are the dimensions of the dataset?
 (129, 9)
What are the datatypes for each variable?
 School          object
Conference      object
Coach           object
SchoolPay       object
TotalPay        object
Bonus           object
BonusPaid       object
AssistantPay    object
Buyout          object
dtype: object
                  School Conference        Coach  ... BonusPaid AssistantPay Buyout
count                129        129          129  ...       129          129    129
unique               129         11          129  ...        51            1    102
top     Middle Tennessee    Big Ten  Gus Malzahn  ...        --           $0     --
freq                   1         14            1  ...        41          129     22

[4 rows x 9 columns]
Are there any null values?
 School - 0.0%
Are there any null values?
 Conference - 0.0%
Are there any null values?
 Coach - 0.0%
 Coach - 0.0%
Are there any null values?
 SchoolPay - 0.0%
Are there any null values?
 TotalPay - 0.0%
Are there any null values?
 Bonus - 0.0%
Are there any null values?
 BonusPaid - 0.0%
Are there any null values?
 AssistantPay - 0.0%
Are there any null values?
 Buyout - 0.0%
```

There are no missing values for each attribute. Nevertheless, there are some columns that need to be excluded from the analysis since they are of no relevant use (SchoolPay, AssistantPay, and Bonus). Plus, for some attributes their datatypes need to be changed.

In [ ]:

```
cols_to_drop = ['SchoolPay', 'Bonus','AssistantPay']
coaches = coaches.drop(cols_to_drop, axis=1)
print("What are the dimensions of the dataset?\n",coaches.shape)
#Reference for the following code:
# Mattiff, M. (2019). Cleaning Up Currency Data with pandas.
# Retrieved October 10, 2020 from https://pbpython.com/currency-cleanup.html
# Set a function to clean the currency data
def currency_clean(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

# Run the 'currency_clean' function for columns of interest
coaches['TotalPay'] = currency_clean(coaches['TotalPay'])
coaches['BonusPaid'] = currency_clean(coaches['BonusPaid'])
coaches['Buyout'] = currency_clean(coaches['Buyout'])

#print("Data Sample\n",coaches.head())
```

```
What are the dimensions of the dataset?
 (129, 6)
```

Step 4: Develop an additional vector for each school using last year’s record.

In [ ]:

```
# WinLossRate dataset obtained from:
# TeamRanking. (2019). College Football Team Win Trends - All Games, 2019.
# Retrieved October 13, 2020 from https://betiq.teamrankings.com/college-football/betting-trends/w
in-loss-records/?season=2019
# GradRate dataset obtained from:
# NCAA. (2019). Graduation Success Rate Retrieved October 13, 2020 from
https://web3.ncaa.org/aprsearch/gsrsearch
# Stadium dataset obtained from:
# College Grid Irons. (n.d). College Football Stadium Comparisons.
# Retrieved October 13, 2020 from https://www.collegegridirons.com/comparisons-by-capacity/
# Assistant dataset obtained from:
# USA Today. (2019). 2019 NCAAF ASSISTANT COACHES SALARIES.
# Retrieved October 16, 2020 from https://sports.usatoday.com/ncaa/salaries/football/assistant

wl = pd.read_csv("WinLossRate.csv")#WinLossRate

wl.rename(columns={'Team':'School'},inplace=True)
wl.rename(columns={'Win %':'WinPercentage'},inplace=True)
wl.rename(columns={'ATS +/-':'ATS'},inplace=True)
wl.sort_values('School', inplace=True, ascending=True)

#changing format of winpercentage
wl["WinPercentage"] = wl['WinPercentage'].str.replace('%', '').str.strip()
```

```
wl["WinPercentage"] = wl.WinPercentage.astype(float)

# Fix Names
wl['School'] = wl['School'].str.replace('App State', 'Appalachian State').str.strip()
wl['School'] = wl['School'].str.replace('Arizona St', 'Arizona State').str.strip()
wl['School'] = wl['School'].str.replace('Arkansas St', 'Arkansas State').str.strip()
wl['School'] = wl['School'].str.replace('Boston Col', 'Boston College').str.strip()
wl['School'] = wl['School'].str.replace('BYU', 'Brigham Young').str.strip()
wl['School'] =wl['School'].str.replace('Bowling Grn', 'Bowling Green').str.strip()
wl['School'] = wl['School'].str.replace('Central FL', 'Central Florida').str.strip()
wl['School'] = wl['School'].str.replace('Central Mich', 'Central Michigan').str.strip()
wl['School'] = wl['School'].str.replace('Coastal Car', 'Coastal Carolina').str.strip()
wl['School'] = wl['School'].str.replace('Colorado St', 'Colorado State').str.strip()
wl['School'] = wl['School'].str.replace('E Carolina', 'East Carolina').str.strip()
wl['School'] = wl['School'].str.replace('E Michigan', 'Eastern Michigan').str.strip()
wl['School'] = wl['School'].str.replace('Fla Atlantic', 'Florida Atlantic').str.strip()
wl['School'] = wl['School'].str.replace('Florida Intl', 'Florida International').str.strip()
wl['School'] = wl['School'].str.replace('Florida St', 'Florida State').str.strip()
wl['School'] = wl['School'].str.replace('Fresno St', 'Fresno State').str.strip()
wl['School'] = wl['School'].str.replace('GA Southern', 'Georgia Southern').str.strip()
wl['School'] = wl['School'].str.replace('GA Tech', 'Georgia Tech').str.strip()
wl['School'] = wl['School'].str.replace('Kansas St', 'Kansas State').str.strip()
wl['School'] = wl['School'].str.replace('LA Lafayette', 'Louisiana-Lafayette').str.strip()
wl['School'] = wl['School'].str.replace('LA Tech', 'Louisiana Tech').str.strip()
wl['School'] = wl['School'].str.replace('LA Monroe', 'Louisiana-Monroe').str.strip()
wl['School'] = wl['School'].str.replace('Miami \\(FL\\)', 'Miami (Fla.)').str.strip()
wl['School'] = wl['School'].str.replace('Miami \\(OH\\)', 'Miami (Ohio)').str.strip()
wl['School'] = wl['School'].str.replace('Michigan St', 'Michigan State').str.strip()
wl['School'] = wl['School'].str.replace('Middle Tenn', 'Middle Tennessee').str.strip()
wl['School'] = wl['School'].str.replace('Miss State', 'Mississippi State').str.strip()
wl['School'] = wl['School'].str.replace('N Carolina', 'North Carolina').str.strip()
wl['School'] = wl['School'].str.replace('N Illinois', 'Northern Illinois').str.strip()
wl['School'] = wl['School'].str.replace('N Mex State', 'New Mexico State').str.strip()
wl['School'] = wl['School'].str.replace('NC State', 'North Carolina State').str.strip()
wl['School'] = wl['School'].str.replace('Oregon St', 'Oregon State').str.strip()
wl['School'] = wl['School'].str.replace('Oklahoma St', 'Oklahoma State').str.strip()
wl['School'] = wl['School'].str.replace('S Alabama', 'South Alabama').str.strip()
wl['School'] = wl['School'].str.replace('S Carolina', 'South Carolina').str.strip()
wl['School'] = wl['School'].str.replace('S Florida', 'South Florida').str.strip()
wl['School'] = wl['School'].str.replace('S Methodist', 'Southern Methodist').str.strip()
wl['School'] = wl['School'].str.replace('S Mississippi', 'Southern Miss').str.strip()
wl['School'] = wl['School'].str.replace('San Diego St', 'San Diego State').str.strip()
wl['School'] = wl['School'].str.replace('San Jose St', 'San Jose State').str.strip()
wl['School'] = wl['School'].str.replace('TX Christian', 'Texas Christian').str.strip()
wl['School'] = wl['School'].str.replace('TX-San Ant', 'Texas-San Antonio').str.strip()
wl['School'] = wl['School'].str.replace('TX El Paso', 'Texas-El Paso').str.strip()
wl['School'] = wl['School'].str.replace('U Mass', 'Massachusetts').str.strip()
wl['School'] = wl['School'].str.replace('UAB', 'Alabama at Birmingham').str.strip()
wl['School'] = wl['School'].str.replace('UNLV', 'Nevada-Las Vegas').str.strip()
wl['School'] = wl['School'].str.replace('USC', 'Southern California').str.strip()
wl['School'] = wl['School'].str.replace('VA Tech', 'Virginia Tech').str.strip()
wl['School'] = wl['School'].str.replace('W Kentucky', 'Western Kentucky').str.strip()
wl['School'] = wl['School'].str.replace('W Michigan', 'Western Michigan').str.strip()
wl['School'] = wl['School'].str.replace('W Virginia', 'West Virginia').str.strip()
wl['School'] = wl['School'].str.replace('Wash State', 'Washington State').str.strip()

grad = pd.read_csv("GradRate.csv")#GradRate

#Fixnames
grad['School'] = grad['School'].str.replace('The University of ', '').str.strip()
grad['School'] = grad['School'].str.replace('University of ', '').str.strip()
grad['School'] = grad['School'].str.replace('University at ', '').str.strip()
grad['School'] = grad['School'].str.replace(', the State New York', '').str.strip()
grad['School'] = grad['School'].str.replace('University', '').str.strip()
grad['School'] = grad['School'].str.replace('U.S. Air Force Academy', 'Air Force').str.strip()
grad['School'] = grad['School'].str.replace('U.S. Naval Academy', 'Navy').str.strip()
grad['School'] = grad['School'].str.replace('U.S. Military Academy', 'Army').str.strip()
grad['School'] = grad['School'].str.replace('Wisconsin-Madison', 'Wisconsin').str.strip()
grad['School'] = grad['School'].str.replace('Bowling Green State', 'Bowling Green').str.strip()
grad['School'] = grad['School'].str.replace('Arkansas, Fayetteville', 'Arkansas').str.strip()
grad['School'] = grad['School'].str.replace('The Ohio State', 'Ohio State').str.strip()
grad['School'] = grad['School'].str.replace('California, Berkeley', 'California').str.strip()
grad['School'] = grad['School'].str.replace('Colorado, Boulder', 'Colorado').str.strip()
grad['School'] = grad['School'].str.replace('California State , Fresno', 'Fresno State').str.strip(
)
grad['School'] = grad['School'].str.replace('Georgia Institute of Technology', 'Georgia Tech').str.
strip()
```

