Predicting College Football

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DSC 630

Imports

In [1]:
```python
import cfbd
import datetime
import numpy as np
import pandas as pd
import seaborn as sns
```

In [2]:
```python
# configure API key
configuration = cfbd.Configuration()
configuration.api_key['Authorization'] = 'T0SZdudSVeE5E5L1mImh1kShvc0t+1HPCXJQp1
configuration.api_key_prefix['Authorization'] = 'Bearer'
```

In [3]:
```python
# create a games API instance
api_config = cfbd.ApiClient(configuration)
games_api = cfbd.GamesApi(cfbd.ApiClient(configuration))
```

Building an Elo Based Model

In [4]:
```python
# create a logistic curve function to create rating win expectancy

def get_expected_score(rating, opp_rating):
    exp = (opp_rating - rating) / 300
    return 1 / (1+10**exp)
```

In [5]:
```python
# creating a get_new_elos function to calculate the elo based on the result

def get_new_elos(home_rating, away_rating, margin):

    # score of 0.5 for a tie
    home_score = 0.5
    if margin > 0:
        # score of 1 for a win
        home_score = 1
    elif margin < 0:
        #score of 0 for a loss
        home_score = 0

    # get expected home score
    expected_home_score = get_expected_score(home_rating, away_rating)
    # multiply difference of actual and expected score by k value and adjust hom
    # removed home_score -
    new_home_score = home_rating + abs(margin) * (home_score - expected_home_sco

    # repeat these steps for the away team
    # away score is inverse of home score
    away_score = 1 - home_score
    expected_away_score = get_expected_score(away_rating, home_rating)
    # removed away_score - expected_away_score
    new_away_score = away_rating + abs(margin) * (away_score - expected_away_sco

    # return a tuple
    return (round(new_home_score), round(new_away_score))
```

In [6]:

```
# sorting the games so the elos are determined in chronological order

def date_sort(game):
    game_date = datetime.datetime.strptime(game['start_date'], "%Y-%m-%dT%H:%M:%
    return game_date

def elo_sort(team):
    return team['elo']
```

2017

Grabbing each season from 2017-2021. This will give me 4 seasons that I can use to train the model that I eventually create and 1 season (2021) to test the model against.

In [7]:

```
games = []

# was 2013
for year in range(2017, 2018):
    response = games_api.get_games(year=year)
    games = [*games, *response]
```

In [8]:

```
games[0]
```

Out[8]:

```
{'attendance': 37583,
 'away_conference': 'Pac-12',
 'away_id': 204,
 'away_line_scores': [10, 10, 0, 7],
 'away_points': 27,
 'away_post_win_prob': 0.001059250629844466,
 'away_postgame_elo': 1345,
 'away_pregame_elo': 1412,
 'away_team': 'Oregon State',
 'conference_game': False,
 'excitement_index': 4.9529115584,
 'highlights': 'https://www.youtube.com/watch?v=vg6e0rzyt70',
 'home_conference': 'Mountain West',
 'home_id': 36,
 'home_line_scores': [7, 17, 10, 24],
 'home_points': 58,
 'home_post_win_prob': 0.9989407493701555,
 'home_postgame_elo': 1613,
 'home_pregame_elo': 1546,
 'home_team': 'Colorado State',
 'id': 400935282,
 'neutral_site': False,
 'notes': None,
 'season': 2017,
 'season_type': 'regular',
 'start_date': '2017-08-26T18:30:00.000Z',
 'start_time_tbd': None,
 'venue': 'Canvas Stadium',
 'venue_id': 5388,
 'week': 1}
```

In [9]:

```
games = [dict(
            game_id = g.id,
            start_date = g.start_date,
            season = g.season,
            home_team = g.home_team,
            home_conference = g.home_conference,
            home_points = g.home_points,
            away_team = g.away_team,
            away_conference = g.away_conference,
            away_points = g.away_points
            ) for g in games if g.home_points is not None and g.away_points is n
games.sort(key=date_sort)
```

In [10]:

```
games[0]
```

Out[10]:

```
{'game_id': 400935282,
 'start_date': '2017-08-26T18:30:00.000Z',
 'season': 2017,
 'home_team': 'Colorado State',
 'home_conference': 'Mountain West',
 'home_points': 58,
 'away_team': 'Oregon State',
 'away_conference': 'Pac-12',
 'away_points': 27}
```

In [11]:

```
# dict object to hold current Elo rating for each team
teams = dict()

# loop through games in order
for game in games:

    # get current rating for home team
    if game['home_team'] in teams:
        home_elo = teams[game['home_team']]
    # Power 5 get boost
    elif game['home_conference'] is not None:
        # if no rating, but FBS set to 1000
        home_elo = 1000
    else:
        # otherwise, set initial rating to 500 for non-FBS teams
        home_elo = 500

    # get current rating for away team
    if game['away_team'] in teams:
        away_elo = teams[game['away_team']]
    elif game['away_conference'] is not None:
        # if no rating, but FBS set to 1000
        away_elo = 1000
    else:
        # otherwise, set initial rating to 500 for non-FBS teams
        away_elo = 500

    # calculate score margin from game
    margin = game['home_points'] - game['away_points']

    # get new elo ratings
    new_elos = get_new_elos(home_elo, away_elo, margin)

    # set pregame elos on game dict
    game['pregame_home_elo'] = home_elo
    game['pregame_away_elo'] = away_elo

    # set postgame elos on game dict
    game['postgame_home_elo'] = new_elos[0]
    game['postgame_away_elo'] = new_elos[1]

    # set current elo values in teams dict
    teams[game['home_team']] = new_elos[0]
    teams[game['away_team']] = new_elos[1]
```

In [12]:
```
end_elos = [dict(team=key, elo=teams[key]) for key in teams]
end_elos.sort(key=elo_sort, reverse=True)
```

In [13]:
```
end_elos_df = pd.DataFrame(end_elos).set_index('elo')
```

In [14]:
```
end_elos_df.head(25)
```

Out[14]:

elo	team
1118	Penn State
1110	Alabama
1109	Ohio State
1107	Oklahoma
1106	Wisconsin
1105	Georgia
1104	Clemson
1096	UCF
1088	Auburn
1087	Washington
1073	Oklahoma State
1068	Florida Atlantic
1064	Stanford
1064	Notre Dame

	team
elo	
1063	South Florida
1063	Memphis
1060	Virginia Tech
1056	TCU
1055	Toledo
1055	Northwestern
1051	Boise State
1051	USC
1047	Iowa
1046	Miami
1046	Troy

In [15]:
```
games_df = pd.DataFrame(games)
```

In [16]:
```
games_df.sample(3)
```

Out[16]:

	game_id	start_date	season	home_team	home_conference	home_points	away_t
525	400935393	2017-10-28T16:00:00.000Z	2017	Michigan	Big Ten	35	Rut
60	400934489	2017-09-02T23:00:00.000Z	2017	Baylor	Big 12	45	Lib
672	400938658	2017-11-11T22:00:00.000Z	2017	North Texas	Conference USA	45	U

In [17]:
```
games_df['margin'] = games_df['home_points'] - games_df['away_points']
```

In [18]:
```
games_df.sample(5)
```

Out[18]:

	game_id	start_date	season	home_team	home_conference	home_points	away_t
8	400941787	2017-08-31T23:00:00.000Z	2017	Cincinnati	American Athletic	26	Austin
68	400934491	2017-09-02T23:10:00.000Z	2017	Kansas State	Big 12	55	Ce Arka
261	400934515	2017-09-23T22:30:00.000Z	2017	Baylor	Big 12	41	Oklah
808	400935327	2017-11-26T00:00:00.000Z	2017	Oregon	Pac-12	69	Ore S

	game_id	start_date	season	home_team	home_conference	home_points	away_t
244	400933869	2017-09-23T19:30:00.000Z	2017	South Carolina	SEC	17	Louis

In [19]:
```
games_df.tail()
```

Out[19]:

	game_id	start_date	season	home_team	home_conference	home_points	away_t
829	400944885	2017-12-03T00:30:00.000Z	2017	Arkansas State	Sun Belt	25	
830	400955154	2017-12-03T00:45:00.000Z	2017	Boise State	Mountain West	17	Fr S
831	400955155	2017-12-03T01:00:00.000Z	2017	Clemson	ACC	38	M
832	400955156	2017-12-03T01:00:00.000Z	2017	Wisconsin	Big Ten	21	Ohio S
833	400934572	2017-12-09T20:00:00.000Z	2017	Navy	American Athletic	13	A

In [20]:
```
games_df.dtypes
```

Out[20]:
```
game_id                int64
start_date            object
season                 int64
home_team             object
home_conference       object
home_points            int64
away_team             object
away_conference       object
away_points            int64
pregame_home_elo       int64
pregame_away_elo       int64
postgame_home_elo      int64
postgame_away_elo      int64
margin                 int64
dtype: object
```

In [21]:
```
games2017 = games_df.loc[games_df['season'] == 2017]
```

In [22]:
```
games2017.head()
```

Out[22]:

	game_id	start_date	season	home_team	home_conference	home_points	away_tear
0	400935282	2017-08-26T18:30:00.000Z	2017	Colorado State	Mountain West	58	Orego Stat
1	400945031	2017-08-26T19:00:00.000Z	2017	BYU	FBS Independents	20	Portlan Stat
2	400938887	2017-08-26T22:00:00.000Z	2017	UMass	FBS Independents	35	Hawa

	game_id	start_date	season	home_team	home_conference	home_points	away_tea
3	400941786	2017-08-26T23:30:00.000Z	2017	San José State	Mountain West	22	Sout Floric
4	400935257	2017-08-27T02:00:00.000Z	2017	Rice	Conference USA	7	Stanfor

2018

In [23]:
```
games1 = []

# was 2014
for year in range(2018, 2019):
    response = games_api.get_games(year=year)
    games1 = [*games1, *response]
```

In [24]:
```
games1[0]
```

Out[24]:
```
{'attendance': 8684,
 'away_conference': None,
 'away_id': 2184,
 'away_line_scores': [3, 6, 0, 6],
 'away_points': 15,
 'away_post_win_prob': 0.001545757783768864,
 'away_postgame_elo': None,
 'away_pregame_elo': None,
 'away_team': 'Duquesne',
 'conference_game': False,
 'excitement_index': 0.2139101303,
 'highlights': 'https://www.youtube.com/watch?v=uwMMvX-tU_U',
 'home_conference': 'FBS Independents',
 'home_id': 113,
 'home_line_scores': [21, 14, 21, 7],
 'home_points': 63,
 'home_post_win_prob': 0.9984542422162311,
 'home_postgame_elo': None,
 'home_pregame_elo': None,
 'home_team': 'UMass',
 'id': 401013357,
 'neutral_site': False,
 'notes': None,
 'season': 2018,
 'season_type': 'regular',
 'start_date': '2018-08-25T21:30:00.000Z',
 'start_time_tbd': None,
 'venue': 'Warren McGuirk Alumni Stadium',
 'venue_id': 3985,
 'week': 1}
```

In [25]:
```
games1 = [dict(
            game_id = g.id,
            start_date = g.start_date,
            season = g.season,
            home_team = g.home_team,
            home_conference = g.home_conference,
            home_points = g.home_points,
            away_team = g.away_team,
            away_conference = g.away_conference,
            away_points = g.away_points
            ) for g in games1 if g.home_points is not None and g.away_points is
games1.sort(key=date_sort)
```

In [26]:
```
games1[0]
```

Out[26]:
```
{'game_id': 401013357,
 'start_date': '2018-08-25T21:30:00.000Z',
 'season': 2018,
 'home_team': 'UMass',
 'home_conference': 'FBS Independents',
 'home_points': 63,
 'away_team': 'Duquesne',
 'away_conference': None,
 'away_points': 15}
```

In [27]:
```
# dict object to hold current Elo rating for each team
teams1 = dict()

# loop through games in order
for game in games1:

    # get current rating for home team
    if game['home_team'] in teams1:
        home_elo = teams1[game['home_team']]
    # Power 5 get boost
    elif game['home_conference'] is not None:
        # if no rating, but FBS set to 1000
        home_elo = 1000
    else:
        # otherwise, set initial rating to 500 for non-FBS teams
        home_elo = 500

    # get current rating for away team
    if game['away_team'] in teams1:
        away_elo = teams1[game['away_team']]
    elif game['away_conference'] is not None:
        # if no rating, but FBS set to 1000
        away_elo = 1000
    else:
        # otherwise, set initial rating to 500 for non-FBS teams
        away_elo = 500


    # calculate score margin from game
    margin = game['home_points'] - game['away_points']

    # get new elo ratings
    new_elos = get_new_elos(home_elo, away_elo, margin)

    # set pregame elos on game dict
    game['pregame_home_elo'] = home_elo
    game['pregame_away_elo'] = away_elo

    # set postgame elos on game dict
    game['postgame_home_elo'] = new_elos[0]
    game['postgame_away_elo'] = new_elos[1]
    # set current elo values in teams dict
    teams1[game['home_team']] = new_elos[0]
    teams1[game['away_team']] = new_elos[1]
```

