Data Analysis of BaseBall teams - Hariyalee Patel

Import primary libraries

In [50]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn import metrics
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
import statsmodels.formula.api as smf
import statsmodels.api as sm2
import warnings
```

import dataset from your computer to here / Read .csv file:-

In [3]:
```
df = pd.read_csv('baseball_teams.csv')
```

To get total number of Columns and Rows:-

In [4]:
```
df.shape
```

Out[4]:
```
(2805, 43)
```

To see the Standard Deviation, Mean, Count and more... :-

In [5]:
```
df.describe()
```

Out[5]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	Runs_Score
count	2805.000000	2805.000000	2805.00000	2406.000000	2805.000000	2805.000000	2805.00000
mean	1955.036720	4.107308	150.34795	78.465919	74.749020	74.749020	681.94581
std	41.519083	2.323414	23.22725	4.698684	17.640402	17.378079	135.73824
min	1871.000000	1.000000	6.00000	44.000000	0.000000	4.000000	24.00000
25%	1919.000000	2.000000	153.00000	77.000000	66.000000	65.000000	613.00000
50%	1963.000000	4.000000	157.00000	81.000000	77.000000	76.000000	690.00000
75%	1992.000000	6.000000	162.00000	81.000000	87.000000	87.000000	763.00000
max	2015.000000	13.000000	165.00000	84.000000	116.000000	134.000000	1220.00000

8 rows × 32 columns

To check the name of columns:-

In [6]:
```
df.columns
```

Out[6]:
```
Index(['Year', 'League', 'Team', 'Franchise ', 'Division', 'Final_Standing',
       'Games_Played', 'Unnamed: 7', 'Games_Won', 'Games_Lost', 'Unnamed: 10',
       'Unnamed: 11', 'League_Win', 'World_Series', 'Runs_Scored', 'At_Bats',
       'Hits', 'Doubles', 'Triples', 'Home_Runs', 'Walks', 'Strike_Outs',
       'Stolen_Bases', 'Caught_Stealing', 'Hit_By_Pitch', 'Sacrifice_Fly',
       'Runs_Against', 'Earned_Runs', 'Earned_Run_Average', 'Complete_Games',
       'Shutout', 'Saves', 'Infield_Put_Outs', 'Hits_Allowed',
       'Home_Run_Allowed', 'Walks_Allowed', 'Strikeouts_Allowed', 'Errors',
       'Double_Plays', 'Fielding_Percentage', 'Team_Name', 'Home_Ball_Park',
       'Attendance'],
      dtype='object')
```

To check datatypes of each Variables :-

In [7]:
```
df.dtypes
```

Out[7]:
```
Year                  int64
League               object
Team                 object
Franchise            object
Division             object
Final_Standing        int64
Games_Played          int64
Unnamed: 7          float64
Games_Won             int64
Games_Lost            int64
Unnamed: 10          object
Unnamed: 11          object
League_Win           object
World_Series         object
Runs_Scored           int64
At_Bats               int64
Hits                  int64
Doubles               int64
Triples               int64
Home_Runs             int64
Walks                 int64
Strike_Outs         float64
Stolen_Bases        float64
Caught_Stealing     float64
Hit_By_Pitch        float64
Sacrifice_Fly       float64
Runs_Against          int64
Earned_Runs           int64
Earned_Run_Average  float64
Complete_Games        int64
Shutout               int64
Saves                 int64
Infield_Put_Outs      int64
Hits_Allowed          int64
Home_Run_Allowed      int64
Walks_Allowed         int64
Strikeouts_Allowed    int64
Errors                int64
Double_Plays        float64
Fielding_Percentage float64
Team_Name            object
Home_Ball_Park       object
Attendance           object
dtype: object
```

To print information about the DataFrame like number of columns, column labels, column data types, memory usage, range index, and the number of cells in each column (non-null values):-

In [91]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2805 entries, 0 to 2804
Data columns (total 43 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   Year                 2805 non-null   int64  
 1   League               2755 non-null   object 
 2   Team                 2805 non-null   object 
 3   Franchise            2805 non-null   object 
 4   Division             1288 non-null   object 
 5   Final_Standing       2805 non-null   int64  
 6   Games_Played         2805 non-null   int64  
 7   Unnamed: 7           2406 non-null   float64
 8   Games_Won            2805 non-null   int64  
 9   Games_Lost           2805 non-null   int64  
 10  Unnamed: 10          1260 non-null   object 
 11  Unnamed: 11          624 non-null    object 
 12  League_Win           2777 non-null   object 
 13  World_Series         2448 non-null   object 
 14  Runs_Scored          2805 non-null   int64  
 15  At_Bats              2805 non-null   int64  
 16  Hits                 2805 non-null   int64  
 17  Doubles              2805 non-null   int64  
 18  Triples              2805 non-null   int64  
 19  Home_Runs            2805 non-null   int64  
 20  Walks                2805 non-null   int64  
 21  Strike_Outs          2805 non-null   float64
 22  Stolen_Bases         2805 non-null   float64
 23  Caught_Stealing      2805 non-null   float64
 24  Hit_By_Pitch         2805 non-null   float64
 25  Sacrifice_Fly        2805 non-null   float64
 26  Runs_Against         2805 non-null   int64  
 27  Earned_Runs          2805 non-null   int64  
 28  Earned_Run_Average   2805 non-null   float64
 29  Complete_Games       2805 non-null   int64  
 30  Shutout              2805 non-null   int64  
 31  Saves                2805 non-null   int64  
 32  Infield_Put_Outs     2805 non-null   int64  
 33  Hits_Allowed         2805 non-null   int64  
 34  Home_Run_Allowed     2805 non-null   int64  
 35  Walks_Allowed        2805 non-null   int64  
 36  Strikeouts_Allowed   2805 non-null   int64  
 37  Errors               2805 non-null   int64  
 38  Double_Plays         2805 non-null   float64
 39  Fielding_Percentage  2805 non-null   float64
 40  Team_Name            2805 non-null   object 
 41  Home_Ball_Park       2771 non-null   object 
 42  Attendance           2527 non-null   object 
dtypes: float64(9), int64(23), object(11)
memory usage: 942.4+ KB
```

To get the number of missing values ifrom the dataset:-

In [92]:
```
print(df.isnull().sum())
```

```
Year                    0
League                 50
Team                    0
Franchise               0
Division             1517
Final_Standing          0
Games_Played            0
Unnamed: 7            399
Games_Won               0
Games_Lost              0
Unnamed: 10          1545
Unnamed: 11          2181
League_Win             28
World_Series          357
Runs_Scored             0
At_Bats                 0
Hits                    0
Doubles                 0
Triples                 0
Home_Runs               0
Walks                   0
Strike_Outs             0
Stolen_Bases            0
Caught_Stealing         0
Hit_By_Pitch            0
Sacrifice_Fly           0
Runs_Against            0
Earned_Runs             0
Earned_Run_Average      0
Complete_Games          0
Shutout                 0
Saves                   0
Infield_Put_Outs        0
Hits_Allowed            0
Home_Run_Allowed        0
Walks_Allowed           0
Strikeouts_Allowed      0
Errors                  0
Double_Plays            0
Fielding_Percentage     0
Team_Name               0
Home_Ball_Park         34
Attendance            278
dtype: int64
```

To get information about a DataFrame including the index dtype and columns, non-null values and memory usage:-

In [87]:
```
mean_value = df[['Strike_Outs', 'Stolen_Bases', 'Caught_Stealing', 'Hit_By_Pitch', 'Sa
```