```
grad['School'] = grad['School'].str.replace('Hawaii, Manoa', 'Hawaii').str.strip()
grad['School'] = grad['School'].str.replace('Illinois Urbana-Champaign', 'Illinois').str.strip()
grad['School'] = grad['School'].str.replace('Indiana , Bloomington', 'Indiana').str.strip()
grad['School'] = grad['School'].str.replace('Louisiana Monroe', 'Louisiana-Monroe').str.strip()
grad['School'] = grad['School'].str.replace('Louisiana State', 'LSU').str.strip()
grad['School'] = grad['School'].str.replace('Louisiana at Lafayette', 'Louisiana-Lafayette').str.st
rip()
grad['School'] = grad['School'].str.replace('Maryland, College Park', 'Maryland').str.strip()
grad['School'] = grad['School'].str.replace('Massachusetts, Amherst', 'Massachusetts').str.strip()
grad['School'] = grad['School'].str.replace('Miami \\(Florida\\)', 'Miami (Fla.)').str.strip()
grad['School'] = grad['School'].str.replace('Miami  \\(Ohio\\)', 'Miami (Ohio)').str.strip()
grad['School'] = grad['School'].str.replace('Middle Tennessee State', 'Middle Tennessee').str.strip
()
grad['School'] = grad['School'].str.replace('Minnesota, Twin Cities', 'Minnesota').str.strip()
grad['School'] = grad['School'].str.replace('Missouri, Columbia', 'Missouri').str.strip()
grad['School'] = grad['School'].str.replace('Nebraska, Lincoln', 'Nebraska').str.strip()
grad['School'] = grad['School'].str.replace('Nevada, Las Vegas', 'Nevada-Las Vegas').str.strip()
grad['School'] = grad['School'].str.replace('Nevada, Reno', 'Nevada').str.strip()
grad['School'] = grad['School'].str.replace('Pennsylvania State', 'Penn State').str.strip()
grad['School'] = grad['School'].str.replace('Rutgers, The State New Jersey, New Brunswick',
'Rutgers').str.strip()
grad['School'] = grad['School'].str.replace('South Carolina, Columbia', 'South Carolina').str.strip
()
grad['School'] = grad['School'].str.replace('Tennessee, Knoxville', 'Tennessee').str.strip()
grad['School'] = grad['School'].str.replace('Texas at Austin', 'Texas').str.strip()
grad['School'] = grad['School'].str.replace('Texas at El Paso', 'Texas-El Paso').str.strip()
grad['School'] = grad['School'].str.replace('Texas A&M , College Station', 'Texas A&M').str.strip()
grad['School'] = grad['School'].str.replace('Virginia Polytechnic Institute and State', 'Virginia
Tech').str.strip()
grad['School'] = grad['School'].str.replace('North Carolina, Chapel Hill', 'North Carolina').str.st
rip()
grad['School'] = grad['School'].str.replace('California, Los Angeles', 'UCLA').str.strip()


stadiums = pd.read_csv("Stadium.csv")#Stadium

stadiums.rename(columns={'College':'School'},inplace=True)

#Fix names
stadiums['School'] = stadiums['School'].str.replace('BYU', 'Brigham Young').str.strip()
stadiums['School'] = stadiums['School'].str.replace('UNC Charlotte', 'Charlotte').str.strip()
stadiums['School'] = stadiums['School'].str.replace('Miami', 'Miami (Fla.)').str.strip()
stadiums['School'] = stadiums['School'].str.replace('Miami \\(Fla\\.\\)-OH', 'Miami (Ohio)').str.st
rip()
stadiums['School'] = stadiums['School'].str.replace('NC State', 'North Carolina State').str.strip()
stadiums['School'] = stadiums['School'].str.replace('SMU', 'Southern Methodist').str.strip()
stadiums['School'] = stadiums['School'].str.replace('Southern Miss', 'Southern Mississippi').str.st
rip()
stadiums['School'] = stadiums['School'].str.replace('TCU', 'Texas Christian').str.strip()
stadiums['School'] = stadiums['School'].str.replace('UAB', 'Alabama at Birmingham').str.strip()
stadiums['School'] = stadiums['School'].str.replace('UMass', 'Massachusetts').str.strip()
stadiums['School'] = stadiums['School'].str.replace('UNLV', 'Nevada-Las Vegas').str.strip()
stadiums['School'] = stadiums['School'].str.replace('USC', 'Southern California').str.strip()
stadiums['School'] = stadiums['School'].str.replace('UTEP', 'Texas-El Paso').str.strip()
stadiums['School'] = stadiums['School'].str.replace('UTSA', 'Texas-San Antonio').str.strip()

# Run the 'currency_clean' function for columns of interest
stadiums['Capacity'] = currency_clean(stadiums['Capacity'])

# Clean up check
print(coaches.School.unique())
print(len(coaches.School),"schools")
print(wl.School.unique())
print(len(wl.School),"schools")
print(grad.School.unique())
print(len(grad.School),"schools")
print(stadiums.School.unique())
print(len(stadiums.School),"schools")