In [28]:

```
end_elos1 = [dict(team=key, elo=teams1[key]) for key in teams1]
end_elos1.sort(key=elo_sort, reverse=True)
```

In [29]:

```
end_elos_df1 = pd.DataFrame(end_elos1).set_index('elo')
```

In [30]:

```
end_elos_df1.head(25)
```

Out[30]:

	team
elo	
1150	Alabama
1136	Clemson
1097	UCF
1097	Ohio State
1094	Oklahoma
1091	Georgia
1091	Michigan
1086	Notre Dame
1084	Utah State
1081	Fresno State
1075	Penn State
1072	Appalachian State
1071	Boise State
1067	Ohio
1064	Washington State
1064	Mississippi State
1063	Cincinnati
1062	Iowa
1061	West Virginia
1058	North Texas
1054	NC State
1053	Missouri
1051	Temple
1050	Washington
1048	Army

In [31]:
```
games1_df = pd.DataFrame(games1)
```

In [32]:
```
games1_df['margin'] = games1_df['home_points'] - games1_df['away_points']
```

In [33]:
```
games2018 = games1_df.loc[games1_df['season'] == 2018]
```

In [34]:
```
games2018.head()
```

Out[34]:

	game_id	start_date	season	home_team	home_conference	home_points	away_tean
0	401013357	2018-08-25T21:30:00.000Z	2018	UMass	FBS Independents	63	Duquesn
1	401014972	2018-08-25T23:00:00.000Z	2018	Rice	Conference USA	31	Prairie Viev
2	401022510	2018-08-25T23:30:00.000Z	2018	Colorado State	Mountain West	34	Hawai'
3	401013437	2018-08-26T02:00:00.000Z	2018	New Mexico State	FBS Independents	7	Wyomin
4	401019470	2018-08-30T23:00:00.000Z	2018	Connecticut	American Athletic	17	UCI

2019

In [35]:
```
games2 = []

# was 2015
for year in range(2019, 2020):
    response = games_api.get_games(year=year)
    games2 = [*games2, *response]
```

In [36]:
```
games2[0]
```

Out[36]:
```
{'attendance': 66543,
 'away_conference': 'ACC',
 'away_id': 2390,
 'away_line_scores': [3, 10, 0, 7],
 'away_points': 20,
 'away_post_win_prob': 0.09404654178677352,
 'away_postgame_elo': 1606,
 'away_pregame_elo': 1611,
 'away_team': 'Miami',
 'conference_game': False,
 'excitement_index': 8.7679102419,
 'highlights': 'https://www.youtube.com/watch?v=WeJi4p0jqXA',
 'home_conference': 'SEC',
 'home_id': 57,
 'home_line_scores': [7, 0, 10, 7],
 'home_points': 24,
 'home_post_win_prob': 0.9059534582132265,
 'home_postgame_elo': 1688,
 'home_pregame_elo': 1683,
 'home_team': 'Florida',
 'id': 401110723,
 'neutral_site': True,
 'notes': 'CAMPING WORLD KICKOFF',
 'season': 2019,
 'season_type': 'regular',
 'start_date': '2019-08-24T23:00:00.000Z',
 'start_time_tbd': None,
 'venue': 'Camping World Stadium',
 'venue_id': 4013,
 'week': 1}
```

In [37]:

```python
games2 = [dict(
            game_id = g.id,
            start_date = g.start_date,
            season = g.season,
            home_team = g.home_team,
            home_conference = g.home_conference,
            home_points = g.home_points,
            away_team = g.away_team,
            away_conference = g.away_conference,
            away_points = g.away_points
            ) for g in games2 if g.home_points is not None and g.away_points is
games2.sort(key=date_sort)
```

In [38]:

```python
# dict object to hold current Elo rating for each team
teams2 = dict()

# loop through games in order
for game in games2:


    # get current rating for home team
    if game['home_team'] in teams2:
        home_elo = teams2[game['home_team']]
    # Power 5 get boost
    elif game['home_conference'] is not None:
        # if no rating, but FBS set to 1000
        home_elo = 1000
    else:
        # otherwise, set initial rating to 500 for non-FBS teams
        home_elo = 500

    # get current rating for away team
    if game['away_team'] in teams2:
        away_elo = teams2[game['away_team']]
    elif game['away_conference'] is not None:
        # if no rating, but FBS set to 1000
        away_elo = 1000
    else:
        # otherwise, set initial rating to 500 for non-FBS teams
        away_elo = 500

    # calculate score margin from game
    margin = game['home_points'] - game['away_points']

    # get new elo ratings
    new_elos = get_new_elos(home_elo, away_elo, margin)
    # set pregame elos on game dict
    game['pregame_home_elo'] = home_elo
    game['pregame_away_elo'] = away_elo

    # set postgame elos on game dict
    game['postgame_home_elo'] = new_elos[0]
    game['postgame_away_elo'] = new_elos[1]

    # set current elo values in teams dict
    teams2[game['home_team']] = new_elos[0]
    teams2[game['away_team']] = new_elos[1]
```

In [39]:

```
end_elos2 = [dict(team=key, elo=teams2[key]) for key in teams2]
end_elos2.sort(key=elo_sort, reverse=True)
```

In [40]:

```
end_elos_df2 = pd.DataFrame(end_elos2).set_index('elo')
```

In [41]:

```
end_elos_df2.head(25)
```

Out[41]:

	team
elo	
1169	Ohio State
1154	Clemson
1123	LSU
1109	Alabama
1102	Oregon
1098	Wisconsin
1092	Utah
1086	Notre Dame
1084	Appalachian State
1080	Oklahoma
1079	Georgia
1078	Memphis
1076	Penn State
1076	Michigan
1072	UCF
1072	Louisiana
1071	Boise State
1071	Baylor
1062	Auburn

elo	team
1061	Florida
1060	Florida Atlantic
1060	Navy
1059	Air Force
1056	SMU
1055	Minnesota

In [42]:
```
games2_df = pd.DataFrame(games2)
```

In [43]:
```
games2_df['margin'] = games2_df['home_points'] - games2_df['away_points']
```

In [44]:
```
games2019 = games2_df.loc[games2_df['season'] == 2019]
```

In [45]:
```
games2019.head()
```

Out[45]:

	game_id	start_date	season	home_team	home_conference	home_points	away_tean
0	401110723	2019-08-24T23:00:00.000Z	2019	Florida	SEC	24	Miam
1	401114164	2019-08-25T02:30:00.000Z	2019	Hawai'i	Mountain West	45	Arizona
2	401119254	2019-08-29T23:00:00.000Z	2019	Bowling Green	Mid-American	46	Morgar State
3	401117855	2019-08-29T23:00:00.000Z	2019	Connecticut	American Athletic	24	Wagne
4	401119255	2019-08-29T23:00:00.000Z	2019	Buffalo	Mid-American	38	Rober Morris

2020

In [46]:
```
games3 = []

#was 2016
for year in range(2020, 2021):
    response = games_api.get_games(year=year)
    games3 = [*games3, *response]
```

In [47]:
```
games3 = [dict(
            game_id = g.id,
            start_date = g.start_date,
            season = g.season,
            home_team = g.home_team,
            home_conference = g.home_conference,
            home_points = g.home_points,
            away_team = g.away_team,
            away_conference = g.away_conference,
            away_points = g.away_points
            ) for g in games3 if g.home_points is not None and g.away_points is
games3.sort(key=date_sort)
```

In [48]:

```
# dict object to hold current Elo rating for each team
teams3 = dict()

# loop through games in order
for game in games3:

    # get current rating for home team
    if game['home_team'] in teams3:
        home_elo = teams3[game['home_team']]
    # Power 5 get boost
    elif game['home_conference'] is not None:
        # if no rating, but FBS set to 1000
        home_elo = 1000
    else:
        # otherwise, set initial rating to 500 for non-FBS teams
        home_elo = 500

    # get current rating for away team
    if game['away_team'] in teams3:
        away_elo = teams3[game['away_team']]
    elif game['away_conference'] is not None:
        # if no rating, but FBS set to 1000
        away_elo = 1000
    else:
        # otherwise, set initial rating to 500 for non-FBS teams
        away_elo = 500

    # calculate score margin from game
    margin = game['home_points'] - game['away_points']

    # get new elo ratings
    new_elos = get_new_elos(home_elo, away_elo, margin)

    # set pregame elos on game dict
    game['pregame_home_elo'] = home_elo
    game['pregame_away_elo'] = away_elo

    # set postgame elos on game dict
    game['postgame_home_elo'] = new_elos[0]
    game['postgame_away_elo'] = new_elos[1]

    # set current elo values in teams dict
    teams3[game['home_team']] = new_elos[0]
    teams3[game['away_team']] = new_elos[1]
```

In [49]:

```
end_elos3 = [dict(team=key, elo=teams3[key]) for key in teams3]
end_elos3.sort(key=elo_sort, reverse=True)
```

In [50]:
```
end_elos_df3 = pd.DataFrame(end_elos3).set_index('elo')
```

In [51]:
```
end_elos_df3.head(25)
```

Out[51]:

	team
elo	
1129	Alabama
1107	Clemson
1106	BYU
1080	Coastal Carolina
1077	Cincinnati
1073	Notre Dame
1063	Oklahoma
1060	Florida
1060	Buffalo
1059	North Carolina
1058	Ohio State
1057	Iowa
1056	Iowa State
1052	Georgia
1051	Liberty
1050	Texas
1050	UCF
1048	Appalachian State
1047	Louisiana
1044	San José State
1043	Texas A&M
1042	Tulane
1039	Marshall
1035	Indiana
1032	Arizona State

In [52]:
```
games3_df = pd.DataFrame(games3)
```

In [53]:
```
games3_df['margin'] = games3_df['home_points'] - games3_df['away_points']
```

In [54]:
```
games2020 = games3_df.loc[games3_df['season'] == 2020]
```

In [55]:
```
games2020.sample(5)
```

Out[55]:

	game_id	start_date	season	home_team	home_conference	home_points	away_t
138	401234606	2020-10-10T23:30:00.000Z	2020	Notre Dame	FBS Independents	42	Flo S
540	401237074	2020-12-20T01:00:00.000Z	2020	Florida	SEC	46	Alab
82	401237096	2020-10-03T16:00:00.000Z	2020	Florida	SEC	38	S Caro
296	401207169	2020-11-07T23:00:00.000Z	2020	Florida Atlantic	Conference USA	10	Wes Kentu
312	401249864	2020-11-12T01:00:00.000Z	2020	Northern Illinois	Mid-American	10	Cer Mich

2021

In [56]:
```
games4 = []

# was 2017
for year in range(2021, 2022):
    response = games_api.get_games(year=year)
    games4 = [*games4, *response]
```

In [57]:
```
games4 = [dict(
            game_id = g.id,
            start_date = g.start_date,
            season = g.season,
            home_team = g.home_team,
            home_conference = g.home_conference,
            home_points = g.home_points,
            away_team = g.away_team,
            away_conference = g.away_conference,
            away_points = g.away_points
            ) for g in games4 if g.home_points is not None and g.away_points is
games4.sort(key=date_sort)
```

In [58]:
```
# dict object to hold current Elo rating for each team
teams4 = dict()

# loop through games in order
for game in games4:

    # get current rating for home team
    if game['home_team'] in teams4:
        home_elo = teams4[game['home_team']]
    # Power 5 get boost
    elif game['home_conference'] is not None:
        # if no rating, but FBS set to 1000
        home_elo = 1000
    else:
        # otherwise, set initial rating to 500 for non-FBS teams
        home_elo = 500

    # get current rating for away team
    if game['away_team'] in teams4:
        away_elo = teams4[game['away_team']]
    elif game['away_conference'] is not None:
        # if no rating, but FBS set to 1000
        away_elo = 1000
    else:
        # otherwise, set initial rating to 500 for non-FBS teams
        away_elo = 500

    # calculate score margin from game
    margin = game['home_points'] - game['away_points']

    # get new elo ratings
    new_elos = get_new_elos(home_elo, away_elo, margin)

    # set pregame elos on game dict
    game['pregame_home_elo'] = home_elo
    game['pregame_away_elo'] = away_elo

    # set postgame elos on game dict
    game['postgame_home_elo'] = new_elos[0]
    game['postgame_away_elo'] = new_elos[1]

    # set current elo values in teams dict
    teams4[game['home_team']] = new_elos[0]
    teams4[game['away_team']] = new_elos[1]
```