In [88]:
```
df.loc[:, ['Strike_Outs', 'Stolen_Bases', 'Caught_Stealing', 'Hit_By_Pitch', 'Sacrific
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2805 entries, 0 to 2804
Data columns (total 43 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   Year                 2805 non-null   int64  
 1   League               2755 non-null   object 
 2   Team                 2805 non-null   object 
 3   Franchise            2805 non-null   object 
 4   Division             1288 non-null   object 
 5   Final_Standing       2805 non-null   int64  
 6   Games_Played         2805 non-null   int64  
 7   Unnamed: 7           2406 non-null   float64
 8   Games_Won            2805 non-null   int64  
 9   Games_Lost           2805 non-null   int64  
 10  Unnamed: 10          1260 non-null   object 
 11  Unnamed: 11          624 non-null    object 
 12  League_Win           2777 non-null   object 
 13  World_Series         2448 non-null   object 
 14  Runs_Scored          2805 non-null   int64  
 15  At_Bats              2805 non-null   int64  
 16  Hits                 2805 non-null   int64  
 17  Doubles              2805 non-null   int64  
 18  Triples              2805 non-null   int64  
 19  Home_Runs            2805 non-null   int64  
 20  Walks                2805 non-null   int64  
 21  Strike_Outs          2805 non-null   float64
 22  Stolen_Bases         2805 non-null   float64
 23  Caught_Stealing      2805 non-null   float64
 24  Hit_By_Pitch         2805 non-null   float64
 25  Sacrifice_Fly        2805 non-null   float64
 26  Runs_Against         2805 non-null   int64  
 27  Earned_Runs          2805 non-null   int64  
 28  Earned_Run_Average   2805 non-null   float64
 29  Complete_Games       2805 non-null   int64  
 30  Shutout              2805 non-null   int64  
 31  Saves                2805 non-null   int64  
 32  Infield_Put_Outs     2805 non-null   int64  
 33  Hits_Allowed         2805 non-null   int64  
 34  Home_Run_Allowed     2805 non-null   int64  
 35  Walks_Allowed        2805 non-null   int64  
 36  Strikeouts_Allowed   2805 non-null   int64  
 37  Errors               2805 non-null   int64  
 38  Double_Plays         2805 non-null   float64
 39  Fielding_Percentage  2805 non-null   float64
 40  Team_Name            2805 non-null   object 
 41  Home_Ball_Park       2771 non-null   object 
 42  Attendance           2527 non-null   object 
dtypes: float64(9), int64(23), object(11)
memory usage: 942.4+ KB
```

To get the correlation analysis:-

In [93]:
```
df.corr(method='pearson',numeric_only='False')
```

Out[93]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	F
Year	1.000000	-0.293981	0.601304	0.341956	0.418790	0.425112	
Final_Standing	-0.293981	1.000000	-0.171295	-0.085398	-0.732510	0.502550	
Games_Played	0.601304	-0.171295	1.000000	0.963764	0.676371	0.661355	
Unnamed: 7	0.341956	-0.085398	0.963764	1.000000	0.358841	0.295313	
Games_Won	0.418790	-0.732510	0.676371	0.358841	1.000000	-0.102111	
Games_Lost	0.425112	0.502550	0.661355	0.295313	-0.102111	1.000000	
Runs_Scored	0.273367	-0.447966	0.532620	0.353552	0.677243	0.028576	
At_Bats	0.605436	-0.199481	0.986522	0.904329	0.689233	0.632149	
Hits	0.506059	-0.306493	0.867794	0.547261	0.725160	0.436382	
Doubles	0.683101	-0.364275	0.679297	0.379173	0.586949	0.339586	
Triples	-0.610569	0.065342	0.002071	-0.169251	0.086865	-0.122844	
Home_Runs	0.837680	-0.358621	0.522866	0.380709	0.484075	0.248887	
Walks	0.572747	-0.283531	0.774200	0.381918	0.655929	0.385736	
Strike_Outs	0.865400	-0.220935	0.649938	0.483962	0.410939	0.484574	
Stolen_Bases	-0.357112	-0.042308	-0.068319	0.017897	0.037039	-0.161418	
Caught_Stealing	-0.131933	0.018669	0.093838	0.037900	0.053204	0.062928	
Hit_By_Pitch	-0.009395	-0.031522	-0.000115	-0.000496	0.043176	-0.044323	
Sacrifice_Fly	-0.012051	-0.065718	0.000485	0.003080	0.079945	-0.080557	
Runs_Against	0.275035	0.305040	0.513703	0.314490	0.006238	0.686534	
Earned_Runs	0.642611	0.100081	0.703112	0.374492	0.235721	0.726280	
Earned_Run_Average	0.371608	0.318717	0.174785	0.086441	-0.220270	0.480528	
Complete_Games	-0.876366	0.196974	-0.246025	-0.284432	-0.134360	-0.243658	
Shutout	0.095318	-0.380173	0.351139	0.121658	0.545568	-0.090116	
Saves	0.897888	-0.403732	0.525381	0.408410	0.505623	0.232377	
Infield_Put_Outs	0.617324	-0.202563	0.996585	0.951415	0.697276	0.637079	
Hits_Allowed	0.507877	0.046543	0.858471	0.519463	0.413214	0.741285	
Home_Run_Allowed	0.884038	-0.173527	0.549978	0.408671	0.320302	0.453769	
Walks_Allowed	0.572311	0.013765	0.776006	0.370675	0.380921	0.667285	
Strikeouts_Allowed	0.879181	-0.346624	0.641185	0.490309	0.518630	0.364530	
Errors	-0.833145	0.308794	-0.494665	-0.208608	-0.430352	-0.267573	
Double_Plays	0.419725	-0.026202	0.378708	0.406277	0.240419	0.284231	
Fielding_Percentage	0.777934	-0.298955	0.859709	0.319166	0.644387	0.521540	

32 rows × 32 columns

Period 1 (>1920), Dataframe 1(df1) :-

In [12]:
```
df1=df[(df['Year']<1920)]
```

In [13]:
```
df1.describe()
```

Out[13]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	Runs_Scored
count	703.000000	703.000000	703.000000	304.000000	703.000000	703.000000	703.000000
mean	1897.237553	4.913229	127.769559	75.167763	62.758179	62.758179	612.795164
std	13.698282	2.722102	35.340280	5.009708	23.223088	22.548362	190.125631
min	1871.000000	1.000000	6.000000	52.000000	0.000000	4.000000	24.000000
25%	1886.000000	3.000000	116.000000	73.000000	49.000000	48.000000	500.500000
50%	1898.000000	5.000000	139.000000	77.000000	66.000000	64.000000	614.000000
75%	1909.500000	7.000000	154.000000	78.000000	80.000000	78.000000	739.000000
max	1919.000000	13.000000	162.000000	84.000000	116.000000	134.000000	1220.000000