#print(wl.sample)
#print(grad.sample)
#print(stadiums.sample)
```

```
['Air Force' 'Akron' 'Alabama' 'Alabama at Birmingham' 'Appalachian State'
 'Arizona' 'Arizona State' 'Arkansas' 'Arkansas State' 'Army' 'Auburn'
 'Ball State' 'Baylor' 'Boise State' 'Boston College' 'Bowling Green'
 'Brigham Young' 'Buffalo' 'California' 'Central Florida'
 'Central Michigan' 'Charlotte' 'Cincinnati' 'Clemson' 'Coastal Carolina'
 'Colorado' 'Colorado State' 'Connecticut' 'Duke' 'East Carolina'
 'Eastern Michigan' 'Florida' 'Florida Atlantic' 'Florida International'
 'Florida State' 'Fresno State' 'Georgia' 'Georgia Southern'
 'Georgia State' 'Georgia Tech' 'Hawaii' 'Houston' 'Illinois' 'Indiana'
 'Iowa' 'Iowa State' 'Kansas' 'Kansas State' 'Kent State' 'Kentucky'
 'Liberty' 'Louisiana Tech' 'Louisiana-Lafayette' 'Louisiana-Monroe'
 'Louisville' 'LSU' 'Marshall' 'Maryland' 'Massachusetts' 'Memphis'
 'Miami (Fla.)' 'Miami (Ohio)' 'Michigan' 'Michigan State'
 'Middle Tennessee' 'Minnesota' 'Mississippi' 'Mississippi State'
 'Missouri' 'Navy' 'Nebraska' 'Nevada' 'Nevada-Las Vegas' 'New Mexico'
 'New Mexico State' 'North Carolina' 'North Carolina State' 'North Texas'
 'Northern Illinois' 'Northwestern' 'Notre Dame' 'Ohio' 'Ohio State'
 'Oklahoma' 'Oklahoma State' 'Old Dominion' 'Oregon' 'Oregon State'
 'Penn State' 'Pittsburgh' 'Purdue' 'Rice' 'Rutgers' 'San Diego State'
 'San Jose State' 'South Alabama' 'South Carolina' 'South Florida'
 'Southern California' 'Southern Methodist' 'Southern Mississippi'
 'Stanford' 'Syracuse' 'Tennessee' 'Texas' 'Texas A&M' 'Texas Christian'
 'Texas State' 'Texas Tech' 'Texas-El Paso' 'Texas-San Antonio' 'Toledo'
 'Troy' 'Tulane' 'Tulsa' 'UCLA' 'Utah' 'Utah State' 'Vanderbilt'
 'Virginia' 'Virginia Tech' 'Wake Forest' 'Washington' 'Washington State'
 'West Virginia' 'Western Kentucky' 'Western Michigan' 'Wisconsin'
 'Wyoming']
129 schools
['Air Force' 'Akron' 'Alabama' 'Appalachian State' 'Arizona'
 'Arizona State' 'Arkansas' 'Arkansas State' 'Army' 'Auburn'
 'Brigham Young' 'Ball State' 'Baylor' 'Boise State' 'Boston College'
 'Bowling Green' 'Buffalo' 'California' 'Central Florida'
 'Central Michigan' 'Charlotte' 'Cincinnati' 'Clemson' 'Coastal Carolina'
 'Colorado' 'Colorado State' 'Connecticut' 'Duke' 'East Carolina'
 'Eastern Michigan' 'Florida Atlantic' 'Florida' 'Florida International'
 'Florida State' 'Fresno State' 'Georgia Southern' 'Georgia Tech'
 'Georgia' 'Georgia State' 'Hawaii' 'Houston' 'Illinois' 'Indiana' 'Iowa'
 'Iowa State' 'Kansas' 'Kansas State' 'Kent State' 'Kentucky'
 'Louisiana-Lafayette' 'Louisiana-Monroe' 'Louisiana Tech' 'LSU' 'Liberty'
 'Louisville' 'Marshall' 'Maryland' 'Memphis' 'Miami (Fla.)'
 'Miami (Ohio)' 'Michigan' 'Michigan State' 'Middle Tennessee' 'Minnesota'
 'Mississippi State' 'Mississippi' 'Missouri' 'North Carolina'
 'Northern Illinois' 'New Mexico State' 'North Carolina State' 'Navy'
 'Nebraska' 'Nevada' 'New Mexico' 'North Texas' 'Northwestern'
 'Notre Dame' 'Ohio' 'Ohio State' 'Oklahoma' 'Oklahoma State'
 'Old Dominion' 'Oregon' 'Oregon State' 'Penn State' 'Pittsburgh' 'Purdue'
 'Rice' 'Rutgers' 'South Alabama' 'South Carolina' 'South Florida'
 'Southern Methodist' 'Southern Miss' 'San Diego State' 'San Jose State'
 'Stanford' 'Syracuse' 'Texas Christian' 'Texas-El Paso'
 'Texas-San Antonio' 'Temple' 'Tennessee' 'Texas' 'Texas A&M'
 'Texas State' 'Texas Tech' 'Toledo' 'Troy' 'Tulane' 'Tulsa'
 'Massachusetts' 'Alabama at Birmingham' 'UCLA' 'Nevada-Las Vegas'
 'Southern California' 'Utah' 'Utah State' 'Virginia Tech' 'Vanderbilt'
 'Virginia' 'Western Kentucky' 'Western Michigan' 'West Virginia'
 'Wake Forest' 'Washington State' 'Washington' 'Wisconsin' 'Wyoming']
130 schools
['Abilene Christian' 'Akron' 'Alabama A&M' 'Alabama State' 'Alabama'
 'Alabama at Birmingham' 'Albany' 'Alcorn State' 'Appalachian State'
 'Arizona State' 'Arizona' 'Arkansas State' 'Arkansas' 'Auburn'
 'Austin Peay State' 'Ball State' 'Charleston Southern' 'Baylor'
 'Bethune-Cookman' 'Boise State' 'Boston College' 'Bowling Green'
 'Brigham Young' 'Brown' 'Bryant' 'Bucknell' 'Buffalo' 'Butler'
 'California Polytechnic State' 'Fresno State'
 'California State , Sacramento' 'California' 'California, Davis' 'UCLA'
 'Campbell' 'Central Connecticut State' 'Central Florida'
 'Central Michigan' 'Cincinnati' 'The Citadel' 'Clemson'
 'Coastal Carolina' 'Colgate' 'Colorado State' 'Colorado'
 'Columbia -Barnard College' 'Connecticut' 'Cornell' 'Dartmouth College'
 'Davidson College' 'Dayton' 'Delaware State' 'Delaware' 'Drake' 'Duke'
 'Duquesne' 'East Carolina' 'Eastern Illinois' 'Eastern Kentucky'
 'Eastern Michigan' 'Eastern Washington' 'Florida A&M' 'Florida Atlantic'
 'Florida International' 'Florida State' 'Florida' 'Fordham' 'Furman'
 'Georgetown' 'Georgia Southern' 'Georgia State' 'Georgia Tech' 'Georgia'
 'Grambling State' 'Hampton' 'Harvard' 'Hawaii'
 'College of the Holy Cross' 'Houston Baptist' 'Houston' 'Howard'
 'Idaho State' 'Idaho' 'Illinois State' 'Illinois' 'Indiana State'
 'Indiana' 'Iowa State' 'Iowa' 'Jackson State' 'Jacksonville State'
 'Jacksonville' 'James Madison' 'Kansas State' 'Kansas' 'Kent State'
 'Kentucky' 'Lafayette College' 'Lamar' 'Lehigh' 'Liberty' 'LSU'
 'Louisiana Tech' 'Louisville' 'Maine' 'Marist College' 'Marshall'
 'Maryland' 'Massachusetts' 'McNeese State' 'Memphis' 'Mercer'
 'Miami (Ohio)' 'Miami (Fla.)' 'Michigan State' 'Michigan'
 'Middle Tennessee' 'Minnesota' 'Mississippi State'
 'Mississippi Valley State' 'Mississippi' 'Missouri' 'Monmouth'
 'Montana State -Bozeman' 'Montana' 'Morehead State' 'Morgan State'
 'Murray State' 'North Carolina' 'North Carolina at Charlotte' 'Nebraska'
 'Nevada-Las Vegas' 'Nevada' 'New Hampshire' 'New Mexico State'
 'New Mexico' 'Nicholls State' 'Norfolk State' 'North Alabama'
 'North Carolina A&T State' 'North Carolina Central'
 'North Carolina State' 'North Dakota State' 'North Dakota' 'North Texas'
 'Louisiana-Monroe' 'Northern Arizona' 'Northern Colorado'
 'Northern Illinois' 'Northern Iowa' 'Northwestern State' 'Northwestern'
 'Notre Dame' 'Ohio State' 'Ohio' 'Oklahoma State' 'Oklahoma'
 'Old Dominion' 'Oregon State' 'Oregon' 'Penn State' 'Pennsylvania'
 'Pittsburgh' 'Portland State' 'Prairie View A&M' 'Princeton' 'Purdue'
 'Rhode Island' 'Rice' 'Richmond' 'Robert Morris' 'Rutgers' 'Sacred Heart'
 'Saint Francis  (Pennsylvania)' 'Sam Houston State' 'Samford'
 'San Diego State' 'San Diego' 'San Jose State' 'South Alabama'
 'South Carolina State' 'South Carolina' 'South Dakota State'
 'South Dakota' 'South Florida' 'Southeast Missouri State'
 'Southeastern Louisiana' 'Southern California'
 'Southern Illinois Carbondale' 'Southern Methodist'
 'Southern Mississippi' 'Southern , Baton Rouge' 'Southern Utah'
 'Missouri State' 'Texas State' 'Louisiana-Lafayette' 'Stanford'
 'Stephen F. Austin State' 'Stony Brook' 'Syracuse' 'Temple'
 'Tennessee State' 'Tennessee Technological' 'Tennessee at Chattanooga'
 'Tennessee' 'Tennessee at Martin' 'Texas A&M' 'Texas Christian'
 'Texas Southern' 'Texas Tech' 'Texas' 'Texas-El Paso'
 'Texas at San Antonio' 'Toledo' 'Towson' 'Troy' 'Tulane' 'Tulsa'
 'Air Force' 'Army' 'Navy' 'Utah State' 'Utah' 'Valparaiso' 'Vanderbilt'
 'Villanova' 'Virginia Military Institute' 'Virginia Tech' 'Virginia'
 'Wagner College' 'Wake Forest' 'Washington State' 'Washington'
 'Weber State' 'West Virginia' 'Western Carolina' 'Western Illinois'
 'Western Kentucky' 'Western Michigan' 'William & Mary' 'Wisconsin'
 'Wyoming' 'Yale' 'Youngstown State' 'Central Arkansas' 'Elon'
 'Gardner-Webb' 'Kennesaw State' 'Presbyterian College'
 'Arkansas, Pine Bluff' 'the Incarnate Word' 'Wofford College']
252 schools
['Michigan' 'Penn State' 'Ohio State' 'Texas A&M' 'Tennessee' 'Alabama'
 'LSU' 'Texas' 'Southern California' 'Georgia' 'Nebraska' 'UCLA' 'Florida'
 'Auburn' 'Oklahoma' 'Florida State' 'Clemson' 'Wisconsin'
 'South Carolina' 'Notre Dame' 'Michigan State' 'Arkansas'
 'Alabama at Birmingham' 'Missouri' 'Iowa' 'San Diego State' 'Washington'
 'Umass' 'Temple' 'Virginia Tech' 'South Florida' 'Pittsburgh'
 'Miami (Fla.)' 'Texas-San Antonio' 'Mississippi State' 'Brigham Young'
 'North Carolina' 'California' 'Purdue' 'Memphis' 'Virginia' 'Iowa State'
 'Kentucky' 'Texas Tech' 'Illinois' 'Oklahoma State' 'West Virginia'
 'Mississippi' 'North Carolina State' 'Arizona State' 'Arizona'
 'Georgia Tech' 'Louisville' 'Maryland' 'Oregon' 'Colorado' 'Indiana'
 'Rutgers' 'Air Force' 'Texas-El Paso' 'Minnesota' 'Kansas'
 'East Carolina' 'Kansas State' 'Hawaii' 'Stanford' 'Syracuse'
 'Northwestern' 'Rice' 'Oregon State' 'Central Florida' 'Baylor' 'Utah'
 'Texas Christian' 'Boston College' 'Colorado State' 'Fresno State'
 'South Alabama' 'Vanderbilt' 'Duke' 'Cincinnati' 'Connecticut' 'Houston'
 'New Mexico' 'Marshall' 'Army' 'Boise State' 'Nevada-Las Vegas'
 'Southern Mississippi' 'Tulsa' 'Washington State' 'Navy'
 'Southern Methodist' 'Wake Forest' 'Middle Tennessee'
 'Louisiana-Lafayette' 'Arkansas State' 'North Texas' 'Louisiana Tech'
 'San Jose State' 'Louisiana-Monroe' 'New Mexico State' 'Central Michigan'
 'Eastern Michigan' 'Western Michigan' 'Tulane' 'Florida Atlantic' 'Akron'
 'Texas State' 'Troy' 'Nevada' 'Wyoming' 'Buffalo' 'Toledo' 'Utah State'
 'Kent State' 'Georgia Southern' 'Miami (Ohio)' 'Appalachian State'
 'Northern Illinois' 'Ohio' 'Bowling Green' 'Florida International'
 'Georgia State' 'Ball State' 'Western Kentucky' 'Old Dominion'
 'Massachusetts' 'Idaho' 'Charlotte' 'Coastal Carolina']
131 schools
```

Step 5: Building a dataframe for the analysis

In [ ]:

```
# Merge all dataframes
df1 = coaches.merge(stadiums, on='School', how='left')
df2 = df1.merge(grad, on='School', how='left')
coach = df2.merge(wl, on='School', how='left')
```

```python
#Descriptive data
print(coach.describe())
print(coach.sample())
print(coach.dtypes)
coach = coach.drop([ 'Conference_y', 'Conference','Cohort Year', 'Year',
                                  'Sport', 'Opened','MOV','ATS', 'Buyout', 'BonusPaid', 'Win-Loss R
cord','FGR'], axis=1)
coach.rename(columns={'Conference_x':'Conference'}, inplace=True)
coach['TPT'] = coach.apply(lambda row: (row.TotalPay * 0.001), axis = 1)
# % of missing.
for col in coach.columns:
    pct_missing = np.mean(coach[col].isnull())
    print("Are there any null values?\n",'{} - {}%'.format(col, round(pct_missing*100)))
# DROP GSR null
coach = coach.dropna(axis=0, subset=['GSR'])
# DROP WinPercentage null
coach = coach.dropna(axis=0, subset=['WinPercentage'])
# DROP missing Capacity
coach = coach.dropna(axis=0, subset=['Capacity'])

# % of missing.
#for col in coach.columns:
    #pct_missing = np.mean(coach[col].isnull())
    #print("Are there any null values?\n",'{} - {}%'.format(col, round(pct_missing*100)))
```