In [59]:

```
end_elos4 = [dict(team=key, elo=teams4[key]) for key in teams4]
end_elos4.sort(key=elo_sort, reverse=True)
```

In [60]:

```
end_elos_df4 = pd.DataFrame(end_elos4).set_index('elo')
```

In [61]:

```
end_elos_df4.head(25)
```

Out[61]:

elo	team
1125	Georgia
1114	Ohio State
1112	Michigan
1109	Cincinnati
1106	Alabama
1083	Notre Dame
1081	Pittsburgh
1079	Coastal Carolina

elo	team
1078	Utah
1069	Louisiana
1069	Oklahoma State
1066	Western Kentucky
1062	Appalachian State
1062	Houston
1057	NC State
1057	Iowa State
1056	Baylor
1054	Wisconsin
1053	Kentucky
1051	Boise State
1051	Air Force
1051	UT San Antonio
1051	Texas A&M
1050	UCLA
1047	Wake Forest

In [62]:
```
games4_df = pd.DataFrame(games4)
```

In [63]:
```
games4_df['margin'] = games4_df['home_points'] - games4_df['away_points']
```

In [64]:
```
games2021 = games4_df.loc[games4_df['season'] == 2021]
```

In [65]:
```
games2021.head()
```

Out[65]:

	game_id	start_date	season	home_team	home_conference	home_points	away_tea
0	401282714	2021-08-28T17:20:00.000Z	2021	Illinois	Big Ten	30	Nebrask
1	401286187	2021-08-28T18:00:00.000Z	2021	Fresno State	Mountain West	45	Connectic
2	401309833	2021-08-28T19:30:00.000Z	2021	UCLA	Pac-12	44	Hawa
3	401282049	2021-08-29T01:30:00.000Z	2021	New Mexico State	FBS Independents	3	UTE

	game_id	start_date	season	home_team	home_conference	home_points	away_tea
4	401310693	2021-08-29T02:00:00.000Z	2021	San José State	Mountain West	45	Souther Uta

Building a Model to Predict Results

Building this model to run through games, based on the pre game elo rating will learn the post game margin in order to begin to predict games in the future.

Concatenating 2017-2020 retroactively to create a test group of data.

In [66]:
```
games2017_2020 = pd.concat([games2017, games2018, games2019, games2020])
```

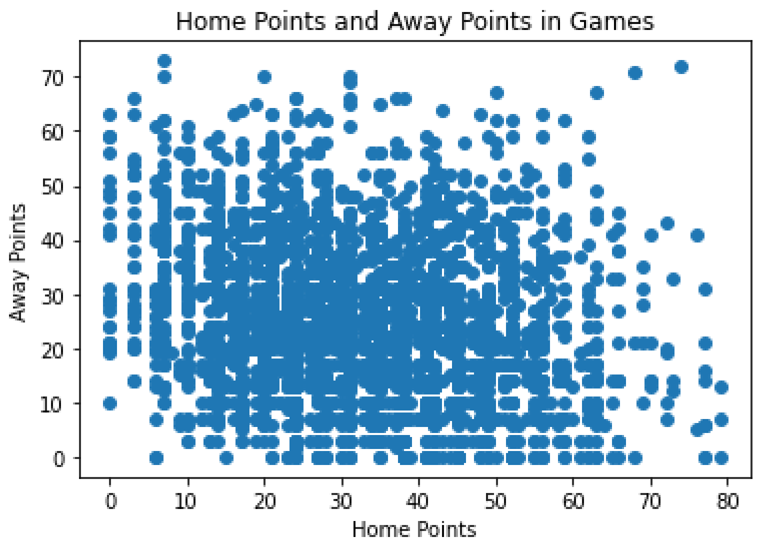
In [67]:
```
games2017_2020.shape
```

Out[67]:
```
(3069, 14)
```

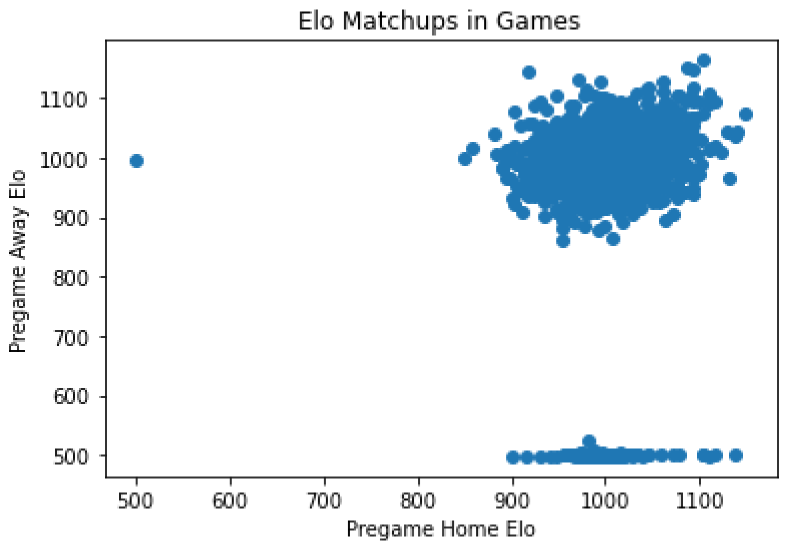
Over 3000 different games to use should be plenty to train the model I build.

In [68]:
```
import matplotlib.pyplot as plt
```

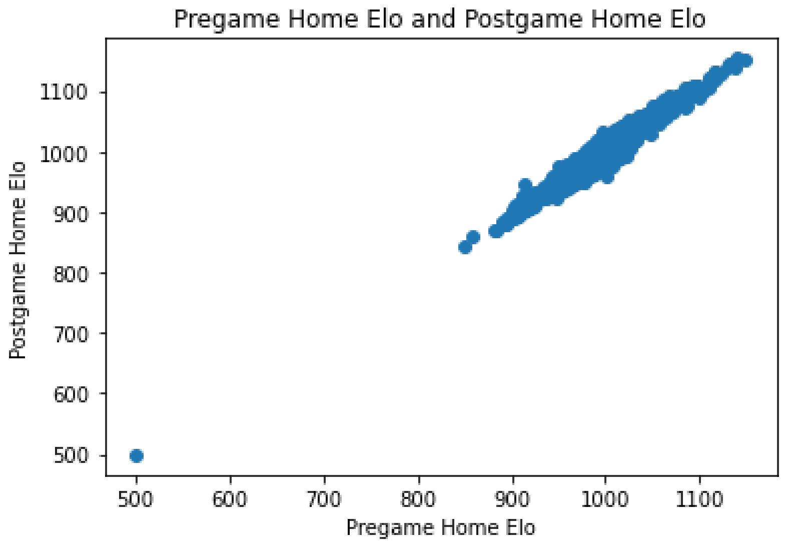
In [69]:
```
plt.scatter(x=games2017_2020['home_points'], y=games2017_2020['away_points'])
plt.xlabel('Home Points')
plt.ylabel('Away Points')
plt.title('Home Points and Away Points in Games')
plt.show()
```



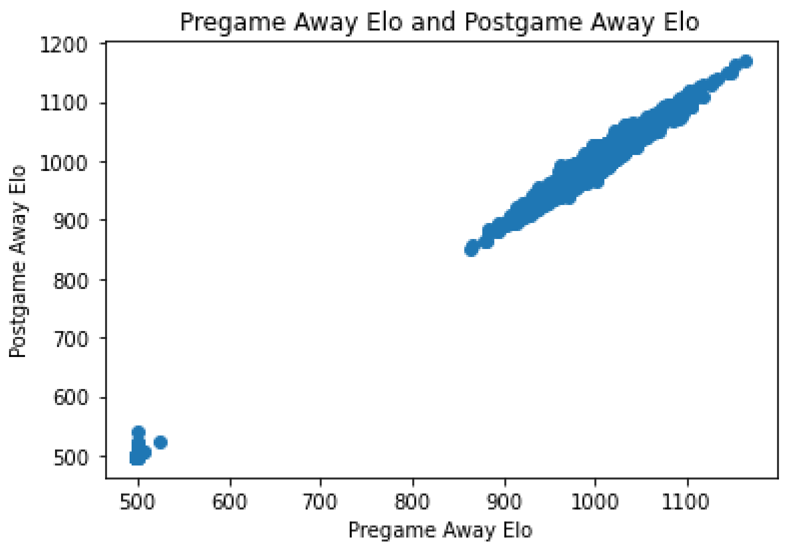
In [70]:
```
plt.scatter(x=games2017_2020['pregame_home_elo'], y=games2017_2020['pregame_away
plt.xlabel('Pregame Home Elo')
plt.ylabel('Pregame Away Elo')
plt.title('Elo Matchups in Games')
plt.show()
```



In [71]:
```
plt.scatter(x=games2017_2020['pregame_home_elo'], y=games2017_2020['postgame_hom
plt.xlabel('Pregame Home Elo')
plt.ylabel('Postgame Home Elo')
plt.title('Pregame Home Elo and Postgame Home Elo')
plt.show()
```

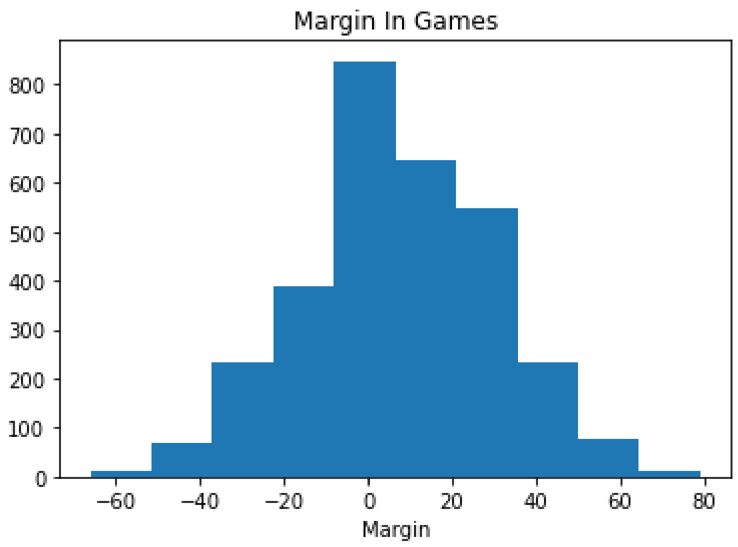


In [72]:
```
plt.scatter(x=games2017_2020['pregame_away_elo'], y=games2017_2020['postgame_awa
plt.xlabel('Pregame Away Elo')
plt.ylabel('Postgame Away Elo')
plt.title('Pregame Away Elo and Postgame Away Elo')
plt.show()
```



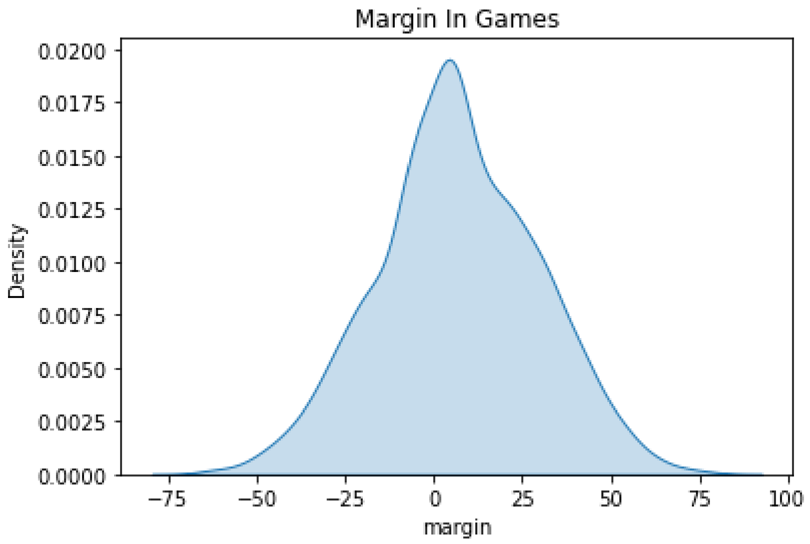
In [73]:

```
plt.hist(games2017_2020['margin'])
plt.xlabel('Margin')
plt.title('Margin In Games')
plt.show()
```