8 rows × 32 columns

pearson method used to get standard correlation coefficient:-

In [94]:
```
df1.corr(method='pearson',numeric_only='False')
```

Out[94]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	F
Year	1.000000	-0.082193	0.802923	0.039266	0.602368	0.620393	
Final_Standing	-0.082193	1.000000	-0.108053	-0.091165	-0.635882	0.489376	
Games_Played	0.802923	-0.108053	1.000000	0.889232	0.765999	0.745224	
Unnamed: 7	0.039266	-0.091165	0.889232	1.000000	0.303142	0.137983	
Games_Won	0.602368	-0.635882	0.765999	0.303142	1.000000	0.144745	
Games_Lost	0.620393	0.489376	0.745224	0.137983	0.144745	1.000000	
Runs_Scored	0.170307	-0.335152	0.564020	0.123811	0.681313	0.160974	
At_Bats	0.735271	-0.131851	0.987764	0.800200	0.775265	0.716733	
Hits	0.655431	-0.225380	0.905877	0.307485	0.808361	0.558298	
Doubles	0.562873	-0.311365	0.760180	0.120461	0.749308	0.397839	
Triples	0.424524	-0.178688	0.666072	0.165061	0.644800	0.362214	
Home_Runs	0.207973	-0.151843	0.431225	0.037063	0.456323	0.192673	
Walks	0.684370	-0.118003	0.844984	0.348215	0.712184	0.563769	
Strike_Outs	0.665538	-0.014480	0.803176	0.654670	0.549502	0.702733	
Stolen_Bases	-0.133942	-0.213909	0.352508	0.325600	0.430729	0.023014	
Caught_Stealing	0.942084	-0.252966	0.943815	0.327101	0.883660	0.854059	
Hit_By_Pitch	NaN	NaN	NaN	NaN	NaN	NaN	
Sacrifice_Fly	NaN	NaN	NaN	NaN	NaN	NaN	
Runs_Against	0.173375	0.391338	0.535903	-0.004590	0.132917	0.685972	
Earned_Runs	0.465079	0.315659	0.714682	-0.008117	0.316495	0.772942	
Earned_Run_Average	-0.207545	0.597110	-0.122262	-0.297767	-0.408200	0.235102	
Complete_Games	0.232261	-0.071234	0.701214	0.010033	0.553754	0.498868	
Shutout	0.627117	-0.462850	0.553754	0.311831	0.673471	0.156623	
Saves	0.676590	-0.277237	0.481929	0.248635	0.526227	0.202158	
Infield_Put_Outs	0.821519	-0.136902	0.997586	0.882112	0.779830	0.727625	
Hits_Allowed	0.664930	0.121449	0.900834	0.244269	0.555890	0.811717	
Home_Run_Allowed	0.230242	0.159822	0.464565	0.015318	0.243336	0.464053	
Walks_Allowed	0.679998	0.095441	0.834464	0.301987	0.532710	0.732441	
Strikeouts_Allowed	0.676153	-0.242680	0.798978	0.577207	0.695112	0.506540	
Errors	-0.549536	0.186997	-0.087397	0.087324	-0.199159	0.065033	
Double_Plays	0.785223	0.087461	0.764035	0.211687	0.497300	0.544475	
Fielding_Percentage	0.878291	-0.234411	0.880804	0.140322	0.752685	0.580469	

32 rows × 32 columns

In [95]:
```
off_def=['Runs_Scored','At_Bats','Hits','Doubles','Triples','Home_Runs','Walks','Strik
'Runs_Against','Earned_Runs','Earned_Run_Average','Complete_Games','Shutout','Saves','
```

To get top 8 variables from df1 -

In [96]:
```
df1.corr(method='pearson',numeric_only=True).loc['Games_Won'][off_def].sort_values(asc
```

Out[96]:
```
Caught_Stealing        0.883660
Hits                   0.808361
Infield_Put_Outs       0.779830
At_Bats                0.775265
Fielding_Percentage    0.752685
Doubles                0.749308
Walks                  0.712184
Strikeouts_Allowed     0.695112
Name: Games_Won, dtype: float64
```

Period 2 (1920 - 1959), Dataframe 2(df2) :-

In [97]:
```
df2=df[(df['Year']>=1920)&(df['Year']<1959)]
```

In [98]:
```
df2.describe()
```

Out[98]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	Runs_Scored
count	624.000000	624.000000	624.000000	624.000000	624.000000	624.000000	624.000000
mean	1939.000000	4.479167	154.314103	77.157051	76.657051	76.657051	714.424679
std	11.263658	2.285318	1.505707	1.484326	14.447703	14.322171	108.047285
min	1920.000000	1.000000	147.000000	70.000000	38.000000	43.000000	394.000000
25%	1929.000000	2.000000	154.000000	77.000000	66.000000	66.000000	643.000000
50%	1939.000000	4.000000	154.000000	77.000000	78.000000	76.000000	707.500000
75%	1949.000000	6.000000	155.000000	78.000000	87.000000	87.000000	778.250000
max	1958.000000	8.000000	158.000000	82.000000	111.000000	115.000000	1067.000000

8 rows × 32 columns

In [99]:
```
df2.corr(method='pearson',numeric_only='False')
```

Out[99]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	F
Year	1.000000	-0.000561	0.187773	0.095239	0.009203	0.009283	
Final_Standing	-0.000561	1.000000	-0.094655	-0.194462	-0.944458	0.943079	
Games_Played	0.187773	-0.094655	1.000000	0.576867	0.122353	-0.060200	
Unnamed: 7	0.095239	-0.194462	0.576867	1.000000	0.212541	-0.177692	
Games_Won	0.009203	-0.944458	0.122353	0.212541	1.000000	-0.996321	
Games_Lost	0.009283	0.943079	-0.060200	-0.177692	-0.996321	1.000000	
Runs_Scored	-0.255401	-0.607823	0.056384	0.107275	0.633883	-0.634312	
At_Bats	-0.201823	-0.227050	0.392102	0.260312	0.237114	-0.218212	
Hits	-0.579199	-0.404228	0.034058	0.086832	0.413347	-0.414882	
Doubles	-0.459580	-0.264623	0.003377	0.070700	0.264535	-0.269011	
Triples	-0.634954	-0.243095	-0.015786	0.084814	0.259337	-0.261680	
Home_Runs	0.540612	-0.329044	0.120390	0.069412	0.347905	-0.334864	
Walks	0.403945	-0.341929	0.173674	0.117755	0.362145	-0.354284	
Strike_Outs	0.745435	0.071954	0.181739	0.035459	-0.060956	0.079134	
Stolen_Bases	-0.534625	-0.147107	-0.021219	0.026234	0.162620	-0.164449	
Caught_Stealing	-0.661049	-0.005568	-0.070378	-0.035724	0.016122	-0.021065	
Hit_By_Pitch	NaN	NaN	NaN	NaN	NaN	NaN	
Sacrifice_Fly	NaN	NaN	NaN	NaN	NaN	NaN	
Runs_Against	-0.259871	0.590099	-0.041705	-0.137689	-0.632395	0.633330	
Earned_Runs	-0.101179	0.571413	-0.021436	-0.127255	-0.609230	0.612229	
Earned_Run_Average	-0.111466	0.581665	-0.085319	-0.165424	-0.622357	0.621170	
Complete_Games	-0.588220	-0.333619	-0.037072	0.064088	0.365759	-0.375751	
Shutout	0.197733	-0.504508	0.116415	0.199273	0.530373	-0.526597	
Saves	0.526857	-0.384499	0.116224	0.067296	0.412007	-0.402038	
Infield_Put_Outs	0.148140	-0.359083	0.683573	0.448297	0.397806	-0.355533	
Hits_Allowed	-0.548918	0.467292	-0.030358	-0.101921	-0.498431	0.497424	
Home_Run_Allowed	0.675809	0.120423	0.117846	0.015153	-0.123852	0.142282	
Walks_Allowed	0.426025	0.242202	0.119133	0.008963	-0.255384	0.263750	
Strikeouts_Allowed	0.708818	-0.313724	0.230651	0.175938	0.346984	-0.327303	
Errors	-0.693122	0.320916	-0.107817	-0.130983	-0.348327	0.340441	
Double_Plays	0.361087	-0.058163	0.116125	0.126884	0.061420	-0.046757	
Fielding_Percentage	0.563599	-0.306013	0.148567	0.153690	0.324973	-0.315295	

32 rows × 32 columns

Top 8 Variables to find from df2 -

In [100…
```
df2.corr(method='pearson',numeric_only=True).loc['Games_Won'][off_def].sort_values(asc
```

Out[100]:
```
Runs_Scored           0.633883
Runs_Against         -0.632395
Earned_Run_Average   -0.622357
Earned_Runs          -0.609230
Shutout               0.530373
Hits_Allowed         -0.498431
Hits                  0.413347
Saves                 0.412007
Name: Games_Won, dtype: float64
```