```
           TotalPay     BonusPaid  ...         MOV         ATS
count  1.290000e+02  1.290000e+02  ...  128.000000  128.000000
mean   2.342113e+06  1.020011e+05  ...    1.526563   -0.070313
std    1.903114e+06  2.088806e+05  ...   11.636749    4.406373
min    0.000000e+00  0.000000e+00  ...  -32.900000  -11.600000
25%    7.625700e+05  0.000000e+00  ...   -4.925000   -3.500000
50%    1.830000e+06  2.000000e+04  ...    0.200000    0.100000
75%    3.550000e+06  1.000000e+05  ...    8.275000    3.125000
max    8.307000e+06  1.350000e+06  ...   33.100000   10.800000

[8 rows x 11 columns]
             School Conference_x       Coach  ...  WinPercentage  MOV  ATS
93  San Diego State     Mt. West  Rocky Long  ...           76.9  8.5  3.7

[1 rows x 21 columns]
School              object
Conference_x        object
Coach               object
TotalPay           float64
BonusPaid          float64
Buyout             float64
Stadium             object
Conference_y        object
Capacity           float64
Opened             float64
Cohort Year        float64
Year                object
Conference          object
Sport               object
State               object
GSR                float64
FGR                float64
Win-Loss Record     object
WinPercentage      float64
MOV                float64
ATS                float64
dtype: object
Are there any null values?
 School - 0.0%
Are there any null values?
 Conference - 0.0%
Are there any null values?
 Coach - 0.0%
Are there any null values?
 TotalPay - 0.0%
Are there any null values?
 Stadium - 1.0%
Are there any null values?
 Capacity - 1.0%
Are there any null values?
 State - 2.0%
 State - 1.0%
Are there any null values?
 GSR - 2.0%
Are there any null values?
 WinPercentage - 1.0%
Are there any null values?
 TPT - 0.0%
```

In [ ]:

```
print("What are the dimensions of the dataset?\n",coach.shape)
```

```
What are the dimensions of the dataset?
 (125, 10)
```

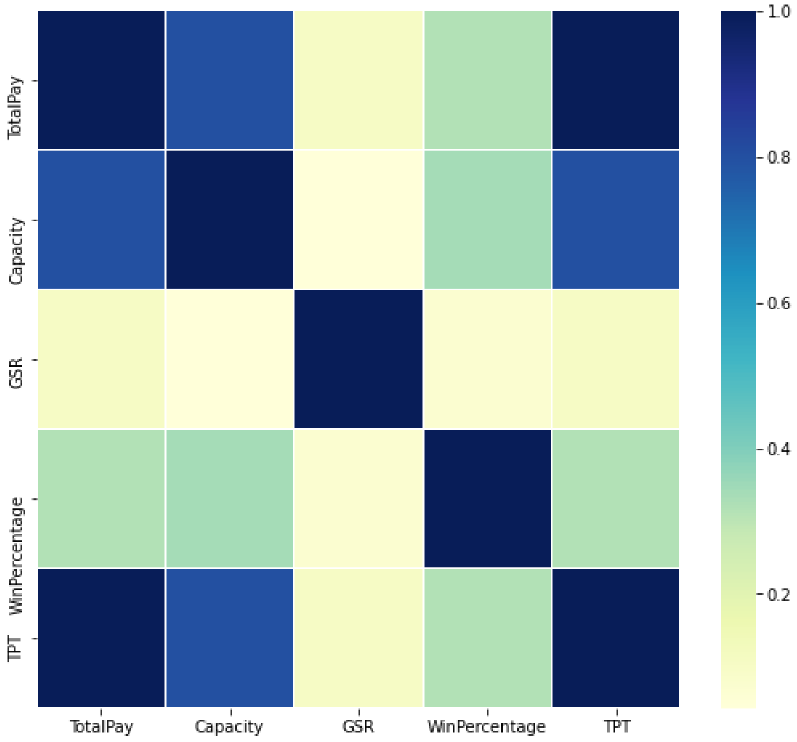
In [ ]:

```
#heatmap
corrmat = coach.corr()

f, ax = plt.subplots(figsize =(9, 8))
sns.heatmap(corrmat, ax = ax, cmap ="YlGnBu", linewidths = 0.1)
```

Out[ ]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f1929888b70>
```



Top Conferences

In [ ]:

```
# Resource:Athlon Sports. (2020) College Football 2020 Conference Power Rankings.
# Retrieved October 26, 2020 from athlonsports.com/college-football/college-football-2020-conferen
ce-power-rankings.
# Top 5 conference column
coach = coach.assign(top5 = coach['Conference'])
coach.top5 = coach.top5.replace({"SEC": "Y"})
coach.top5 = coach.top5.replace({"Big Ten": "Y"})
coach.top5 = coach.top5.replace({"ACC": "Y"})
coach.top5 = coach.top5.replace({"Big 12": "Y"})
coach.top5 = coach.top5.replace({"Pac-12": "Y"})
coach.loc[(coach.top5 != 'Y'),'top5']='N'
coach['top5'].astype('category')
```

```
# A column for each conference
coach['Mt. West'] = coach['Conference'].apply(lambda x: 1 if x == 'Mt. West' else 0)
coach['Mt. West'].astype('float')

coach['MAC'] = coach['Conference'].apply(lambda x: 1 if x == 'MAC' else 0)
coach['MAC'].astype('float')

coach['SEC'] = coach['Conference'].apply(lambda x: 1 if x == 'SEC' else 0)
coach['SEC'].astype('float')

coach['C-USA'] = coach['Conference'].apply(lambda x: 1 if x == 'C-USA' else 0)
coach['C-USA'].astype('float')

coach['Sun Belt'] = coach['Conference'].apply(lambda x: 1 if x == 'Sun Belt' else 0)
coach['Sun Belt'].astype('float')

coach['Pac-12'] = coach['Conference'].apply(lambda x: 1 if x == 'Pac-12' else 0)
coach['Pac-12'].astype('float')

coach['Ind.'] = coach['Conference'].apply(lambda x: 1 if x == 'Ind.' else 0)
coach['Ind.'].astype('float')

coach['ACC'] = coach['Conference'].apply(lambda x: 1 if x == 'ACC' else 0)
coach['ACC'].astype('float')

coach['AAC'] = coach['Conference'].apply(lambda x: 1 if x == 'AAC' else 0)
coach['AAC'].astype('float')

coach['Big Ten'] = coach['Conference'].apply(lambda x: 1 if x == 'Big Ten' else 0)
coach['Big Ten'].astype('float')

coach['Big 12'] = coach['Conference'].apply(lambda x: 1 if x == 'Big 12' else 0)
coach['Big 12'].astype('float')
```

Out[ ]:

```
19     0.0
29     0.0
69     0.0
59     0.0
113    0.0
      ... 
4      0.0
52     0.0
24     0.0
8      0.0
53     0.0
Name: Big 12, Length: 125, dtype: float64
```

Superfan Schools

In [ ]:

```
coach = coach.assign(superfan = coach['School'])
coach.superfan = coach.superfan.replace({"LSU": "Y"})
coach.superfan = coach.superfan.replace({"Alabama": "Y"})
coach.superfan = coach.superfan.replace({"Michigan": "Y"})
coach.superfan = coach.superfan.replace({"Clemson": "Y"})
coach.superfan = coach.superfan.replace({"Oklahoma": "Y"})
coach.superfan = coach.superfan.replace({"Georgia": "Y"})
coach.superfan = coach.superfan.replace({"Notre Dame": "Y"})
coach.superfan = coach.superfan.replace({"Auburn": "Y"})
coach.superfan = coach.superfan.replace({"Texas": "Y"})
coach.superfan = coach.superfan.replace({"Nebraska": "Y"})
coach.superfan = coach.superfan.replace({"Tennessee": "Y"})
coach.superfan = coach.superfan.replace({"Penn State": "Y"})
coach.superfan = coach.superfan.replace({"Florida": "Y"})
coach.superfan = coach.superfan.replace({"Florida State": "Y"})
coach.superfan = coach.superfan.replace({"Texas A&M": "Y"})
coach.superfan = coach.superfan.replace({"Wisconsin": "Y"})
coach.superfan = coach.superfan.replace({"South Carolina": "Y"})
coach.superfan = coach.superfan.replace({"Oregon": "Y"})
coach.loc[(coach.superfan != 'Y'),'superfan']='N'
coach['superfan'].astype('category')
```

Out[ ]:

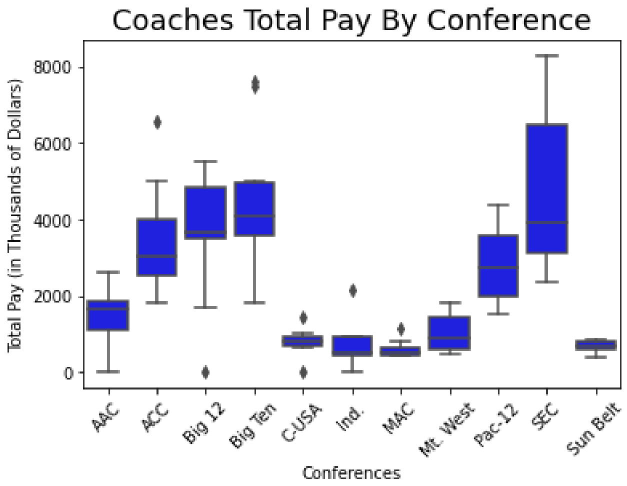
```
0      N
1      N
2      Y
3      N
4      N
      ..
124    N
125    N
126    N
127    Y
128    N
Name: superfan, Length: 125, dtype: category
Categories (2, object): ['N', 'Y']
```

Descriptive Viz

In [ ]:

```
#Boxplot By Conference
coach.sort_values('Conference', inplace=True, ascending=True)
bp = sns.boxplot(x="Conference",
                          y="TPT",
                          data=coach,
                          color = "blue")

#add title, xlabel and y label
plt.title('Coaches Total Pay By Conference', fontsize = 18)
plt.xlabel('Conferences')
plt.ylabel('Total Pay (in Thousands of Dollars)')
#rotate names to reduce overlap
bp.set_xticklabels(bp.get_xticklabels(),rotation=45)
plt.show()
```