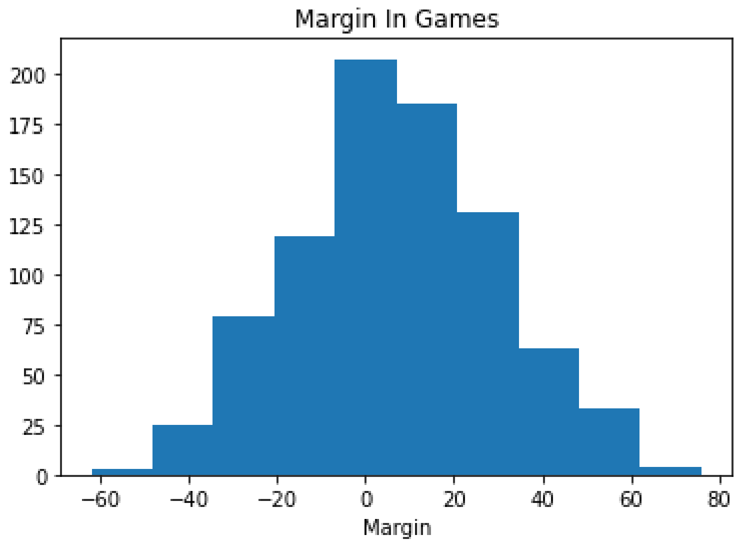
In [74]:

```
sns.kdeplot(games2017_2020['margin'], shade=True)
plt.title('Margin In Games')
plt.show()
```



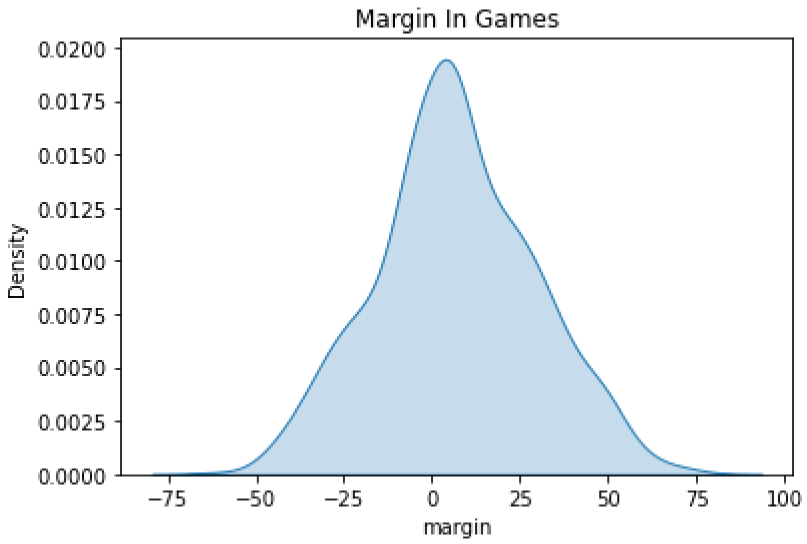
In [75]:

```
plt.hist(games2021['margin'])
plt.xlabel('Margin')
plt.title('Margin In Games')
plt.show()
```



In [76]:

```
sns.kdeplot(games2021['margin'], shade=True)
plt.title('Margin In Games')
plt.show()
```



Separating the pregame elo rankings from the target variable of margin in order to begin to predict games.

In [77]:
```
games17_20 = pd.get_dummies(games2017_2020, columns=['home_conference', 'away_co
```

In [78]:
```
games17_20.head()
```

Out[78]:

	game_id	start_date	season	home_team	home_points	away_team	away_points	pr
0	400935282	2017-08-26T18:30:00.000Z	2017	Colorado State	58	Oregon State	27	
1	400945031	2017-08-26T19:00:00.000Z	2017	BYU	20	Portland State	6	
2	400938887	2017-08-26T22:00:00.000Z	2017	UMass	35	Hawai'i	38	
3	400941786	2017-08-26T23:30:00.000Z	2017	San José State	22	South Florida	42	
4	400935257	2017-08-27T02:00:00.000Z	2017	Rice	7	Stanford	62	

5 rows × 34 columns

In [79]:
```
games17_20.columns
```

Out[79]:
```
Index(['game_id', 'start_date', 'season', 'home_team', 'home_points',
       'away_team', 'away_points', 'pregame_home_elo', 'pregame_away_elo',
       'postgame_home_elo', 'postgame_away_elo', 'margin',
       'home_conference_ACC', 'home_conference_American Athletic',
       'home_conference_Big 12', 'home_conference_Big Ten',
       'home_conference_Conference USA', 'home_conference_FBS Independents',
       'home_conference_Mid-American', 'home_conference_Mountain West',
       'home_conference_Pac-12', 'home_conference_SEC',
       'home_conference_Sun Belt', 'away_conference_ACC',
       'away_conference_American Athletic', 'away_conference_Big 12',
       'away_conference_Big Ten', 'away_conference_Conference USA',
       'away_conference_FBS Independents', 'away_conference_Mid-American',
       'away_conference_Mountain West', 'away_conference_Pac-12',
       'away_conference_SEC', 'away_conference_Sun Belt'],
      dtype='object')
```

In [80]:

```
features = ['pregame_home_elo', 'pregame_away_elo', 'home_conference_ACC', 'home
       'home_conference_Big 12', 'home_conference_Big Ten',
       'home_conference_Conference USA', 'home_conference_FBS Independents',
       'home_conference_Mid-American', 'home_conference_Mountain West',
       'home_conference_Pac-12', 'home_conference_SEC',
       'home_conference_Sun Belt', 'away_conference_ACC',
       'away_conference_American Athletic', 'away_conference_Big 12',
       'away_conference_Big Ten', 'away_conference_Conference USA',
       'away_conference_FBS Independents', 'away_conference_Mid-American',
       'away_conference_Mountain West', 'away_conference_Pac-12',
       'away_conference_SEC', 'away_conference_Sun Belt']

x = games17_20[features]
y = games17_20['margin']
```

In [81]:

```
games21 = pd.get_dummies(games2021, columns=['home_conference', 'away_conference
```

In [82]:

```
x_test = games21[features]
y_test = games21['margin']
```

Linear Regression

In [83]:

```
from sklearn.linear_model import LinearRegression
```

In [84]:

```
lr = LinearRegression()
```

In [85]:

```
lr.fit(x,y)
```

Out[85]:

```
LinearRegression()
```

In [86]:

```
y_pred = lr.predict(x_test)
```

In [87]:

```
# importing r2_score module
from sklearn.metrics import r2_score
from sklearn.metrics import mean_squared_error
```

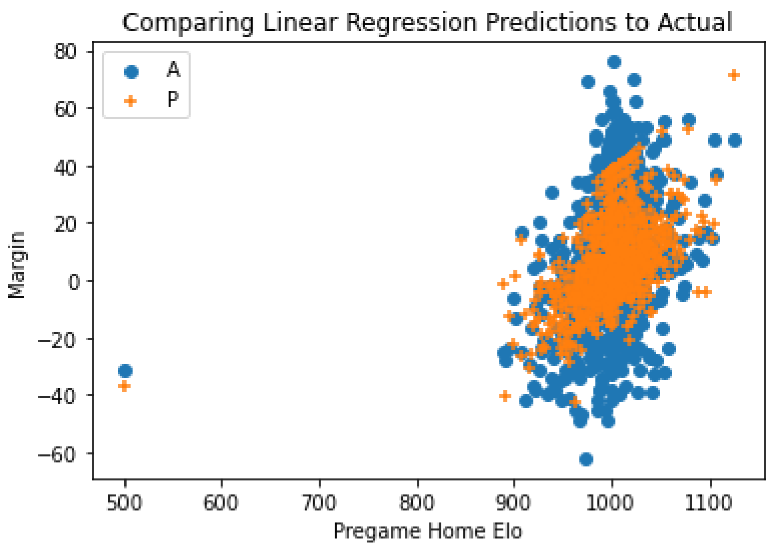
In [88]:

```
# predicting the accuracy score
score=r2_score(y_test,y_pred)
print('r2 score is ',score)
print('mean_sqrd_error is ',mean_squared_error(y_test,y_pred))
print('root_mean_squared error of is ',np.sqrt(mean_squared_error(y_test,y_pred)
```

```
r2 score is  0.38262381370022713
mean_sqrd_error is  315.1952017173782
```

```
root_mean_squared error of is  17.75373768301701
```

In [89]:
```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing Linear Regression Predictions to Actual')
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Margin')
plt.show()
```



Linear Regression returns rather poor scores, will likely need to look into other modeling methods

Random Forest Regressor

In [90]:
```
from sklearn.ensemble import RandomForestRegressor
```

In [91]:
```
forest = RandomForestRegressor(random_state=42)
```

In [92]:
```
forest.fit(x,y)
```

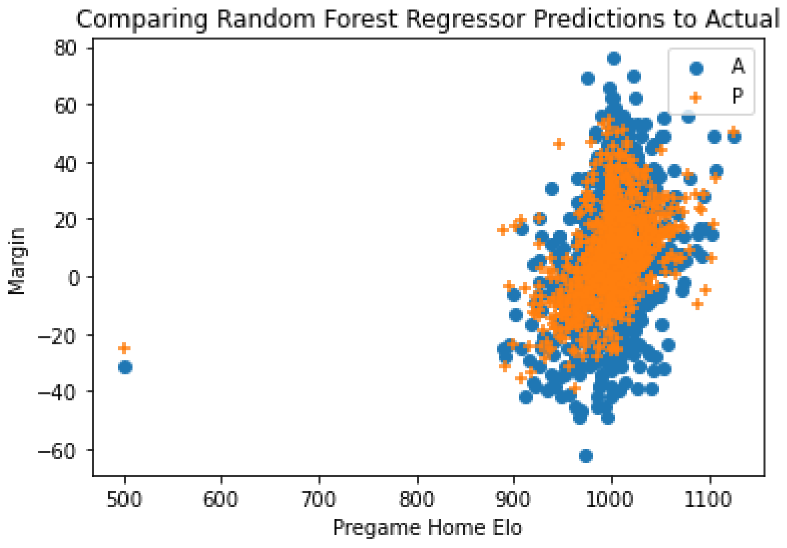
Out[92]:
```
RandomForestRegressor(random_state=42)
```

In [93]:
```
y_pred = forest.predict(x_test)
```

In [94]:
```
score=r2_score(y_test,y_pred)
print('r2 score is ',score)
print('mean_sqrd_error is ',mean_squared_error(y_test,y_pred))
print('root_mean_squared error of is ',np.sqrt(mean_squared_error(y_test,y_pred)
```

```
r2 score is  0.2643281369083236
mean_sqrd_error is  375.5898695651807
root_mean_squared error of is  19.380141113139004
```

In [95]:
```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing Random Forest Regressor Predictions to Actual')
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Margin')
plt.show()
```



In [96]:
```
from sklearn.svm import SVR
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
```

In [97]:
```
regr = make_pipeline(StandardScaler(), SVR(C=1.0, epsilon=0.2))
```

In [98]:
```
regr.fit(x,y)
```

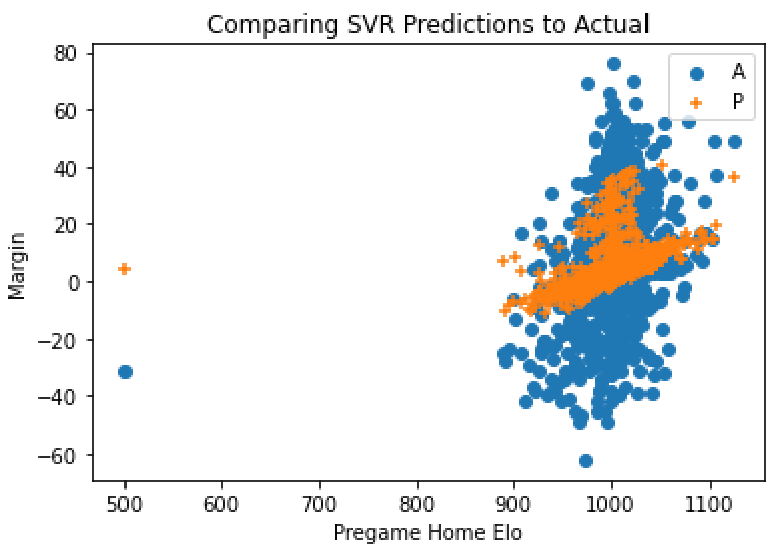
Out[98]:
```
Pipeline(steps=[('standardscaler', StandardScaler()),
                ('svr', SVR(epsilon=0.2))])
```