Period 3(1960-1989), Dataframe 3(df3) :-

In [22]:
```
df3=df[(df['Year']>=1960)&(df['Year']<1989)]
```

In [23]:
```
df3.describe()
```

Out[23]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	Runs_Scored
count	678.000000	678.000000	678.000000	678.000000	678.000000	678.000000	678.000000
mean	1974.952802	4.060472	159.286136	79.643068	79.541298	79.541298	665.259587
std	8.167603	2.239210	10.603537	5.369868	12.819756	12.747887	94.704128
min	1960.000000	1.000000	103.000000	47.000000	37.000000	42.000000	329.000000
25%	1968.000000	2.000000	161.000000	81.000000	71.000000	71.000000	612.000000
50%	1975.000000	4.000000	162.000000	81.000000	81.000000	79.000000	673.000000
75%	1982.000000	6.000000	162.000000	81.000000	89.000000	88.000000	729.000000
max	1988.000000	10.000000	165.000000	84.000000	109.000000	120.000000	896.000000

8 rows × 32 columns

In [24]:
```
df3.corr(method='pearson',numeric_only='False')
```

Out[24]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	F
Year	1.000000	-0.225985	-0.103337	-0.102026	-0.038832	-0.039051	
Final_Standing	-0.225985	1.000000	0.022724	0.026489	-0.752349	0.771939	
Games_Played	-0.103337	0.022724	1.000000	0.986877	0.419862	0.411640	
Unnamed: 7	-0.102026	0.026489	0.986877	1.000000	0.408798	0.411491	
Games_Won	-0.038832	-0.752349	0.419862	0.408798	1.000000	-0.653611	
Games_Lost	-0.039051	0.771939	0.411640	0.411491	-0.653611	1.000000	
Runs_Scored	0.123500	-0.438513	0.517861	0.508217	0.677972	-0.248408	
At_Bats	-0.065018	-0.030466	0.974049	0.960355	0.464663	0.344977	
Hits	0.119865	-0.276893	0.728832	0.715028	0.582773	0.022938	
Doubles	0.398739	-0.278873	0.430477	0.420387	0.422006	-0.060621	
Triples	-0.127428	-0.091210	0.223524	0.223195	0.230426	-0.047491	
Home_Runs	-0.026274	-0.216235	0.327481	0.321226	0.438812	-0.167957	
Walks	0.002980	-0.215874	0.466453	0.459443	0.404958	-0.015958	
Strike_Outs	-0.191727	0.193289	0.558960	0.555709	0.133940	0.330392	
Stolen_Bases	0.493340	-0.269634	0.113247	0.110507	0.194718	-0.097932	
Caught_Stealing	0.438374	-0.117312	0.134281	0.129969	0.036846	0.079660	
Hit_By_Pitch	NaN	NaN	NaN	NaN	NaN	NaN	
Sacrifice_Fly	NaN	NaN	NaN	NaN	NaN	NaN	
Runs_Against	0.124761	0.403543	0.516278	0.517365	-0.232727	0.665209	
Earned_Runs	0.167076	0.376344	0.494815	0.496429	-0.212740	0.627682	
Earned_Run_Average	0.236416	0.433860	0.059468	0.069643	-0.469733	0.522994	
Complete_Games	-0.462488	-0.170827	0.206329	0.203890	0.331273	-0.163729	
Shutout	-0.236727	-0.327229	0.134420	0.130979	0.450653	-0.342018	
Saves	0.247808	-0.401180	0.217303	0.210268	0.507155	-0.325266	
Infield_Put_Outs	-0.111400	-0.028216	0.988740	0.975905	0.469873	0.351925	
Hits_Allowed	0.121694	0.223014	0.731456	0.727754	0.049474	0.561029	
Home_Run_Allowed	-0.032160	0.220013	0.397062	0.398502	0.000030	0.330626	
Walks_Allowed	0.002900	0.267633	0.452790	0.453638	-0.156217	0.536507	
Strikeouts_Allowed	-0.183314	-0.040948	0.536654	0.530567	0.354762	0.089233	
Errors	-0.237284	0.303890	0.439297	0.434045	-0.134957	0.498784	
Double_Plays	-0.039167	0.015028	0.456284	0.450226	0.170943	0.209105	
Fielding_Percentage	0.208630	-0.265697	-0.058552	-0.060396	0.249344	-0.295882	

32 rows × 32 columns

Top 8 Variables to find from df3 -

In [25]:
```
df3.corr(method='pearson',numeric_only=True).loc['Games_Won'][off_def].sort_values(asc
```

Out[25]:
```
Runs_Scored            0.677972
Hits                   0.582773
Saves                  0.507155
Infield_Put_Outs       0.469873
Earned_Run_Average    -0.469733
At_Bats                0.464663
Shutout                0.450653
Home_Runs              0.438812
Name: Games_Won, dtype: float64
```

Period 41990-2010Dataframe 4(df4) :-

In [26]:
```
df4=df[(df['Year']>=1990)&(df['Year']<2010)]
```

In [27]:
```
df4.describe()
```

Out[27]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	Runs_Scored
count	578.000000	578.000000	578.000000	578.000000	578.000000	578.000000	578.000000
mean	1999.754325	3.124567	158.771626	79.361592	79.365052	79.365052	749.415225
std	5.710387	1.567118	10.763557	5.492618	12.348912	12.324608	94.213964
min	1990.000000	1.000000	112.000000	44.000000	43.000000	40.000000	466.000000
25%	1995.000000	2.000000	162.000000	81.000000	71.000000	71.000000	688.250000
50%	2000.000000	3.000000	162.000000	81.000000	79.000000	79.000000	747.000000
75%	2005.000000	4.000000	162.000000	81.000000	88.000000	88.000000	809.750000
max	2009.000000	7.000000	163.000000	84.000000	116.000000	119.000000	1009.000000

8 rows × 32 columns

In [28]:
```
df4.corr(method='pearson',numeric_only='False')
```

Out[28]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	F
Year	1.000000	-0.107352	0.283988	0.277515	0.124086	0.124330	
Final_Standing	-0.107352	1.000000	0.054707	0.045699	-0.734652	0.784864	
Games_Played	0.283988	0.054707	1.000000	0.980078	0.439008	0.433981	
Unnamed: 7	0.277515	0.045699	0.980078	1.000000	0.434521	0.421092	
Games_Won	0.124086	-0.734652	0.439008	0.434521	1.000000	-0.618811	
Games_Lost	0.124330	0.784864	0.433981	0.421092	-0.618811	1.000000	
Runs_Scored	0.286646	-0.427075	0.473063	0.467861	0.627709	-0.216235	
At_Bats	0.313859	0.019478	0.978408	0.958905	0.456900	0.397169	
Hits	0.319450	-0.189215	0.769363	0.756511	0.554099	0.116928	
Doubles	0.527540	-0.165760	0.528244	0.519716	0.393862	0.066509	
Triples	-0.043209	0.014883	0.158189	0.152510	0.030072	0.108665	
Home_Runs	0.373986	-0.353521	0.283593	0.276738	0.423865	-0.177911	
Walks	0.081930	-0.343058	0.410851	0.407903	0.537761	-0.180357	
Strike_Outs	0.488025	0.063241	0.555172	0.543812	0.137599	0.347899	
Stolen_Bases	-0.261464	-0.062566	0.129099	0.118182	0.165352	-0.053715	
Caught_Stealing	-0.493359	0.118041	0.118987	0.110791	0.019056	0.085206	
Hit_By_Pitch	-0.064956	-0.046295	-0.012764	-0.020509	0.091551	-0.093613	
Sacrifice_Fly	-0.096238	-0.261052	0.124981	0.077768	0.331581	-0.327902	
Runs_Against	0.274440	0.402194	0.449139	0.445515	-0.282918	0.675790	
Earned_Runs	0.318483	0.374340	0.444810	0.442029	-0.261973	0.651068	
Earned_Run_Average	0.191278	0.396296	-0.073155	-0.063100	-0.550992	0.488004	
Complete_Games	-0.607178	0.012466	-0.040015	-0.045660	0.082703	-0.117801	
Shutout	0.030275	-0.276035	0.345723	0.325513	0.533061	-0.231001	
Saves	0.006018	-0.458565	0.380938	0.378986	0.709256	-0.378716	
Infield_Put_Outs	0.263700	0.010630	0.991931	0.972855	0.487229	0.378650	
Hits_Allowed	0.302516	0.290372	0.726720	0.719960	0.012052	0.622535	
Home_Run_Allowed	0.457301	0.159982	0.344681	0.346374	-0.111259	0.412008	
Walks_Allowed	0.087109	0.309262	0.434202	0.418510	-0.146569	0.526540	
Strikeouts_Allowed	0.484901	-0.266267	0.552917	0.538039	0.495095	-0.012486	
Errors	-0.304833	0.303055	0.301507	0.284148	-0.144582	0.407927	
Double_Plays	0.216581	0.187352	0.489225	0.479078	0.051243	0.376302	
Fielding_Percentage	0.602149	-0.234164	0.153049	0.163810	0.272719	-0.138527	