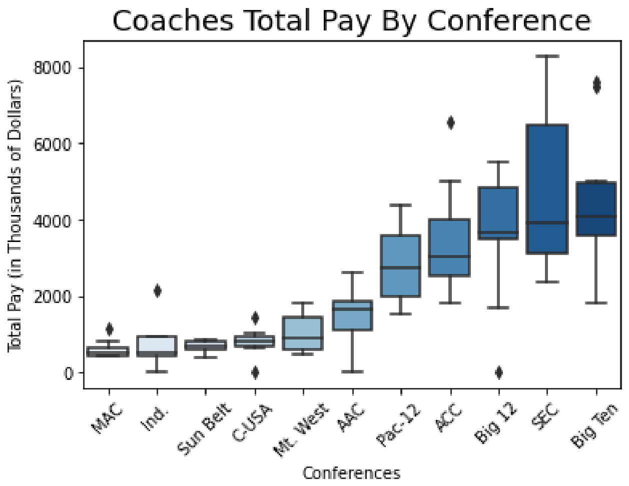
In [ ]:

```
grouped = coach.loc[:,['Conference', 'TPT']] \
    .groupby(['Conference']) \
    .median() \
    .sort_values(by='TPT')

bp = sns.boxplot(x="Conference",
                          y="TPT",
                          data=coach,order=grouped.index,
                          palette="Blues")
plt.title('Coaches Total Pay By Conference', fontsize = 18)
plt.xlabel('Conferences')
plt.ylabel('Total Pay (in Thousands of Dollars)')
bp.set_xticklabels(bp.get_xticklabels(),rotation=45)
```

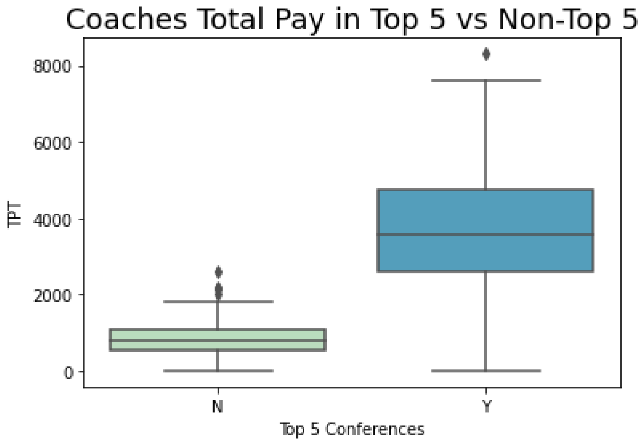
Out[ ]:

```
[Text(0, 0, 'MAC'),
 Text(0, 0, 'Ind.'),
 Text(0, 0, 'Sun Belt'),
 Text(0, 0, 'C-USA'),
 Text(0, 0, 'Mt. West'),
 Text(0, 0, 'AAC'),
 Text(0, 0, 'Pac-12'),
 Text(0, 0, 'ACC'),
 Text(0, 0, 'Big 12'),
 Text(0, 0, 'SEC'),
 Text(0, 0, 'Big Ten')]
```



In [ ]:

```
bp = sns.boxplot(x="top5",
                         y="TPT",palette="GnBu",
                         data=coach
                         )
#add title, xlabel and y label
plt.title('Coaches Total Pay in Top 5 vs Non-Top 5', fontsize = 18)
plt.xlabel('Top 5 Conferences')
plt.show()
```



In [ ]:

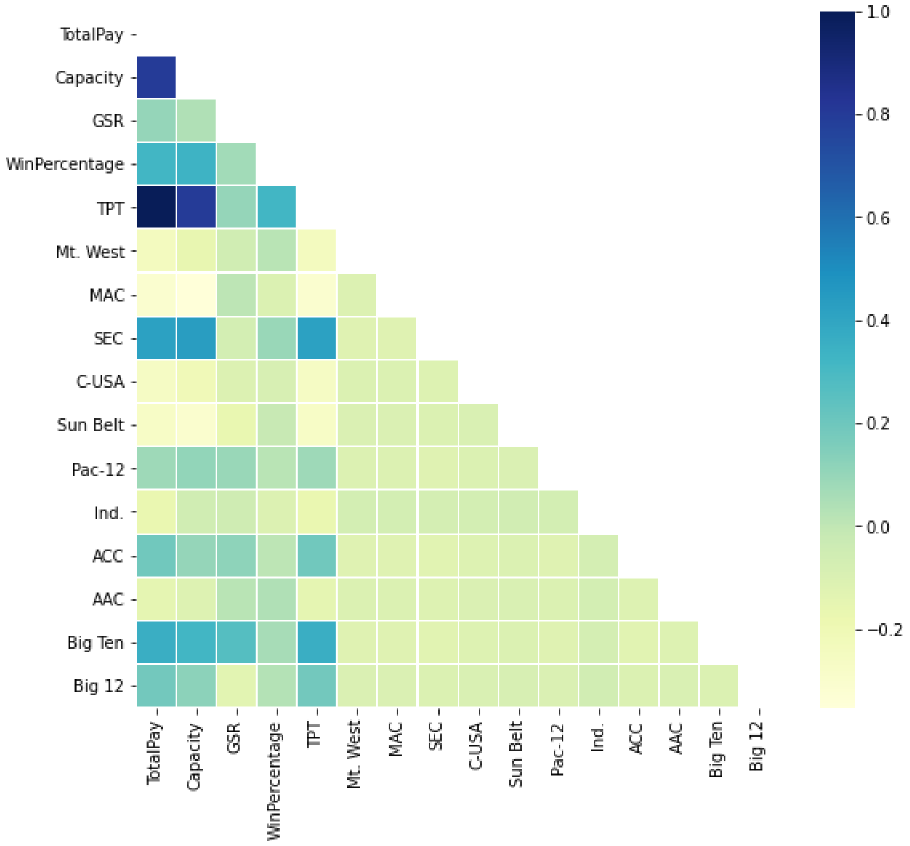
```
#heatmap
corrmat = coach.corr()

f, ax = plt.subplots(figsize =(9, 8))
mask = np.zeros_like(corrmat, dtype=np.bool)
mask[np.triu_indices_from(mask)] = True

sns.heatmap(corrmat, mask=mask,ax = ax, cmap ="YlGnBu", linewidths = 0.1)
```

Out[ ]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f19125e7278>
```

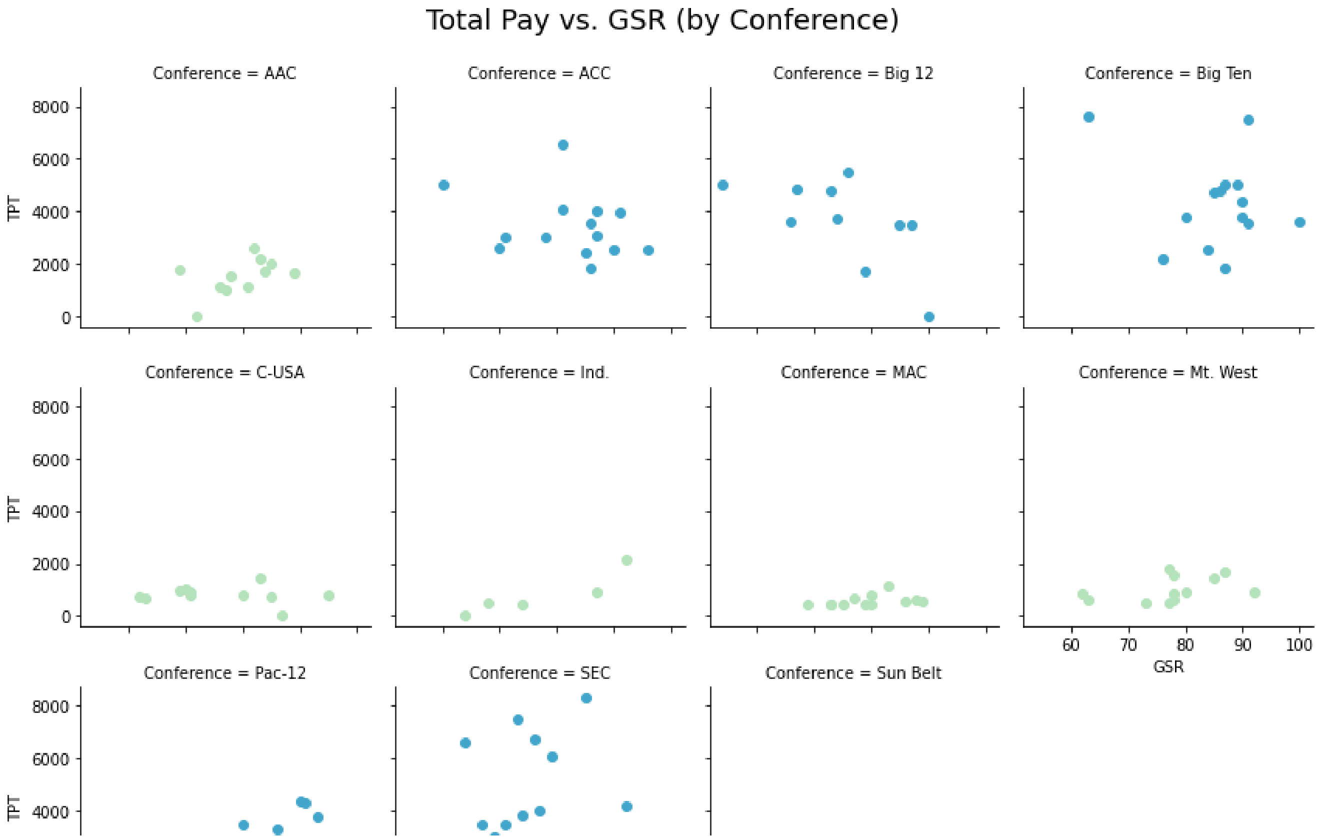


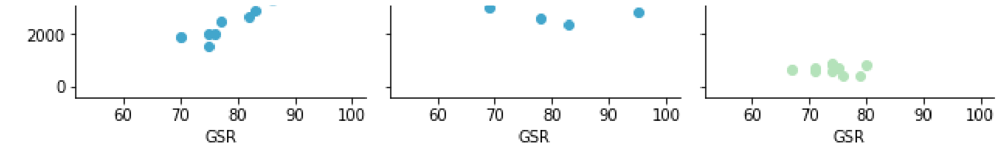
```
In [ ]:
```