In [99]:
```
y_pred = regr.predict(x_test)
```

In [100…
```
score=r2_score(y_test,y_pred)
print('r2 score is ',score)
print('mean_sqrd_error is ',mean_squared_error(y_test,y_pred))
print('root_mean_squared error of is ',np.sqrt(mean_squared_error(y_test,y_pred)
```

```
r2 score is  0.27964039040148214
mean_sqrd_error is  367.77235257047715
root_mean_squared error of is  19.17739170404769
```

In [101…
```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing SVR Predictions to Actual')
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Margin')
plt.show()
```



Support Vector Regression

In [102…

```
features = ['pregame_home_elo', 'pregame_away_elo']

x = games2017_2020[features]
y = games2017_2020['margin']

x_test = games2021[features]
y_test = games2021['margin']
```

In [103…

```
regr = make_pipeline(StandardScaler(), SVR(C=1.0, epsilon=0.2))
```

In [104…

```
regr.fit(x,y)
```

Out[104…

```
Pipeline(steps=[('standardscaler', StandardScaler()),
                ('svr', SVR(epsilon=0.2))])
```

In [105…

```
y_pred = regr.predict(x_test)
```

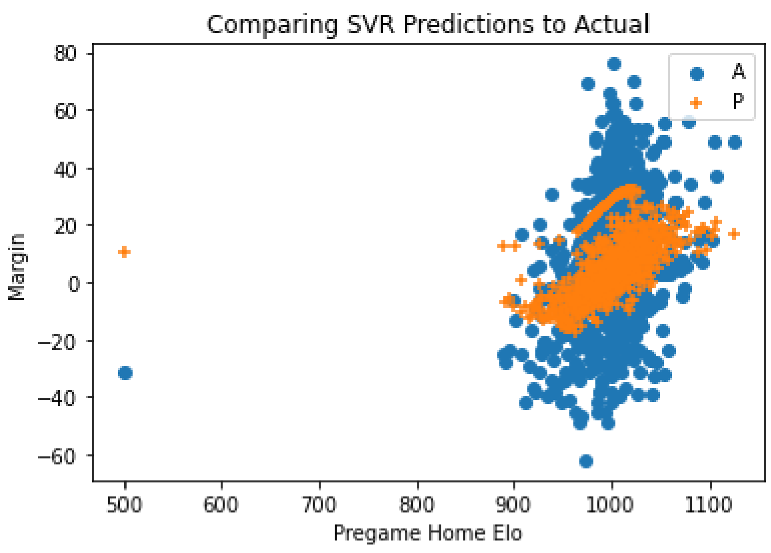
In [106…

```
score=r2_score(y_test,y_pred)
print('r2 score is ',score)
print('mean_sqrd_error is ',mean_squared_error(y_test,y_pred))
print('root_mean_squared error of is ',np.sqrt(mean_squared_error(y_test,y_pred)
```

```
r2 score is  0.3319445619194592
mean_sqrd_error is  341.0689839305598
root_mean_squared error of is  18.468053062804422
```

In [107…

```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing SVR Predictions to Actual')
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Margin')
plt.show()
```



Linear Regression

In [108…
```
lr = LinearRegression()
```

In [109…
```
lr.fit(x,y)
```

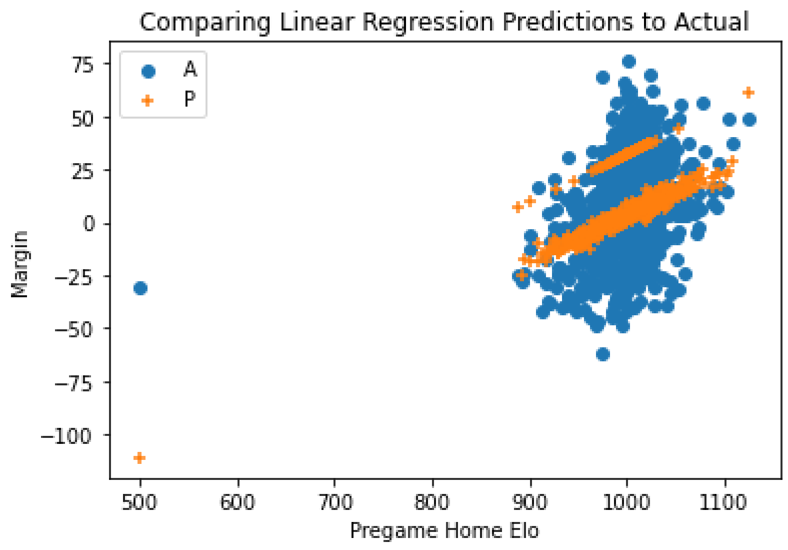
Out[109…
```
LinearRegression()
```

In [110…
```
y_pred = lr.predict(x_test)
```

In [111…
```
score=r2_score(y_test,y_pred)
print('r2 score is ',score)
print('mean_sqrd_error is ',mean_squared_error(y_test,y_pred))
print('root_mean_squared error of is ',np.sqrt(mean_squared_error(y_test,y_pred)
```

```
r2 score is  0.2686092429933037
mean_sqrd_error is  373.4041939172159
root_mean_squared error of is  19.323669266400103
```

In [112…
```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing Linear Regression Predictions to Actual')
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Margin')
plt.show()
```



In [113…

```
from sklearn.ensemble import RandomForestRegressor
```

In [114…

```
forest = RandomForestRegressor()
```

In [115…

```
forest.fit(x,y)
```

Out[115…

```
RandomForestRegressor()
```

In [116…

```
y_pred = forest.predict(x_test)
```

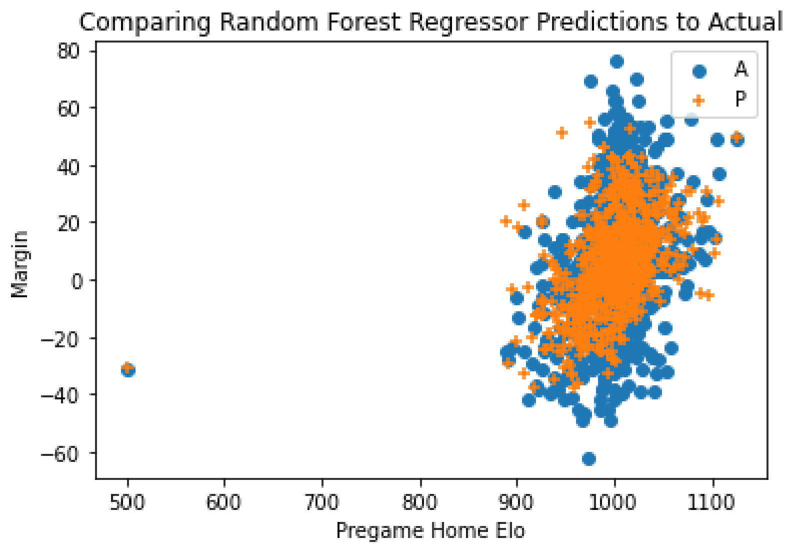
In [117…

```
score=r2_score(y_test,y_pred)
print('r2 score is ',score)
print('mean_sqrd_error is ',mean_squared_error(y_test,y_pred))
print('root_mean_squared error of is ',np.sqrt(mean_squared_error(y_test,y_pred)
```

```
r2 score is  0.14986773402253628
mean_sqrd_error is  434.0264768993036
root_mean_squared error of is  20.83330211222656
```

In [118…

```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing Random Forest Regressor Predictions to Actual')
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Margin')
plt.show()
```



Summary

Overall it is rather difficult to guess the end of game margin accurately. The next step in this process would be trying to accurate predict who the winner is. Predicting the winner of a game would help tremendously with an accurate model predicting who wins.

In [119…
```
HomeWin1 = games2017_2020[games2017_2020['margin'] > 0]

AwayWin1 = games2017_2020[games2017_2020['margin'] < 0]
```

In [120…
```
HomeWin1.sample(5)
```

Out[120…

	game_id	start_date	season	home_team	home_conference	home_points	away_t
462	401012765	2018-10-14T02:30:00.000Z	2018	USC	Pac-12	31	Colo
6	400937445	2017-08-31T22:30:00.000Z	2017	Wake Forest	ACC	51	Presbyt Co
587	401013341	2018-11-03T16:00:00.000Z	2018	Ohio State	Big Ten	36	Nebr
601	401114189	2019-11-03T01:00:00.000Z	2019	UCLA	Pac-12	31	Colo
597	401022552	2018-11-03T18:00:00.000Z	2018	Wyoming	Mountain West	24	San S

In [121…
```
AwayWin1.sample(5)
```

Out[121…

	game_id	start_date	season	home_team	home_conference	home_points	away_te
51	401235996	2020-09-26T16:00:00.000Z	2020	Oklahoma	Big 12	35	Kar S
704	401022560	2018-11-17T02:00:00.000Z	2018	New Mexico	Mountain West	14	Boise S

	game_id	start_date	season	home_team	home_conference	home_points	away_te
677	401021702	2018-11-10T21:00:00.000Z	2018	Texas State	Sun Belt	7	Appalac S
63	401014974	2018-09-01T23:00:00.000Z	2018	South Alabama	Sun Belt	26	Louis T
519	401249432	2020-12-13T03:00:00.000Z	2020	Oregon State	Pac-12	24	Stan

In [122…

```
HomeWin1['Winner'] = 'H'
AwayWin1['Winner'] = 'A'
```

```
/Users/wrasmussen/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.p
y:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stab
le/user_guide/indexing.html#returning-a-view-versus-a-copy
  """Entry point for launching an IPython kernel.
/Users/wrasmussen/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.p
y:2: 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/stab
le/user_guide/indexing.html#returning-a-view-versus-a-copy
```

In [123…

```
HomeWin1.head()
```

Out[123…

	game_id	start_date	season	home_team	home_conference	home_points	away_tea
0	400935282	2017-08-26T18:30:00.000Z	2017	Colorado State	Mountain West	58	Orego Sta
1	400945031	2017-08-26T19:00:00.000Z	2017	BYU	FBS Independents	20	Portlar Sta
5	400938591	2017-08-31T22:00:00.000Z	2017	UCF	American Athletic	61	Floric Internatior
6	400937445	2017-08-31T22:30:00.000Z	2017	Wake Forest	ACC	51	Presbyteri Colleg
8	400941787	2017-08-31T23:00:00.000Z	2017	Cincinnati	American Athletic	26	Austin Pe

In [124…

```
frames = [HomeWin1, AwayWin1]

games20172020 = pd.concat(frames)
```

In [125…

```
games20172020.sample(5)
```

Out[125…

	game_id	start_date	season	home_team	home_conference	home_points	away_t

	game_id	start_date	season	home_team	home_conference	home_points	away_t
513	401022541	2018-10-20T23:30:00.000Z	2018	New Mexico	Mountain West	7	Fr S
337	401215331	2020-11-14T20:30:00.000Z	2020	Georgia Southern	Sun Belt	40	Texas S
810	400938669	2017-11-26T00:30:00.000Z	2017	Louisiana Tech	Conference USA	20	UT Ant
534	401013044	2018-10-27T16:00:00.000Z	2018	Iowa State	Big 12	40	Texas
731	401013064	2018-11-17T20:30:00.000Z	2018	Kansas State	Big 12	21	Texas

In [126…

```
HomeWin2 = games2021[games2021['margin'] > 0]

AwayWin2 = games2021[games2021['margin'] < 0]
```

In [127…

```
HomeWin2['Winner'] = 'H'
AwayWin2['Winner'] = 'A'
```

```
/Users/wrasmussen/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.p
y:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stab
le/user_guide/indexing.html#returning-a-view-versus-a-copy
  """Entry point for launching an IPython kernel.
/Users/wrasmussen/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.p
y:2: 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/stab
le/user_guide/indexing.html#returning-a-view-versus-a-copy
```

In [128…

```
frames = [HomeWin2, AwayWin2]

games2021 = pd.concat(frames)
```

Now that we have created a column value for who won the game we can use a model that will predict whether the home team or away team will win a game.