32 rows × 32 columns

Top 8 Variables to find from df4 -

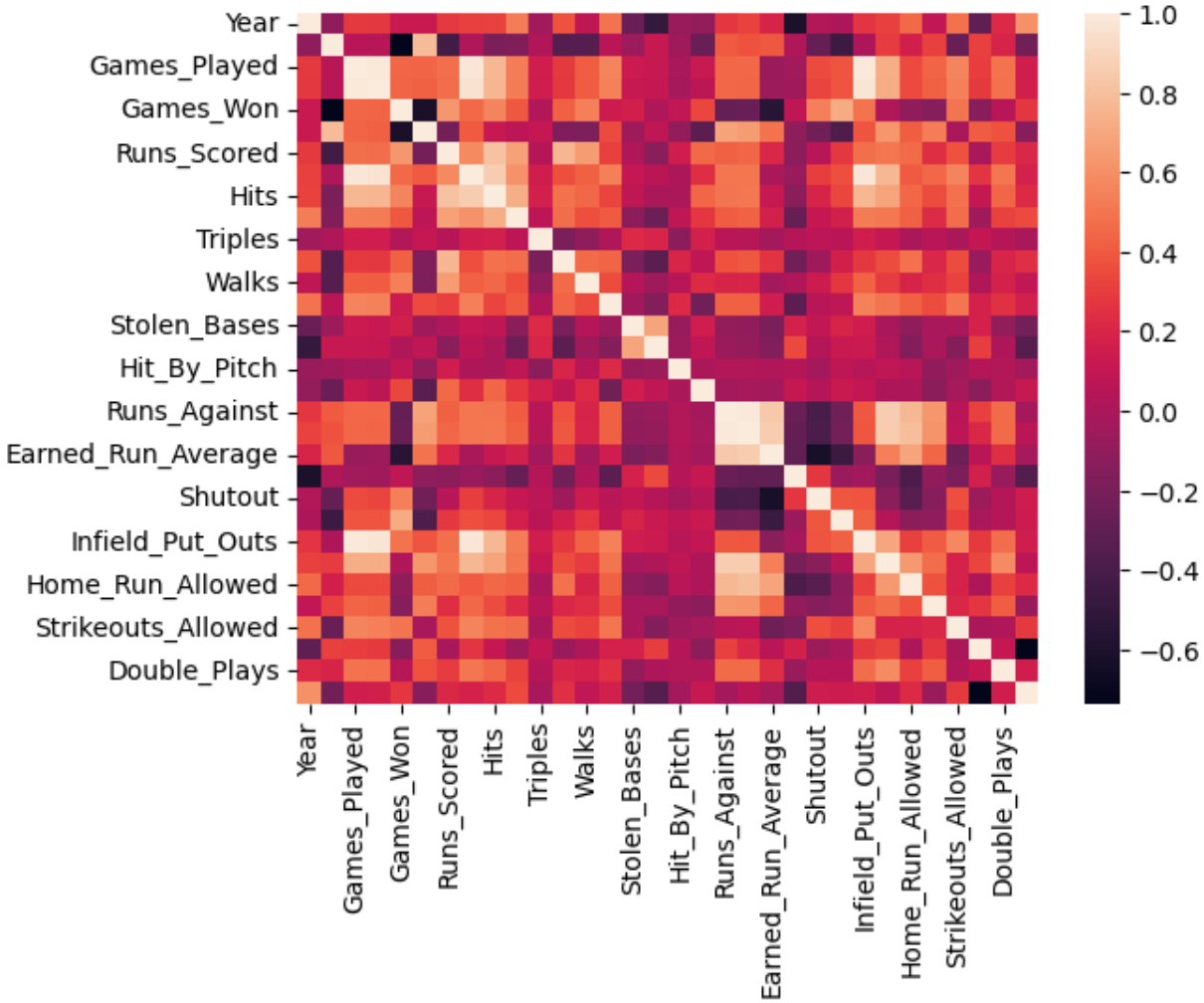
In [102…
```
df4.corr(method='pearson',numeric_only=True).loc['Games_Won'][off_def].sort_values(asc
```

Out[102]:
```
Saves                 0.709256
Runs_Scored           0.627709
Hits                  0.554099
Earned_Run_Average   -0.550992
Walks                 0.537761
Shutout               0.533061
Strikeouts_Allowed    0.495095
Infield_Put_Outs      0.487229
Name: Games_Won, dtype: float64
```

To get the heatmap using dataframe 4 (df4) :-

In [103…
```
sns.heatmap(df4.corr(method='pearson',numeric_only='True'))
```

Out[103]:
```
<Axes: >
```



To get the descriptive statistics of Period 4 :-

In [104…
```
df4.describe()
```

Out[104]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	Runs_Scored
count	578.000000	578.000000	578.000000	578.000000	578.000000	578.000000	578.000000
mean	1999.754325	3.124567	158.771626	79.361592	79.365052	79.365052	749.415225
std	5.710387	1.567118	10.763557	5.492618	12.348912	12.324608	94.213964
min	1990.000000	1.000000	112.000000	44.000000	43.000000	40.000000	466.000000
25%	1995.000000	2.000000	162.000000	81.000000	71.000000	71.000000	688.250000
50%	2000.000000	3.000000	162.000000	81.000000	79.000000	79.000000	747.000000
75%	2005.000000	4.000000	162.000000	81.000000	88.000000	88.000000	809.750000
max	2009.000000	7.000000	163.000000	84.000000	116.000000	119.000000	1009.000000

8 rows × 32 columns

Linear Regression (Histogram & BoxPlot)