```
g = sns.FacetGrid(coach, col="Conference", col_wrap=4, hue="top5", palette="GnBu")
g.map(plt.scatter, "GSR","TPT", alpha=1);
plt.subplots_adjust(top=0.9)
g.fig.suptitle('Total Pay vs. GSR (by Conference)',fontsize = 18)
```

```
Out[ ]:
```

```
Text(0.5, 0.98, 'Total Pay vs. GSR (by Conference)')
```



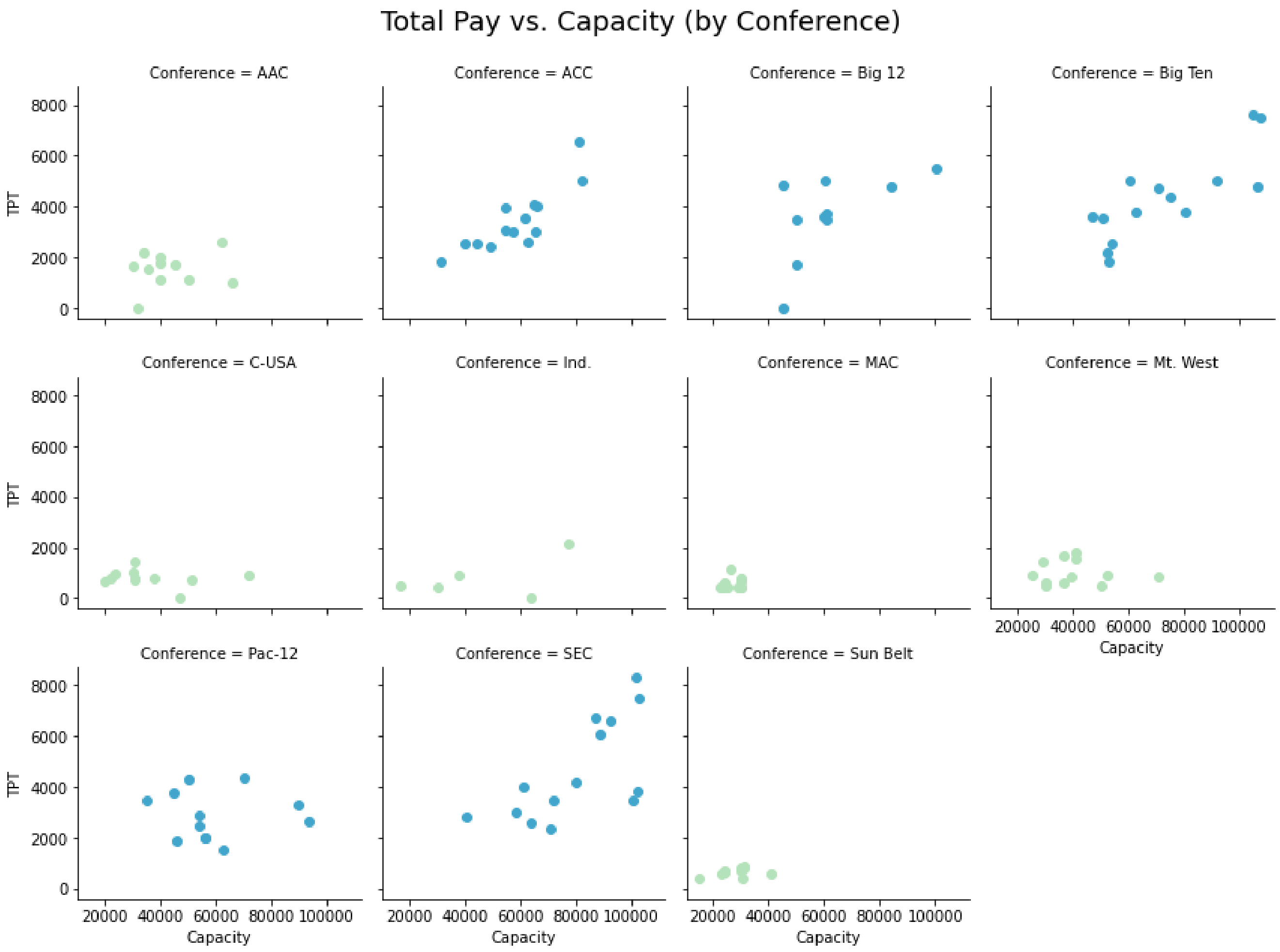


In [ ]:

```
g = sns.FacetGrid(coach, col="Conference", col_wrap=4, hue="top5", palette="GnBu")
g.map(plt.scatter, "Capacity","TPT", alpha=1);
plt.subplots_adjust(top=0.9)
g.fig.suptitle('Total Pay vs. Capacity (by Conference)',fontsize = 18)
```

Out[ ]:

```
Text(0.5, 0.98, 'Total Pay vs. Capacity (by Conference)')
```

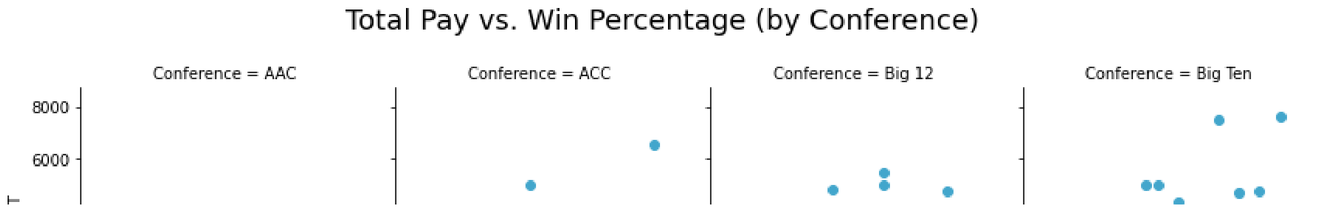


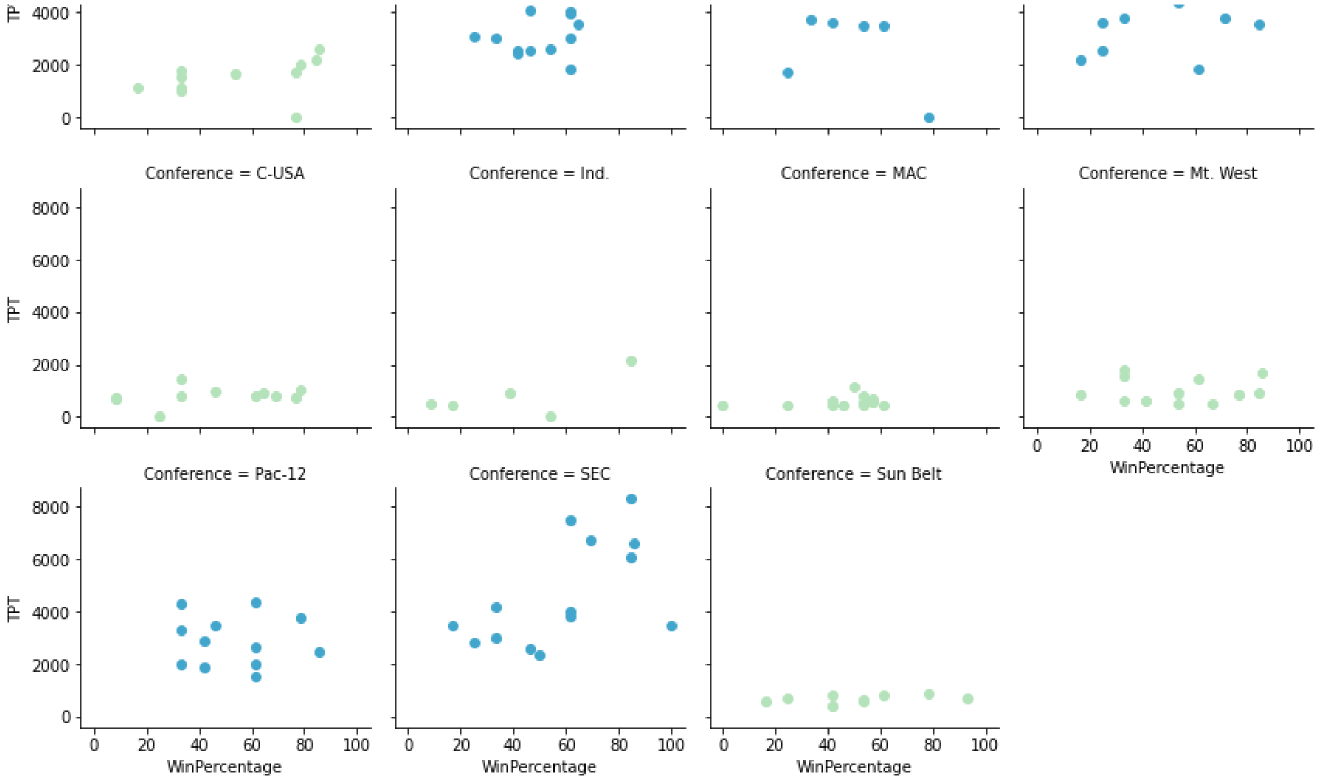
In [ ]:

```
g = sns.FacetGrid(coach, col="Conference", col_wrap=4, hue="top5", palette="GnBu")
g.map(plt.scatter, "WinPercentage","TPT", alpha=1);
plt.subplots_adjust(top=0.9)
g.fig.suptitle('Total Pay vs. Win Percentage (by Conference)',fontsize = 18)
```

Out[ ]:

```
Text(0.5, 0.98, 'Total Pay vs. Win Percentage (by Conference)')
```





Step 6: Initial analysis

In [ ]:

```
# Split data
np.random.seed(1234)
coach['runiform'] = uniform.rvs(loc = 0, scale = 1, size = len(coach))
train = coach[coach['runiform'] >= 0.33]
test = coach[coach['runiform'] < 0.33]

# check training data frame

print('\ntrain dataframe (rows, columns): ',train.shape)


# check test data frame
print('\ntest dataframe (rows, columns): ',test.shape)

# models to investigate
m1 = str('TotalPay ~ WinPercentage') #Single Regression
m2 = str('TotalPay ~ Capacity +  WinPercentage')
m3 = str('TotalPay ~ WinPercentage + Capacity + GSR') #Modeled on those with the a correlation rel
ationship
m4 = str('TotalPay ~ top5 + superfan + Capacity')
m5 = str('TotalPay ~ top5 + superfan + Capacity + WinPercentage')
```

```
train dataframe (rows, columns):  (90, 24)

test dataframe (rows, columns):  (35, 24)
```

Step 7: Regressional Model

In [ ]:

```
# M1: fit the model to the training set
train_m1_fit = smf.ols(m1,data=train).fit()
print(train_m1_fit.summary())
# training set predictions
train['predicted_TotalPay'] = train_m1_fit.fittedvalues
test['predicted_TotalPay'] = train_m1_fit.predict(test)

# what is the response variance RMSE
rmse = round(np.power(test['TotalPay'].corr(test['predicted_TotalPay']),2),3)
```

```
print("M1: Proportion of Test Set Variance Accounted for: {0}".format(rmse))
```

```
                            OLS Regression Results                            
==============================================================================
Dep. Variable:               TotalPay   R-squared:                       0.086
Model:                            OLS   Adj. R-squared:                  0.076
Method:                 Least Squares   F-statistic:                     8.300
Date:                Sat, 17 Oct 2020   Prob (F-statistic):            0.00498
Time:                        17:33:42   Log-Likelihood:                -1424.3
No. Observations:                  90   AIC:                             2853.
Df Residuals:                      88   BIC:                             2858.
Df Model:                           1                                         
Covariance Type:            nonrobust                                         
=================================================================================
                    coef    std err          t      P>|t|      [0.025      0.975]
---------------------------------------------------------------------------------
Intercept      1.156e+06   4.91e+05      2.355      0.021    1.81e+05    2.13e+06
WinPercentage  2.535e+04   8800.127      2.881      0.005    7864.851    4.28e+04
==============================================================================
Omnibus:                        7.201   Durbin-Watson:                   0.956
Prob(Omnibus):                  0.027   Jarque-Bera (JB):                7.372
Skew:                           0.700   Prob(JB):                       0.0251
Kurtosis:                       2.934   Cond. No.                         142.
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
M1: Proportion of Test Set Variance Accounted for: 0.157
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:5: 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-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  """
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:6: 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-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

In [ ]:

```
# M2: fit the model to the training set
train_m2_fit = smf.ols(m2,data=train).fit()
print(train_m2_fit.summary())

# which parameter has the most significant effect on TotalPay?
# look at each parameter in the model
print("\nM2: Most significant attribute: '{0}' with value: {1}".format(train_m2_fit.params[1:].idxmax(),round(train_m2_fit.params[1:].max()),0))
# training set predictions
train['predicted_TotalPay'] = train_m2_fit.fittedvalues
test['predicted_TotalPay'] = train_m2_fit.predict(test)

# what is the response variance
rmse = round(np.power(test['TotalPay'].corr(test['predicted_TotalPay']),2),3)
print("M2: Proportion of Test Set Variance Accounted for: {0}".format(rmse))
```

```
                            OLS Regression Results                            
==============================================================================
Dep. Variable:               TotalPay   R-squared:                       0.560
Model:                            OLS   Adj. R-squared:                  0.550
Method:                 Least Squares   F-statistic:                     55.46
Date:                Sat, 17 Oct 2020   Prob (F-statistic):           2.96e-16
Time:                        17:33:50   Log-Likelihood:                -1391.4
No. Observations:                  90   AIC:                             2789.
Df Residuals:                      87   BIC:                             2796.
Df Model:                           2                                         
Covariance Type:            nonrobust                                         
=================================================================================
                  coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept     -9.521e+05   4.06e+05     -2.347      0.021   -1.76e+06   -1.46e+05
Capacity         58.7366      6.062      9.689      0.000      46.687      70.786
WinPercentage  5628.7086   6467.100      0.870      0.386   -7225.354    1.85e+04
==============================================================================
Omnibus:                        0.179   Durbin-Watson:                   2.000
Prob(Omnibus):                  0.914   Jarque-Bera (JB):                0.059
Skew:                          -0.063   Prob(JB):                        0.971
Kurtosis:                       2.999   Cond. No.                     1.75e+05
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.75e+05. This might indicate that there are
strong multicollinearity or other numerical problems.

M2: Most significant attribute: 'WinPercentage' with value: 5629
M2: Proportion of Test Set Variance Accounted for: 0.889
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:9: 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-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  if __name__ == '__main__':
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:10: 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-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  # Remove the CWD from sys.path while we load stuff.
```

In [ ]:

```
# M3: fit the model to the training set
train_m3_fit = smf.ols(m3,data=train).fit()
print(train_m3_fit.summary())

# which parameter has the most significant effect on TotalPay?
# look at each parameter in the model
print("\nM3: Most significant attribute: '{0}' with value:
{1}".format(train_m3_fit.params[1:].idxmax(),round(train_m3_fit.params[1:].max()),0))
# training set predictions
train['predicted_TotalPay'] = train_m3_fit.fittedvalues
test['predicted_TotalPay'] = train_m3_fit.predict(test)

# what is the response variance
rmse = round(np.power(test['TotalPay'].corr(test['predicted_TotalPay']),2),3)
print("M3: Proportion of Test Set Variance Accounted for: {0}".format(rmse))
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:               TotalPay   R-squared:                       0.572
Model:                            OLS   Adj. R-squared:                  0.557
Method:                 Least Squares   F-statistic:                     38.31
Date:                Sat, 17 Oct 2020   Prob (F-statistic):           8.08e-16
Time:                        17:33:53   Log-Likelihood:                -1390.2
No. Observations:                  90   AIC:                             2788.
Df Residuals:                      86   BIC:                             2798.
Df Model:                           3
Covariance Type:            nonrobust
==================================================================================
                  coef    std err          t      P>|t|      [0.025      0.975]
----------------------------------------------------------------------------------
Intercept     -2.648e+06   1.18e+06     -2.237      0.028      -5e+06   -2.95e+05
WinPercentage  4340.1512   6474.015      0.670      0.504   -8529.765    1.72e+04
Capacity         58.3915      6.021      9.698      0.000      46.422      70.361
GSR            2.233e+04   1.47e+04      1.524      0.131   -6803.486    5.15e+04
==================================================================================
Omnibus:                        0.453   Durbin-Watson:                   2.039
Prob(Omnibus):                  0.797   Jarque-Bera (JB):                0.126
Skew:                           0.050   Prob(JB):                        0.939
```

```
Kurtosis:                       3.154   Cond. No.                     5.15e+05
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 5.15e+05. This might indicate that there are
strong multicollinearity or other numerical problems.

M3: Most significant attribute: 'GSR' with value: 22326
M3: Proportion of Test Set Variance Accounted for: 0.879
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:9: 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-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  if __name__ == '__main__':
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:10: 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-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  # Remove the CWD from sys.path while we load stuff.
```

In [ ]:

```
# M4: fit the model to the training set
train_m4_fit = smf.ols(m4,data=train).fit()
print(train_m4_fit.summary())

# which parameter has the most significant effect on TotalPay?
# look at each parameter in the motel
print("\nM4: Most significant attribute: '{0}' with value:
{1}".format(train_m4_fit.params[1:].idxmax(),round(train_m4_fit.params[1:].max()),0))
# training set predictions
train['predicted_TotalPay'] = train_m4_fit.fittedvalues
test['predicted_TotalPay'] = train_m4_fit.predict(test)

# what is the response variance RMSE, when predicting out-of-sample
rmse = round(np.power(test['TotalPay'].corr(test['predicted_TotalPay']),2),3)
print("M4: Proportion of Test Set Variance Accounted for: {0}".format(rmse))
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:               TotalPay   R-squared:                       0.749
Model:                            OLS   Adj. R-squared:                  0.740
Method:                 Least Squares   F-statistic:                     85.33
Date:                Sat, 17 Oct 2020   Prob (F-statistic):           1.08e-25
Time:                        17:33:58   Log-Likelihood:                -1366.2
No. Observations:                  90   AIC:                             2740.
Df Residuals:                      86   BIC:                             2750.
Df Model:                           3
Covariance Type:            nonrobust
=================================================================================
                    coef    std err          t      P>|t|      [0.025      0.975]
---------------------------------------------------------------------------------
Intercept      4.529e+05   3.29e+05      1.378      0.172      -2e+05    1.11e+06
top5[T.Y]      2.051e+06   2.69e+05      7.640      0.000    1.52e+06    2.59e+06
superfan[T.Y]  1.806e+06   4.25e+05      4.246      0.000     9.6e+05    2.65e+06
Capacity         12.2711      7.942      1.545      0.126      -3.517      28.059
==============================================================================
Omnibus:                        2.820   Durbin-Watson:                   2.034
Prob(Omnibus):                  0.244   Jarque-Bera (JB):                2.688
Skew:                          -0.000   Prob(JB):                        0.261
Kurtosis:                       3.847   Cond. No.                     2.81e+05
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.81e+05. This might indicate that there are
strong multicollinearity or other numerical problems.

M4: Most significant attribute: 'top5[T.Y]' with value: 2051399
```

```
M4: Most significant attribute: 'top5[T.Y]' with value: 2051599
M4: Proportion of Test Set Variance Accounted for: 0.737
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:9: 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-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  if __name__ == '__main__':
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:10: 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-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  # Remove the CWD from sys.path while we load stuff.
```