Logistic Regression of Winning Team

In [129…

```
from sklearn.linear_model import LogisticRegression
```

In [130…

```
# minimal features

features = ['pregame_home_elo', 'pregame_away_elo']
```

```
x = games20172020[features]
y = games20172020['Winner']

x_test = games2021[features]
y_test = games2021['Winner']
```

In [131…
```
log = LogisticRegression()
```

In [132…
```
log.fit(x,y)
```

Out[132…
```
LogisticRegression()
```

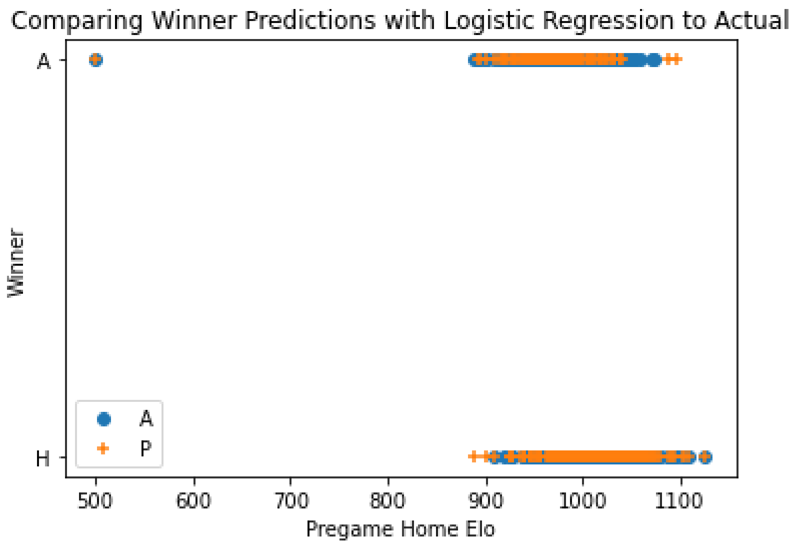
In [133…
```
y_pred = log.predict(x_test)
```

In [134…
```
from sklearn.metrics import accuracy_score
```

In [135…
```
score=accuracy_score(y_test,y_pred)
print('Accuracy score is ',score)
```

```
Accuracy score is  0.696113074204947
```

In [136…
```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing Winner Predictions with Logistic Regression to Actual')
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Winner')
plt.show()
```



In [137…
```
from sklearn.ensemble import RandomForestClassifier
```

In [138…
```
forest = RandomForestClassifier(random_state=42)
```

In [139…
```
forest.fit(x,y)
```

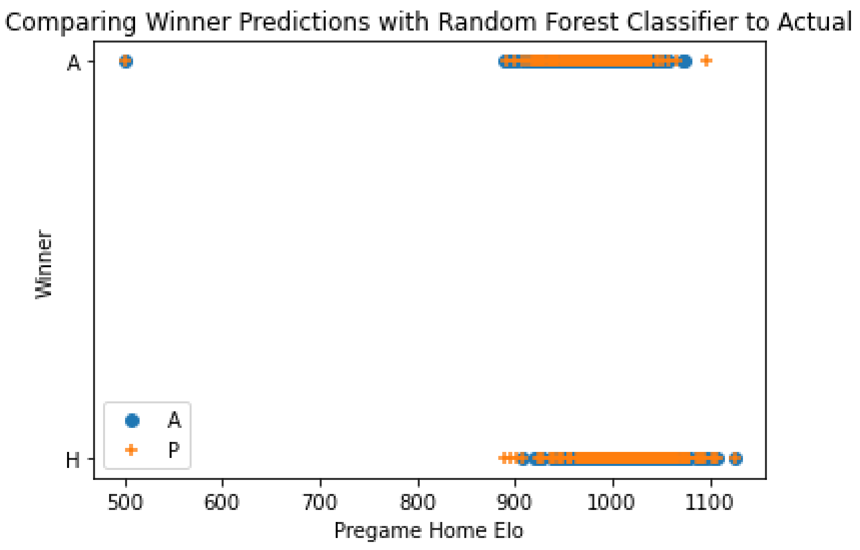
Out[139…
```
RandomForestClassifier(random_state=42)
```

In [140…
```
y_pred = forest.predict(x_test)
```

In [141…
```
score=accuracy_score(y_test,y_pred)
print('Accuracy score is ',score)
```

```
Accuracy score is  0.6855123674911661
```

In [142…
```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing Winner Predictions with Random Forest Classifier to Actual'
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Winner')
plt.show()
```



In [143…
```
from sklearn.tree import DecisionTreeClassifier
```

In [144…
```
tree = DecisionTreeClassifier(random_state=42)
```

In [145…
```
tree.fit(x,y)
```

Out[145…
```
DecisionTreeClassifier(random_state=42)
```

In [146…
```
y_pred = tree.predict(x_test)
```

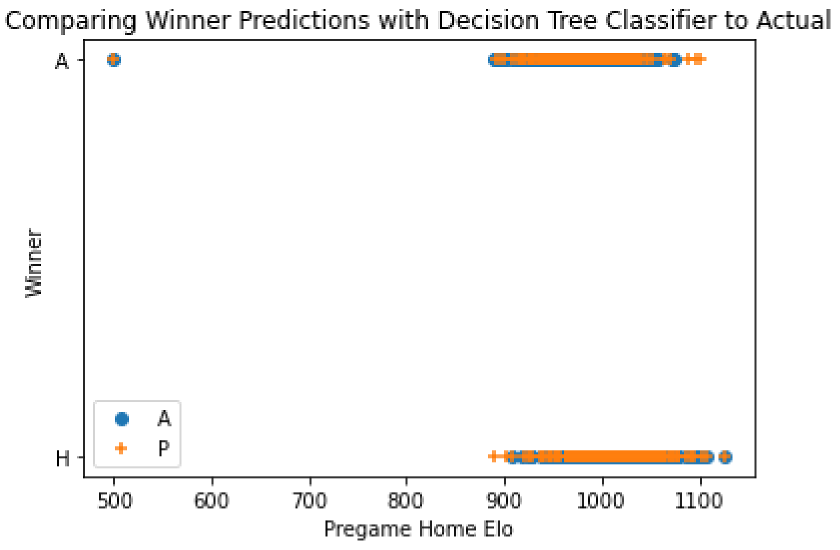
In [147…
```
score=accuracy_score(y_test,y_pred)
```

```
print('Accuracy score is ',score)
```

```
Accuracy score is  0.640753828O3298
```

In [148…

```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing Winner Predictions with Decision Tree Classifier to Actual'
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Winner')
plt.show()
```



In [149…

```
games1720 = pd.get_dummies(games20172020, columns=['home_conference', 'away_conf
```

In [150…

```
features = ['pregame_home_elo', 'pregame_away_elo', 'home_conference_ACC', 'home
       'home_conference_Big 12', 'home_conference_Big Ten',
       'home_conference_Conference USA', 'home_conference_FBS Independents',
       'home_conference_Mid-American', 'home_conference_Mountain West',
       'home_conference_Pac-12', 'home_conference_SEC',
       'home_conference_Sun Belt', 'away_conference_ACC',
       'away_conference_American Athletic', 'away_conference_Big 12',
       'away_conference_Big Ten', 'away_conference_Conference USA',
       'away_conference_FBS Independents', 'away_conference_Mid-American',
       'away_conference_Mountain West', 'away_conference_Pac-12',
       'away_conference_SEC', 'away_conference_Sun Belt']

x = games1720[features]
y = games1720['Winner']
```

In [151…

```
games21 = pd.get_dummies(games2021, columns=['home_conference', 'away_conference
```

In [152…

```
x_test = games21[features]
y_test = games21['Winner']
```

In [153…

```
log = LogisticRegression()
```

In [154…
```
log.fit(x,y)
```

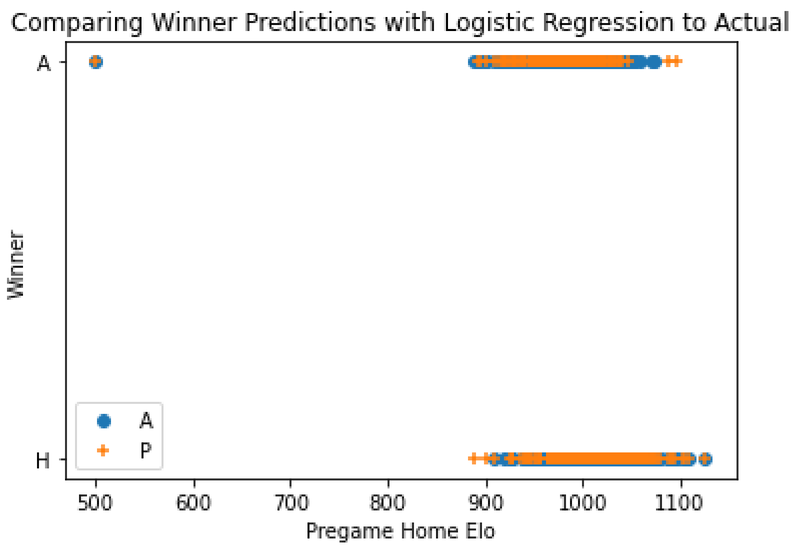
Out[154…
```
LogisticRegression()
```

In [155…
```
y_pred = log.predict(x_test)
```

In [156…
```
score=accuracy_score(y_test,y_pred)
print('Accuracy score is ',score)
```

```
Accuracy score is  0.7078916372202592
```

In [157…
```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing Winner Predictions with Logistic Regression to Actual')
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Winner')
plt.show()
```



Adding in the conference really doesn't improve the accuracy enough and is bordering on overfitting.

In [158…
```
from sklearn.ensemble import RandomForestClassifier
```

In [159…
```
forest = RandomForestClassifier(random_state=42)
```

In [160…
```
forest.fit(x,y)
```

Out[160…
```
RandomForestClassifier(random_state=42)
```

In [161…
```
y_pred = forest.predict(x_test)
```

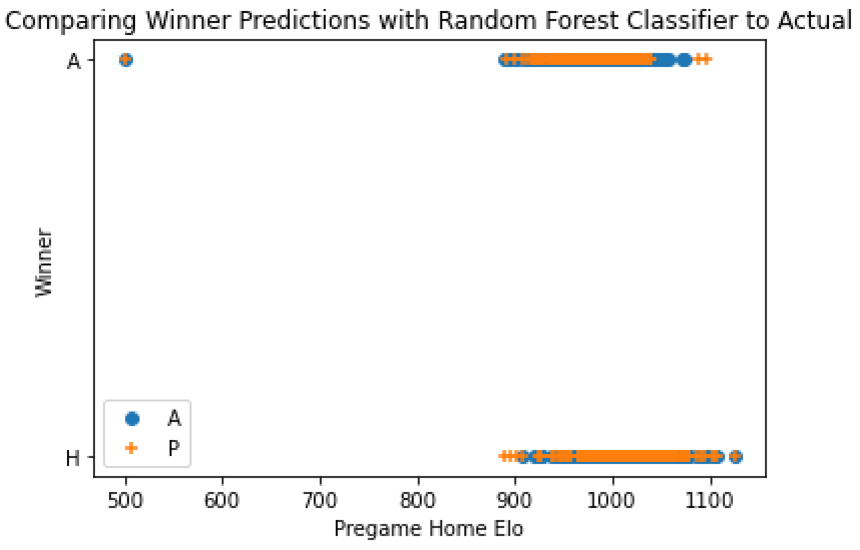
In [162…

```
score=accuracy_score(y_test,y_pred)
print('Accuracy score is ',score)
```

```
Accuracy score is  0.6866902237926973
```

In [163…

```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing Winner Predictions with Random Forest Classifier to Actual'
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Winner')
plt.show()
```



In [164…

```
from sklearn.tree import DecisionTreeClassifier
```

In [165…

```
tree = DecisionTreeClassifier(random_state=42)
```

In [166…

```
tree.fit(x,y)
```

Out[166…

```
DecisionTreeClassifier(random_state=42)
```

In [167…

```
y_pred = tree.predict(x_test)
```

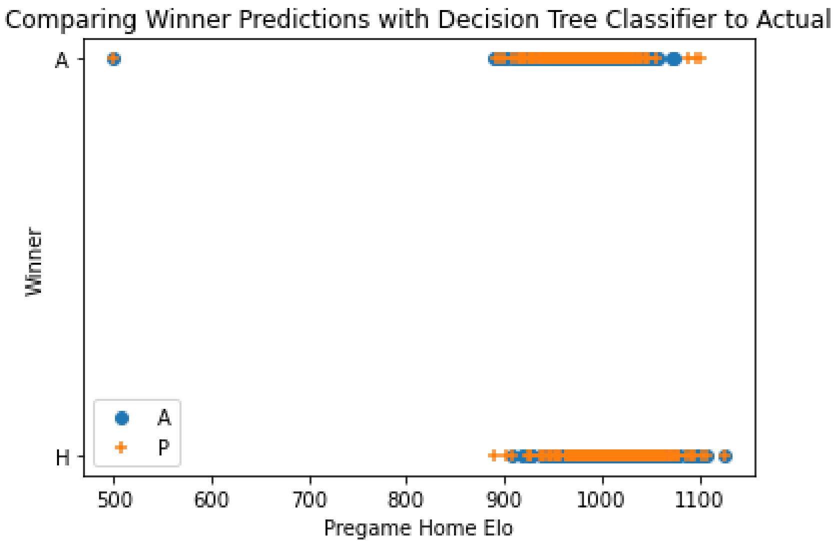
In [168…

```
score=accuracy_score(y_test,y_pred)
print('Accuracy score is ',score)
```

```
Accuracy score is  0.6395759717314488
```