Histogram of each top 8 variables of Period 4:-

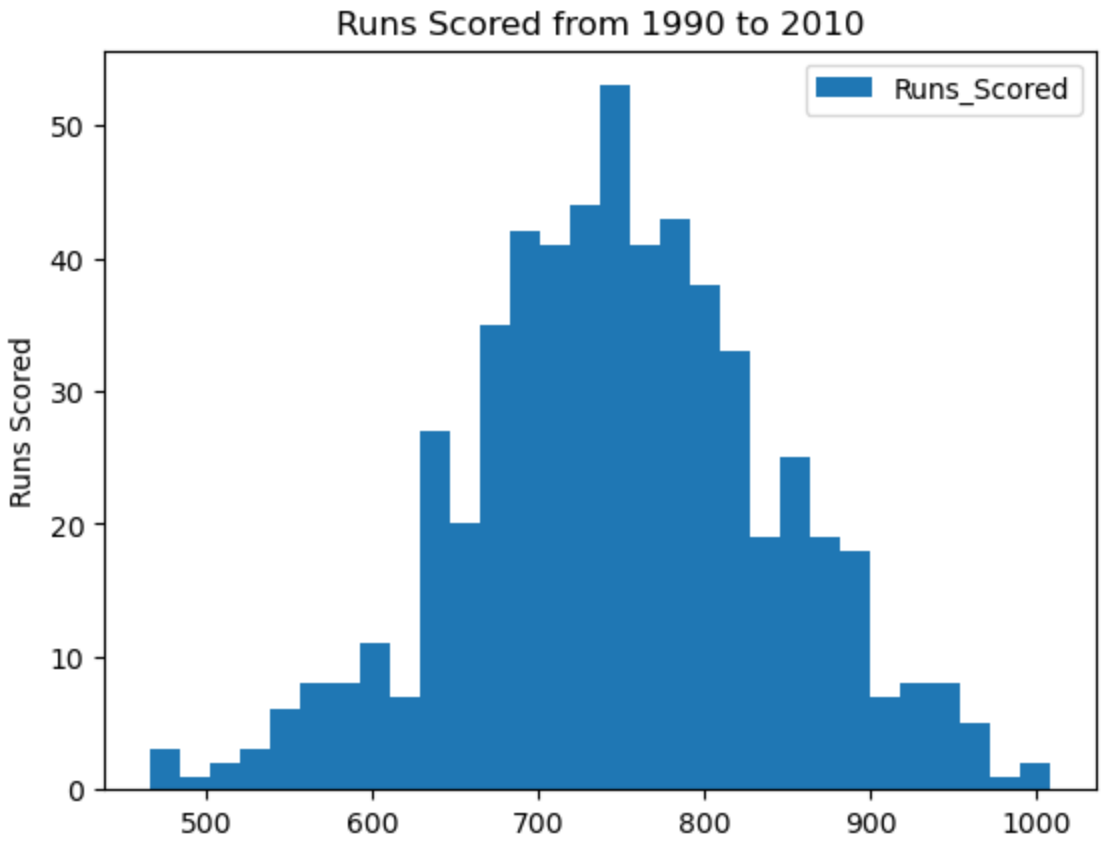
Method 1 to get histogram of "Runs_Scored' of df4:-

In [107…

```
df4.plot(kind='hist', y='Runs_Scored', bins=30 ,ylabel='Runs Scored', title='Runs Scor
```

Out[107]:

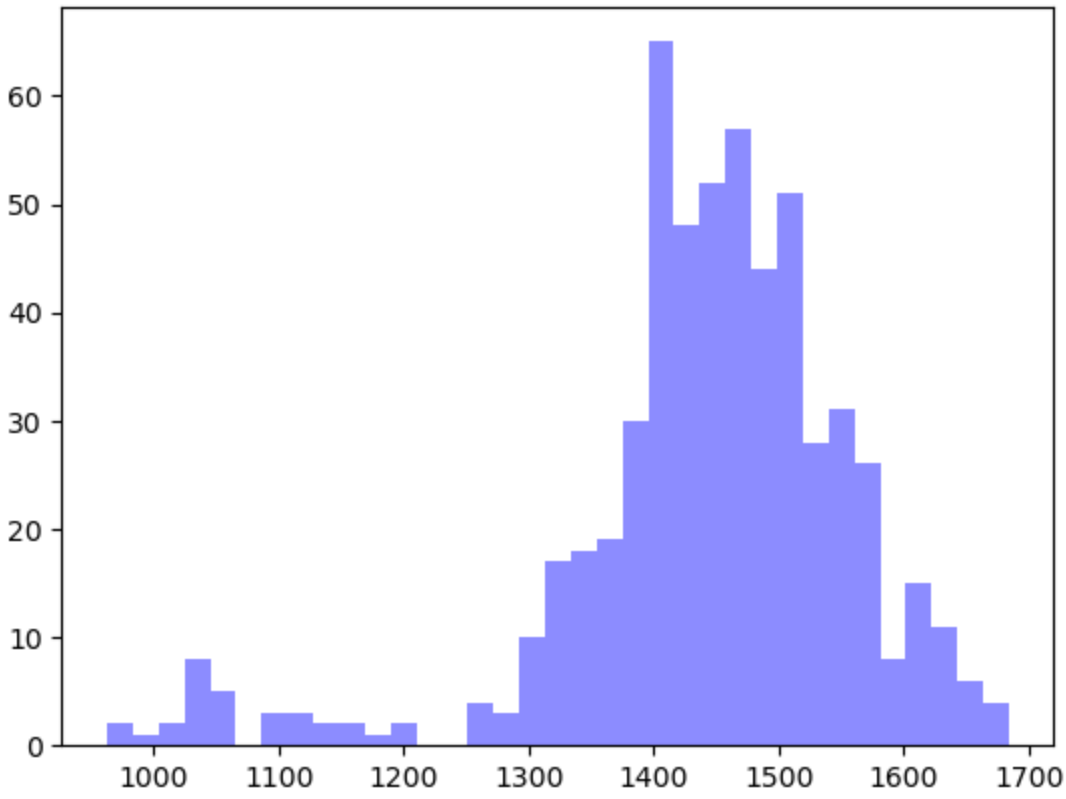
```
<Axes: title={'center': 'Runs Scored from 1990 to 2010'}, ylabel='Runs Scored'>
```



Method2 / Design 2, to get histogram of "Hits' from df4:-

In [109…

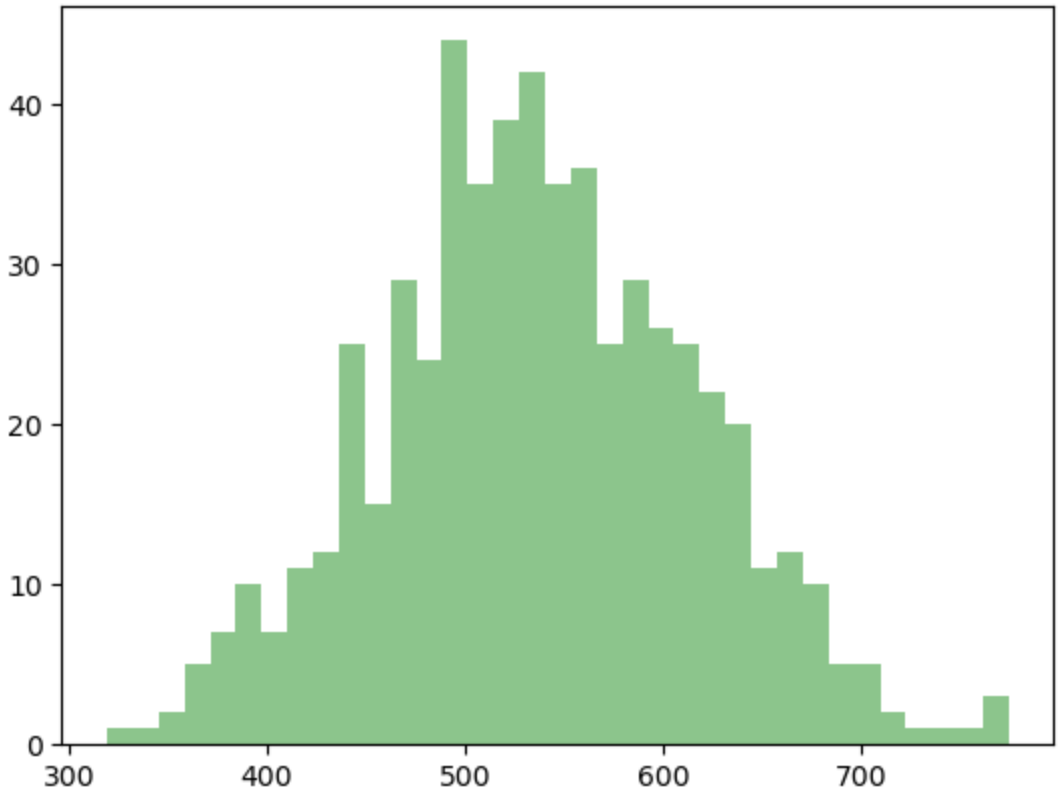
```
plt.hist(df4['Hits'],bins = 35,
         alpha = 0.45, color = 'blue')
plt.show()
```