In [ ]:

```
# M5: fit the model to the training set
train_m5_fit = smf.ols(m5,data=train).fit()
print(train_m5_fit.summary())

# which parameter has the most significant effect on TotalPay?
# look at each parameter in the motel
print("\nM5: Most significant attribute: '{0}' with value:
{1}".format(train_m5_fit.params[1:].idxmax(),round(train_m5_fit.params[1:].max()),0))
# training set predictions
train['predicted_TotalPay'] = train_m5_fit.fittedvalues
test['predicted_TotalPay'] = train_m5_fit.predict(test)

# what is the response variance RMSE, when predicting out-of-sample
rmse = round(np.power(test['TotalPay'].corr(test['predicted_TotalPay']),2),3)
print("M5: Proportion of Test Set Variance Accounted for: {0}".format(rmse))
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:               TotalPay   R-squared:                       0.750
Model:                            OLS   Adj. R-squared:                  0.738
Method:                 Least Squares   F-statistic:                     63.66
Date:                Sat, 17 Oct 2020   Prob (F-statistic):           8.90e-25
Time:                        17:34:01   Log-Likelihood:                -1366.0
No. Observations:                  90   AIC:                             2742.
Df Residuals:                      85   BIC:                             2755.
Df Model:                           4
Covariance Type:            nonrobust
=================================================================================
                    coef    std err          t      P>|t|      [0.025      0.975]
---------------------------------------------------------------------------------
Intercept       3.18e+05   3.92e+05      0.811      0.420   -4.62e+05     1.1e+06
top5[T.Y]       2.05e+06   2.69e+05      7.609      0.000    1.51e+06    2.59e+06
superfan[T.Y]  1.759e+06   4.33e+05      4.062      0.000    8.98e+05    2.62e+06
Capacity         11.8803      7.993      1.486      0.141      -4.013      27.773
WinPercentage  3186.6462   5011.991      0.636      0.527   -6778.535    1.32e+04
==============================================================================
Omnibus:                        3.712   Durbin-Watson:                   2.069
Prob(Omnibus):                  0.156   Jarque-Bera (JB):                4.088
Skew:                          -0.092   Prob(JB):                        0.130
Kurtosis:                       4.028   Cond. No.                     3.00e+05
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large,  3e+05. This might indicate that there are
strong multicollinearity or other numerical problems.

M5: Most significant attribute: 'top5[T.Y]' with value: 2050229
M5: Proportion of Test Set Variance Accounted for: 0.747
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:9: 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-
See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  if __name__ == '__main__':
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:10: 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-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  # Remove the CWD from sys.path while we load stuff.
```

In [91]:

```
# specify a simple model with Team Conference
m6 = str('TotalPay ~ Q("SEC") + Q("C-USA") + Q("Sun Belt") + Q("Pac-12") + Q("Ind.") + Q("ACC") +
Q("AAC") + Q("Big Ten") + Q("Big 12") + Q("Mt. West") + Q("MAC") + Capacity + WinPercentage + GSR'
)

# fit the model to the training set
train_m6_fit = smf.ols(m6, data = train).fit()

# summary of model fit to the training set
print(train_m6_fit.summary())

# print the coefficients
print(train_m6_fit.params)
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:               TotalPay   R-squared:                       0.725
Model:                            OLS   Adj. R-squared:                  0.678
Method:                 Least Squares   F-statistic:                     15.42
Date:                Sat, 17 Oct 2020   Prob (F-statistic):           2.32e-16
Time:                        18:55:09   Log-Likelihood:                -1370.2
No. Observations:                  90   AIC:                             2768.
Df Residuals:                      76   BIC:                             2803.
Df Model:                          13
Covariance Type:            nonrobust
=================================================================================
                    coef    std err          t      P>|t|      [0.025      0.975]
---------------------------------------------------------------------------------
Intercept      1.444e+05   1.14e+06      0.127      0.899   -2.12e+06    2.41e+06
Q("SEC")       1.313e+06   4.65e+05      2.823      0.006    3.87e+05    2.24e+06
Q("C-USA")    -9.215e+05   3.57e+05     -2.579      0.012   -1.63e+06    -2.1e+05
Q("Sun Belt") -8.073e+05   4.22e+05     -1.912      0.060   -1.65e+06    3.38e+04
Q("Pac-12")    4.968e+05   3.74e+05      1.328      0.188   -2.48e+05    1.24e+06
Q("Ind.")     -1.565e+06   5.86e+05     -2.669      0.009   -2.73e+06   -3.97e+05
Q("ACC")       1.106e+06   3.52e+05      3.147      0.002    4.06e+05    1.81e+06
Q("AAC")      -3.846e+05   3.85e+05     -0.999      0.321   -1.15e+06    3.82e+05
Q("Big Ten")   1.329e+06   4.97e+05      2.676      0.009     3.4e+05    2.32e+06
Q("Big 12")    1.183e+06   3.79e+05      3.122      0.003    4.28e+05    1.94e+06
Q("Mt. West") -8.562e+05   3.54e+05     -2.419      0.018   -1.56e+06   -1.51e+05
Q("MAC")      -7.497e+05   4.22e+05     -1.777      0.080   -1.59e+06    9.07e+04
Capacity         32.1778      7.815      4.118      0.000      16.614      47.742
WinPercentage  5977.4924   5629.133      1.062      0.292   -5233.897    1.72e+04
GSR            1559.1217   1.43e+04      0.109      0.914    -2.7e+04    3.01e+04
==============================================================================
Omnibus:                        4.832   Durbin-Watson:                   2.313
Prob(Omnibus):                  0.089   Jarque-Bera (JB):                6.611
Skew:                          -0.023   Prob(JB):                       0.0367
Kurtosis:                       4.327   Cond. No.                     3.27e+18
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 2.84e-26. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.
Intercept        1.444214e+05
Q("SEC")         1.313286e+06
Q("C-USA")      -9.215371e+05
Q("Sun Belt")   -8.073194e+05
Q("Pac-12")      4.968340e+05
Q("Ind.")       -1.564764e+06
Q("ACC")         1.106361e+06
Q("AAC")        -3.845710e+05
Q("Big Ten")     1.329477e+06
```

```
Q("Big 12")        1.182560e+06
Q("Mt. West")     -8.562356e+05
Q("MAC")          -7.496705e+05
Capacity           3.217775e+01
WinPercentage      5.977492e+03
GSR                1.559122e+03
dtype: float64
```

Questions

Question 1: What is the recommended salary for the Syracuse football coach?

In [83]:

```
coach.loc[(coach.top5 != 'Y'),'top5']='0'
coach.loc[(coach.top5 != '0'),'top5']='1'
coach['top5'].astype('float')
coach.loc[(coach.superfan != 'Y'),'superfan']='0'
coach.loc[(coach.superfan != '0'),'superfan']='1'
coach['superfan'].astype('float')
np.random.seed(1234)
coach['runiform'] = uniform.rvs(loc = 0, scale = 1, size = len(coach))
train = coach[coach['runiform'] >= 0.33]
test = coach[coach['runiform'] < 0.33]

#linearRegression from SKlearn
lin_reg = LinearRegression()

# train
y_train = train[['TotalPay']]
X_train = train[['top5' , 'superfan' , 'Capacity' , 'WinPercentage']]
lin_reg.fit(X_train, y_train)


#Predict
y_test = test[['TotalPay']]
X_test = test[['top5' , 'superfan' , 'Capacity' , 'WinPercentage']]
y_pred = lin_reg.predict(X_test)

s = coach[coach['School'] == 'Syracuse']
lin_reg.predict(s[['top5' , 'superfan' , 'Capacity' , 'WinPercentage']])

spred = lin_reg.predict(s[['top5' , 'superfan' , 'Capacity' , 'WinPercentage']])


# print amount
print("Syracuse's Coach Salary should be ",(spred))
print('${:,.2f}'.format(2175410.29571167))
```

```
Syracuse's Coach Salary should be  [[2175410.29571167]]
$2,175,410.30
```

Question 2: What would his salary be if we were still in the Big East? What if we went to the Big Ten?

In [93]:

```
print(train_m6_fit.params)
print(train_m6_fit.params[6]) #Coefficiant for ACC
print(train_m6_fit.params[7]) #Coefficiant for AAC
acc = train_m6_fit.params[6]
aac = train_m6_fit.params[7]
spredbe=(spred-acc)+aac
print("Syracuse's Coach AAC Salary should be ",(spredbe))
print('${:,.2f}'.format(684477.80749561))
```

```
Intercept          1.444214e+05
Q("SEC")           1.313286e+06
Q("C-USA")        -9.215371e+05
Q("Sun Belt")     -8.073194e+05
Q("Pac-12")        4.968340e+05
Q("Ind.")         -1.564764e+06
```

```
Q("ACC")          1.106361e+06
Q("AAC")         -3.845710e+05
Q("Big Ten")      1.329477e+06
Q("Big 12")       1.182560e+06
Q("Mt. West")    -8.562356e+05
Q("MAC")         -7.496705e+05
Capacity          3.217775e+01
WinPercentage     5.977492e+03
GSR               1.559122e+03
dtype: float64
1106361.466654052
-384571.02156201063
Syracuse's Coach AAC Salary should be  [[684477.80749561]]
$684,477.81
```

In [96]:

```
print(train_m6_fit.params)
print(train_m6_fit.params[8]) #Coefficiant for B10
b10 = train_m6_fit.params[8]
spredb10=(spred-acc)+b10
print("Syracuse's Coach Big 10 Salary should be ",(spredb10))
print('${:,.2f}'.format(2398525.61801676))
```

```
Intercept         1.444214e+05
Q("SEC")          1.313286e+06
Q("C-USA")       -9.215371e+05
Q("Sun Belt")    -8.073194e+05
Q("Pac-12")       4.968340e+05
Q("Ind.")        -1.564764e+06
Q("ACC")          1.106361e+06
Q("AAC")         -3.845710e+05
Q("Big Ten")      1.329477e+06
Q("Big 12")       1.182560e+06
Q("Mt. West")    -8.562356e+05
Q("MAC")         -7.496705e+05
Capacity          3.217775e+01
WinPercentage     5.977492e+03
GSR               1.559122e+03
dtype: float64
1329476.7889591393
Syracuse's Coach Big 10 Salary should be  [[2398525.61801676]]
$2,398,525.62
```