In [169…

```
plt.scatter(x_test['pregame_home_elo'], y_test, marker='o')
plt.scatter(x_test['pregame_home_elo'], y_pred, marker='+')
plt.title('Comparing Winner Predictions with Decision Tree Classifier to Actual'
plt.legend(labels='AP')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Winner')
plt.show()
```



A few more data visualizations

In [170…

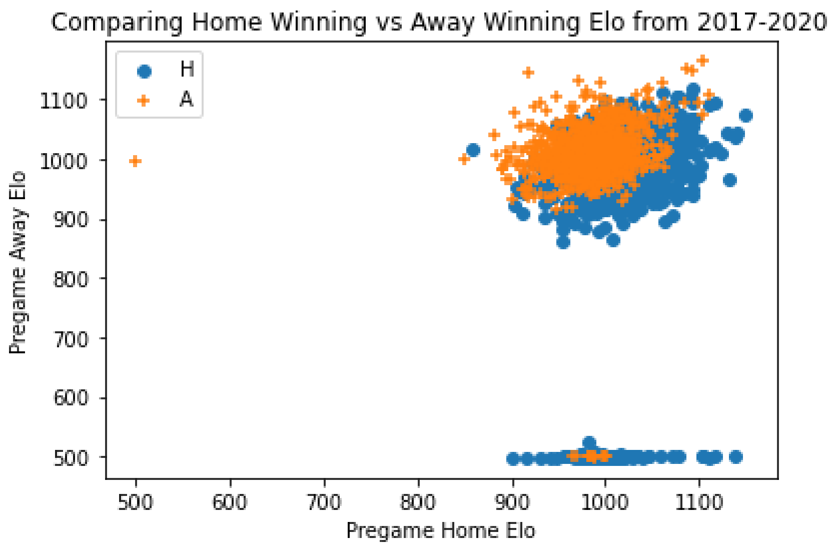
```
HomeWin1.head()
```

Out[170…

	game_id	start_date	season	home_team	home_conference	home_points	away_tea
0	400935282	2017-08-26T18:30:00.000Z	2017	Colorado State	Mountain West	58	Orego Sta
1	400945031	2017-08-26T19:00:00.000Z	2017	BYU	FBS Independents	20	Portlan Sta
5	400938591	2017-08-31T22:00:00.000Z	2017	UCF	American Athletic	61	Floric Internatior
6	400937445	2017-08-31T22:30:00.000Z	2017	Wake Forest	ACC	51	Presbyteria Colleg
8	400941787	2017-08-31T23:00:00.000Z	2017	Cincinnati	American Athletic	26	Austin Pe

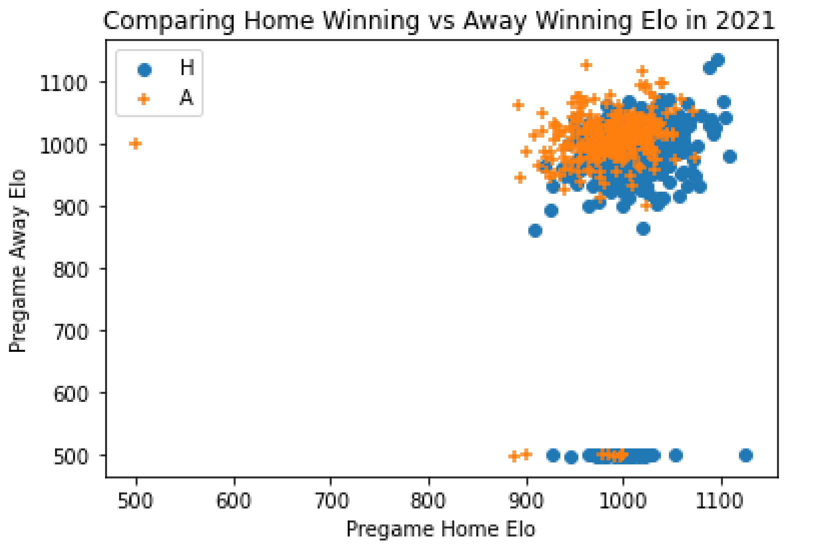
In [171…

```
plt.scatter(HomeWin1['pregame_home_elo'], HomeWin1['pregame_away_elo'], marker='
plt.scatter(AwayWin1['pregame_home_elo'], AwayWin1['pregame_away_elo'], marker='
plt.legend(labels='HA')
plt.title('Comparing Home Winning vs Away Winning Elo from 2017-2020')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Pregame Away Elo')
plt.show()
```



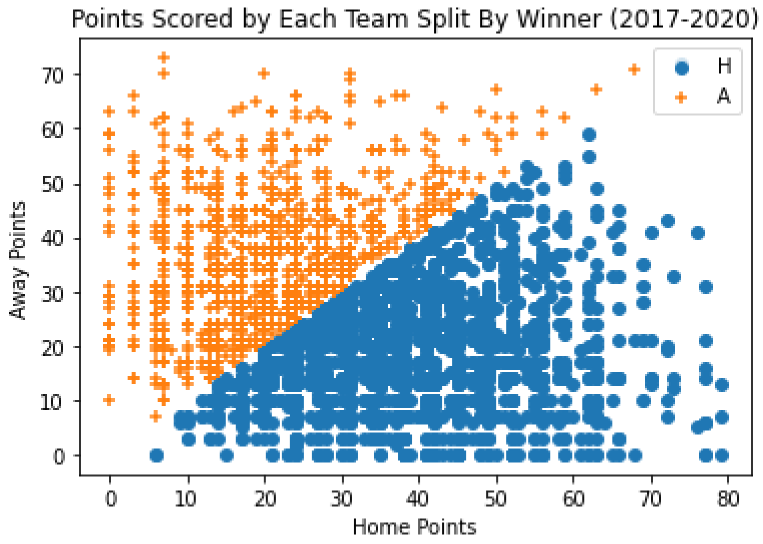
In [172…

```
plt.scatter(HomeWin2['pregame_home_elo'], HomeWin2['pregame_away_elo'], marker='
plt.scatter(AwayWin2['pregame_home_elo'], AwayWin2['pregame_away_elo'], marker='
plt.legend(labels='HA')
plt.title('Comparing Home Winning vs Away Winning Elo in 2021')
plt.xlabel('Pregame Home Elo')
plt.ylabel('Pregame Away Elo')
plt.show()
```



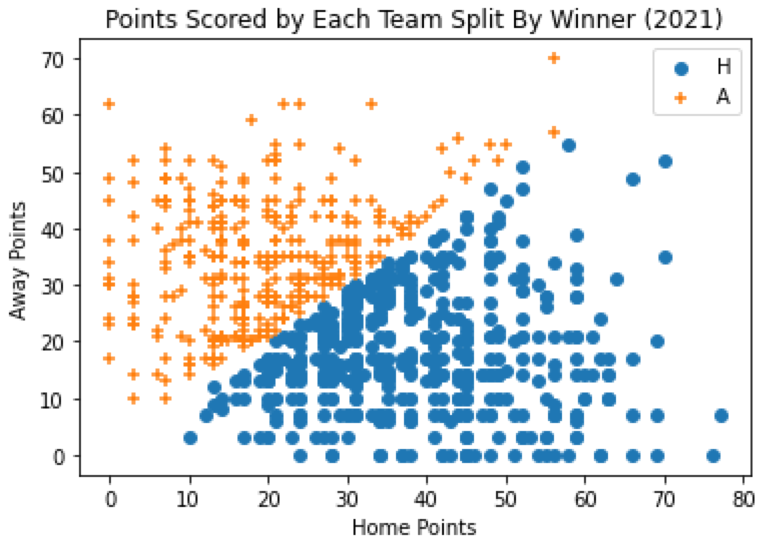
In [173…

```
plt.scatter(HomeWin1['home_points'], HomeWin1['away_points'], marker='o')
plt.scatter(AwayWin1['home_points'], AwayWin1['away_points'], marker='+')
plt.legend(labels='HA')
plt.title('Points Scored by Each Team Split By Winner (2017-2020)')
plt.xlabel('Home Points')
plt.ylabel('Away Points')
plt.show()
```



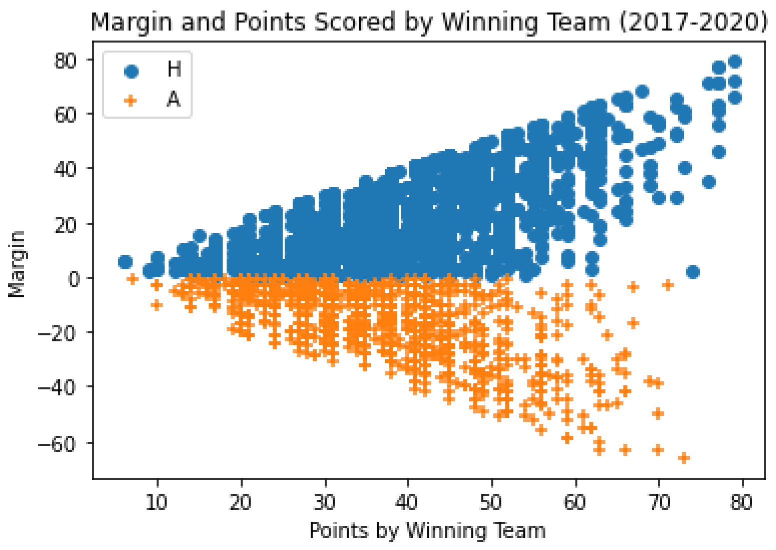
In [174…

```
plt.scatter(HomeWin2['home_points'], HomeWin2['away_points'], marker='o')
plt.scatter(AwayWin2['home_points'], AwayWin2['away_points'], marker='+')
plt.legend(labels='HA')
plt.title('Points Scored by Each Team Split By Winner (2021)')
plt.xlabel('Home Points')
plt.ylabel('Away Points')
plt.show()
```



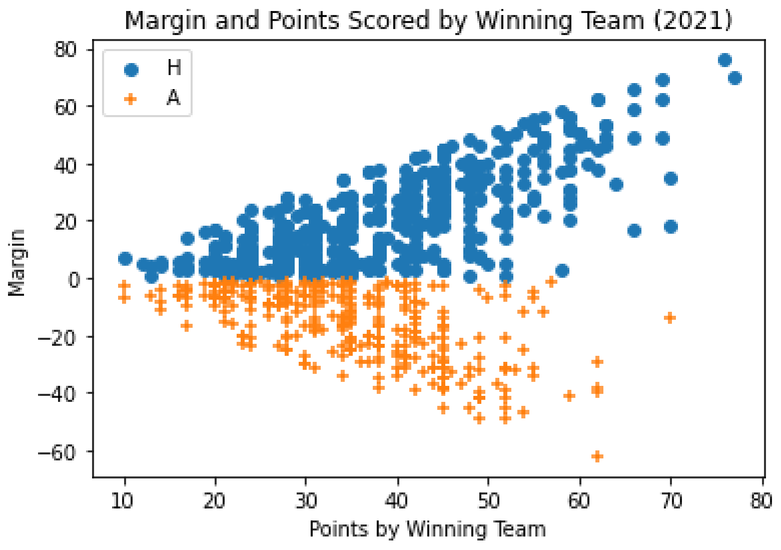
In [175…

```
plt.scatter(HomeWin1['home_points'], HomeWin1['margin'], marker='o')
plt.scatter(AwayWin1['away_points'], AwayWin1['margin'], marker='+')
plt.legend(labels='HA')
plt.title('Margin and Points Scored by Winning Team (2017-2020)')
plt.xlabel('Points by Winning Team')
plt.ylabel('Margin')
plt.show()
```