Method2 / Design 2, to get histogram of 'Walks' from df4:-

In [110…

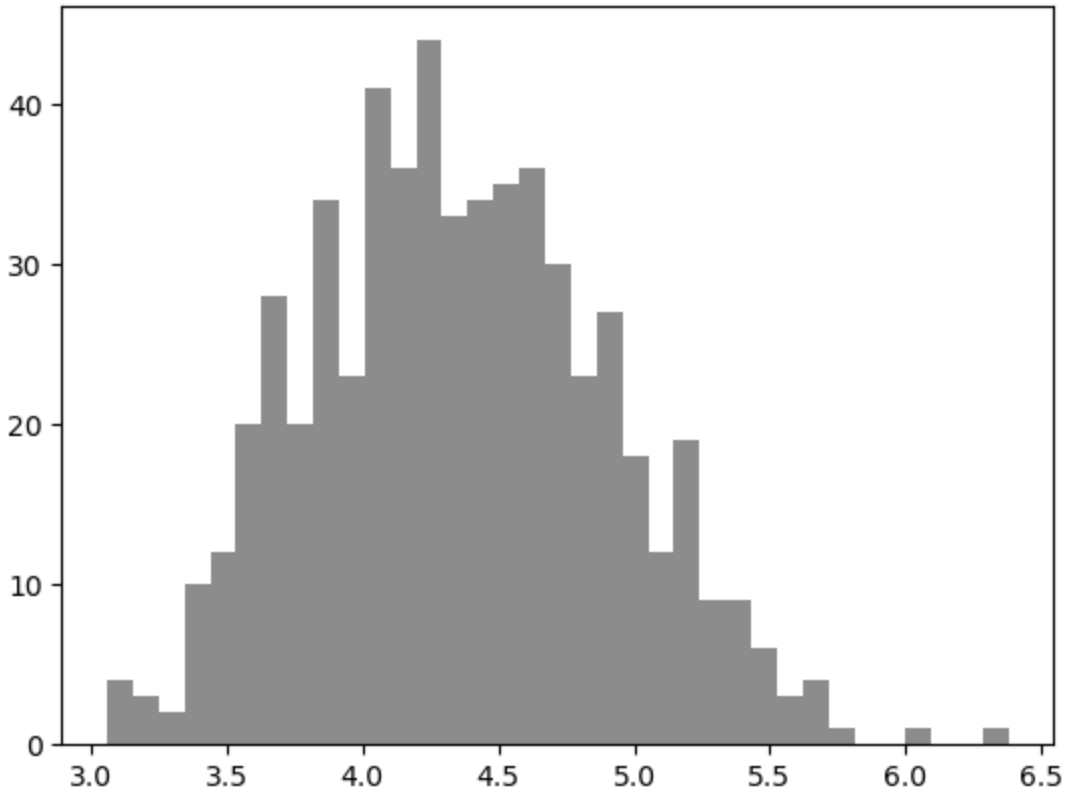
```
plt.hist(df4['Walks'],bins = 35,
         alpha = 0.45, color = 'green')
plt.show()
```



Method2 / Design 2, to get histogram of "Earned_Run_Average' from df4:-

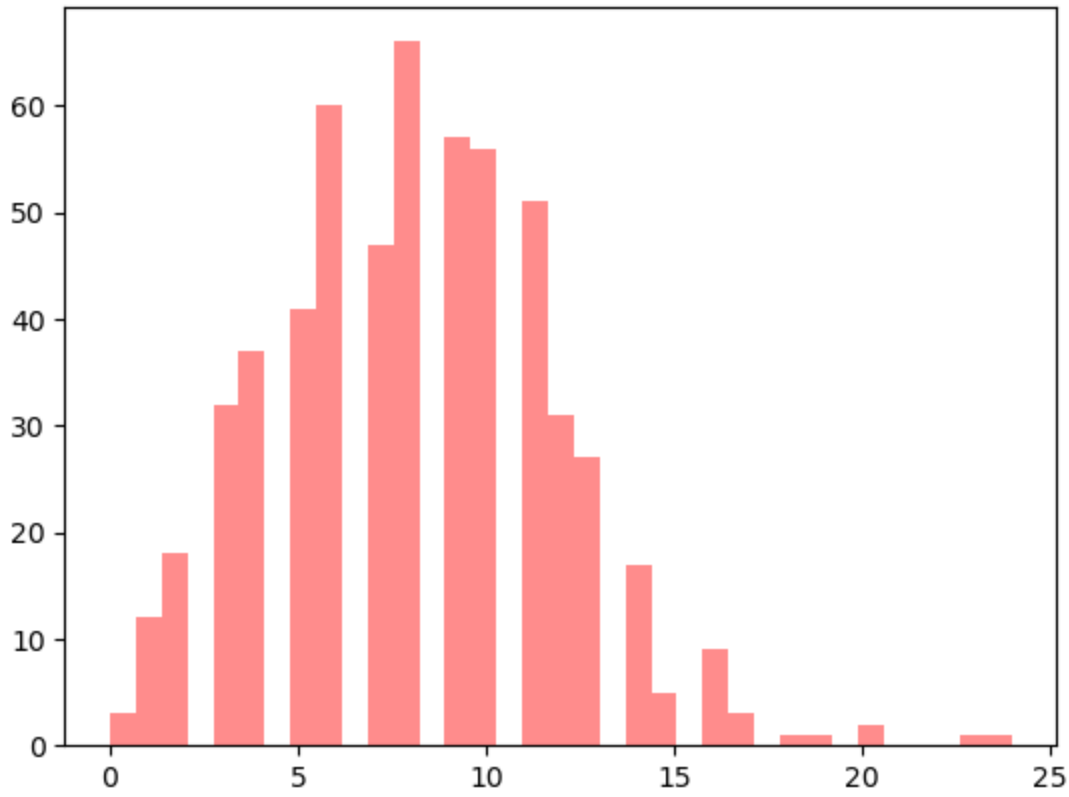
In [111…

```
plt.hist(df4['Earned_Run_Average'],bins = 35,
         alpha = 0.45, color = 'black')
plt.show()
```