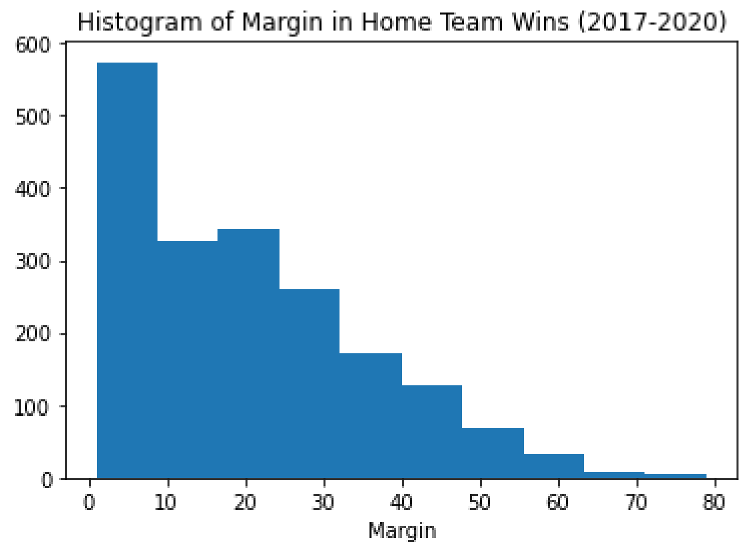
In [176…

```
plt.scatter(HomeWin2['home_points'], HomeWin2['margin'], marker='o')
plt.scatter(AwayWin2['away_points'], AwayWin2['margin'], marker='+')
plt.legend(labels='HA')
plt.title('Margin and Points Scored by Winning Team (2021)')
plt.xlabel('Points by Winning Team')
plt.ylabel('Margin')
plt.show()
```



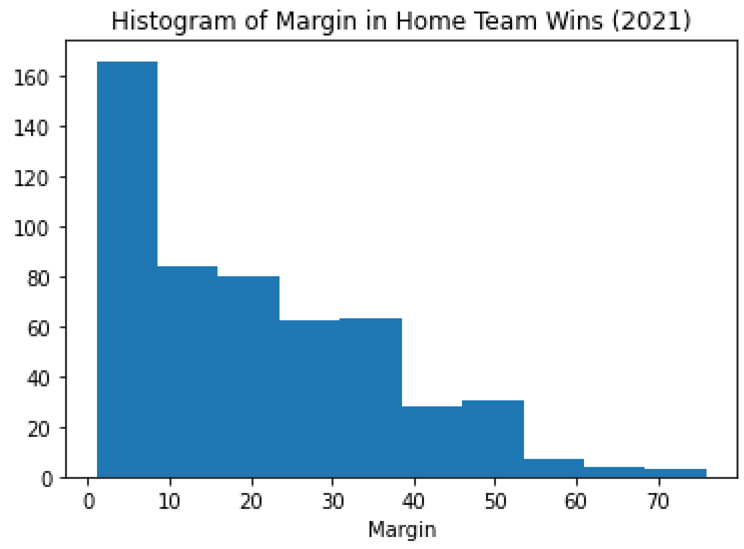
In [177…

```
plt.hist(HomeWin1['margin'])
plt.title('Histogram of Margin in Home Team Wins (2017-2020)')
plt.xlabel('Margin')
plt.show()
```



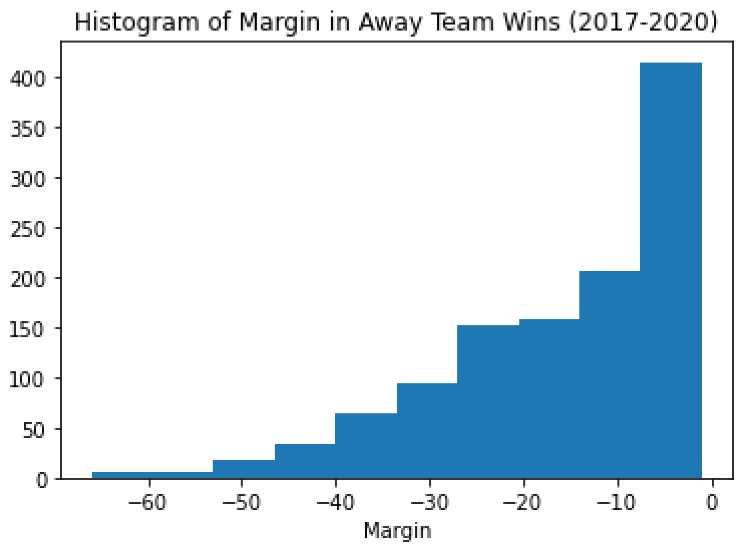
In [178…

```
plt.hist(HomeWin2['margin'])
plt.title('Histogram of Margin in Home Team Wins (2021)')
plt.xlabel('Margin')
plt.show()
```



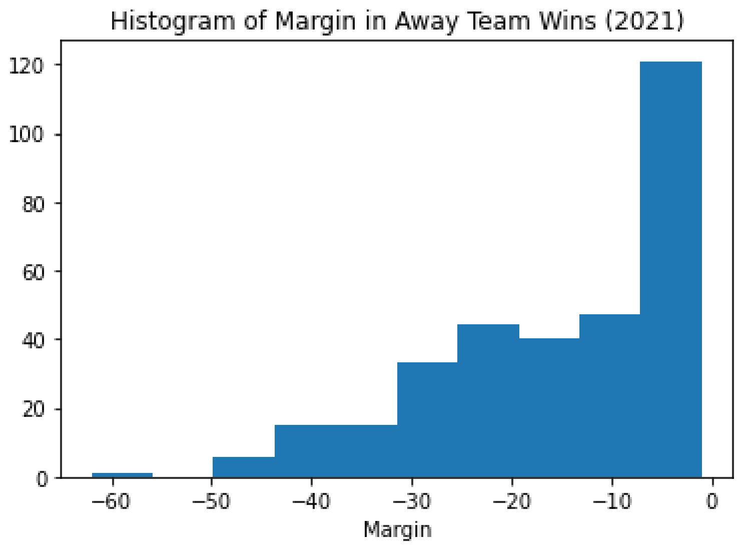
In [179…

```
plt.hist(AwayWin1['margin'])
plt.title('Histogram of Margin in Away Team Wins (2017-2020)')
plt.xlabel('Margin')
plt.show()
```



In [180…

```
plt.hist(AwayWin2['margin'])
plt.title('Histogram of Margin in Away Team Wins (2021)')
plt.xlabel('Margin')
plt.show()
```

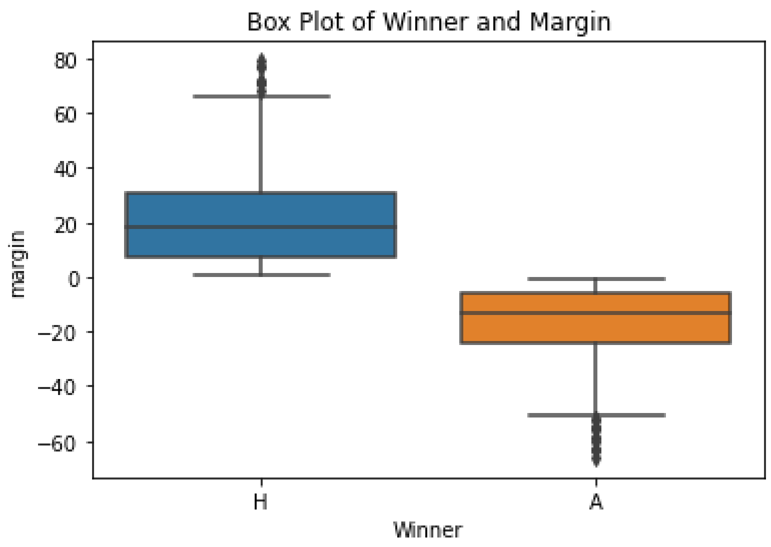


In [181…

```
import seaborn as sns
```

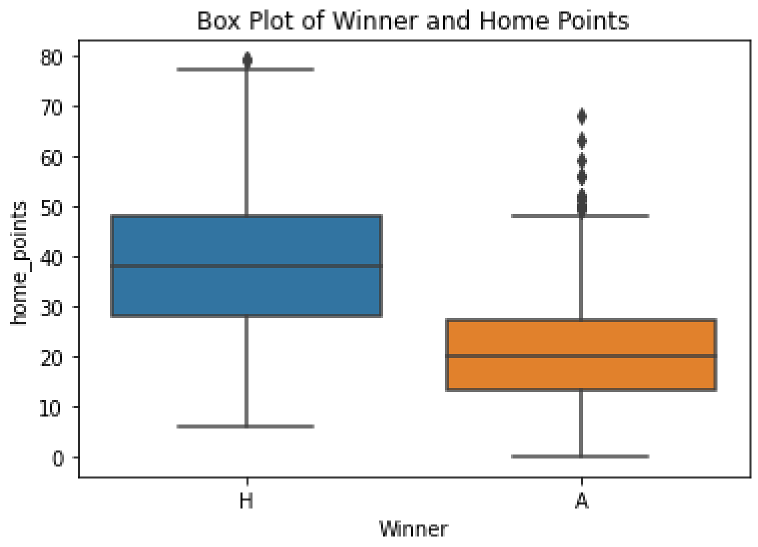
In [182…

```
sns.boxplot(x=games1720['Winner'], y=games1720['margin'])
plt.title('Box Plot of Winner and Margin')
plt.show()
```



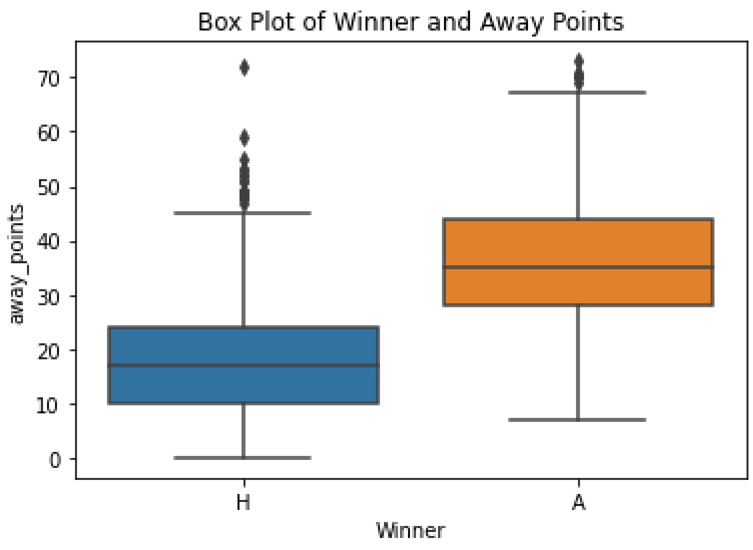
In [183…

```
sns.boxplot(x=games1720['Winner'], y=games1720['home_points'])
plt.title('Box Plot of Winner and Home Points')
plt.show()
```



In [184…

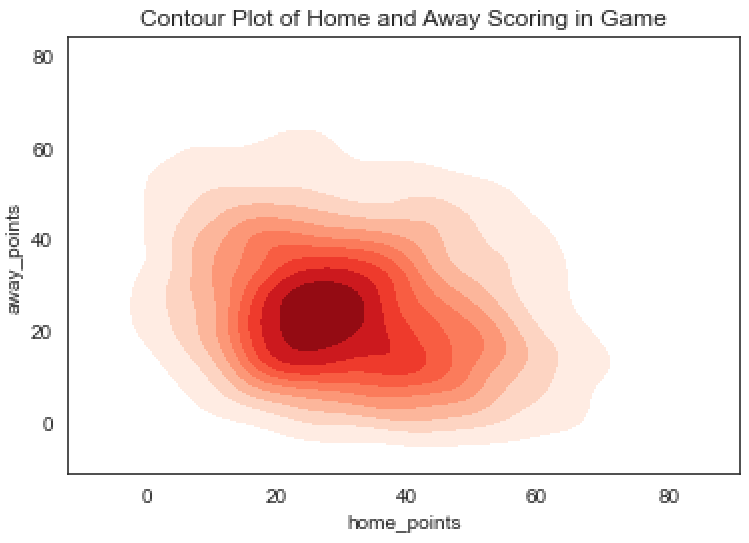
```
sns.boxplot(x=games1720['Winner'], y=games1720['away_points'])
plt.title('Box Plot of Winner and Away Points')
plt.show()
```



In [185…

```python
sns.set_style('white')

sns.kdeplot(x=games1720['home_points'], y=games1720['away_points'], cmap='Reds',
plt.title('Contour Plot of Home and Away Scoring in Game')
plt.show()
```



In [ ]:

```python

```