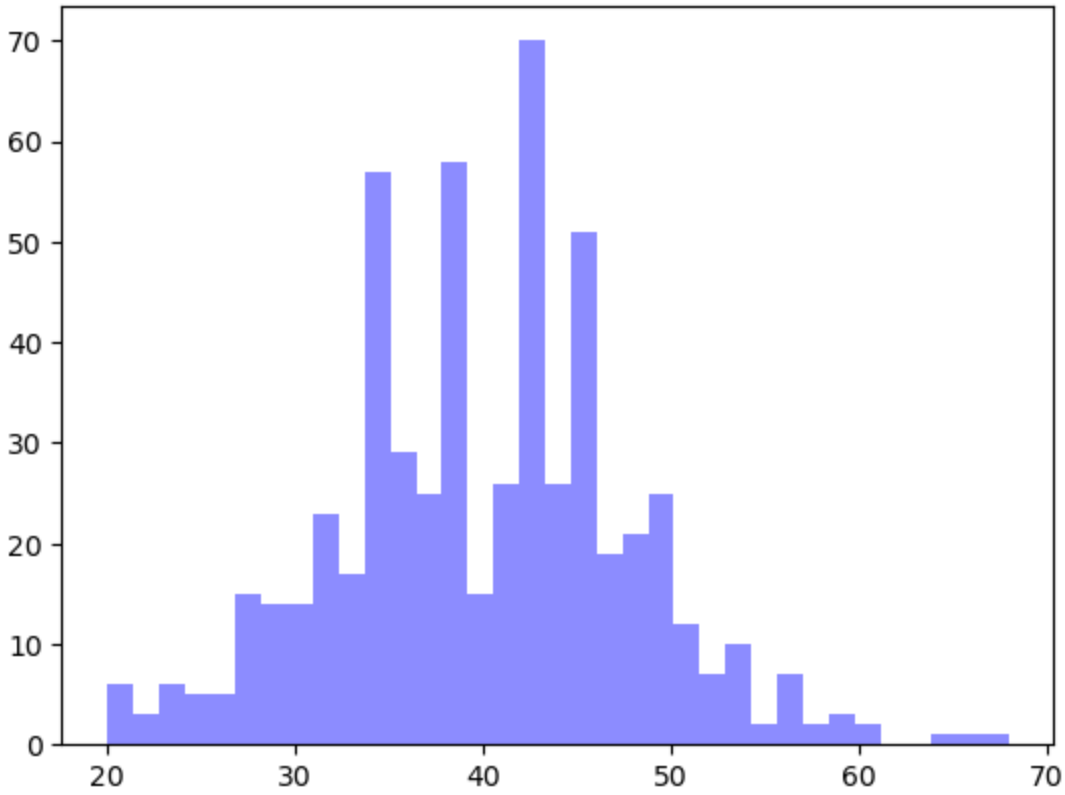
Method2 / Design 2, to get histogram of 'Shutout' from df4:-

In [112…
```
plt.hist(df4['Shutout'],bins = 35,
         alpha = 0.45, color = 'red')
plt.show()
```



Method2 / Design 2, to get histogram of 'Saves' from df4:-

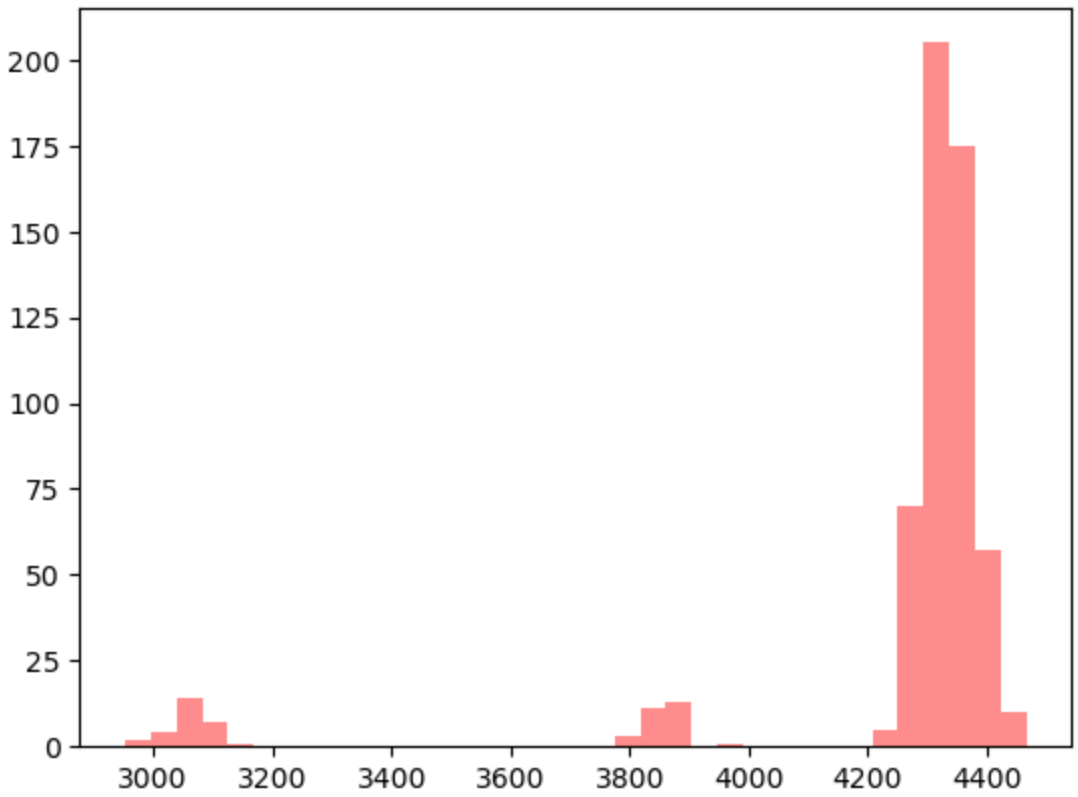
In [113…
```
plt.hist(df4['Saves'],bins = 35,
         alpha = 0.45, color = 'blue')
plt.show()
```



Method2 / Design 2, to get histogram of 'Infield_Put_Outs' from df4:-

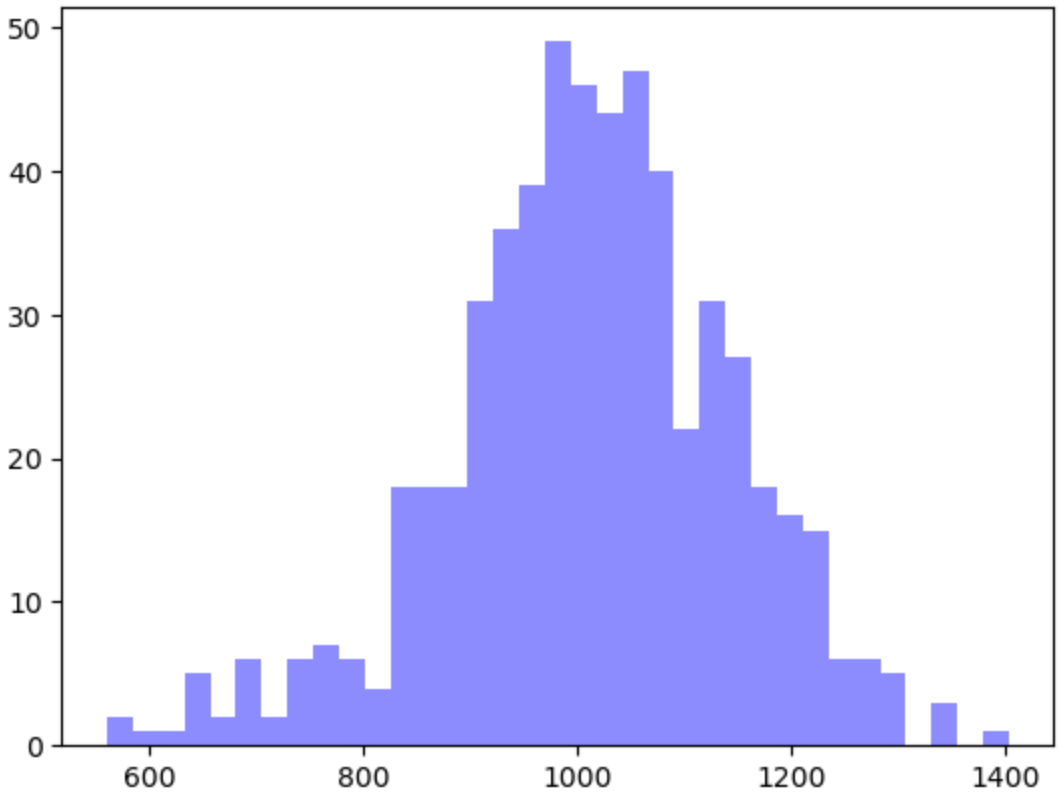
In [114…

```
plt.hist(df4['Infield_Put_Outs'],bins = 35,
         alpha = 0.45, color = 'red')
plt.show()
```



Method2 / Design 2, to get histogram of 'Strikeouts_Allowed' from df4:-

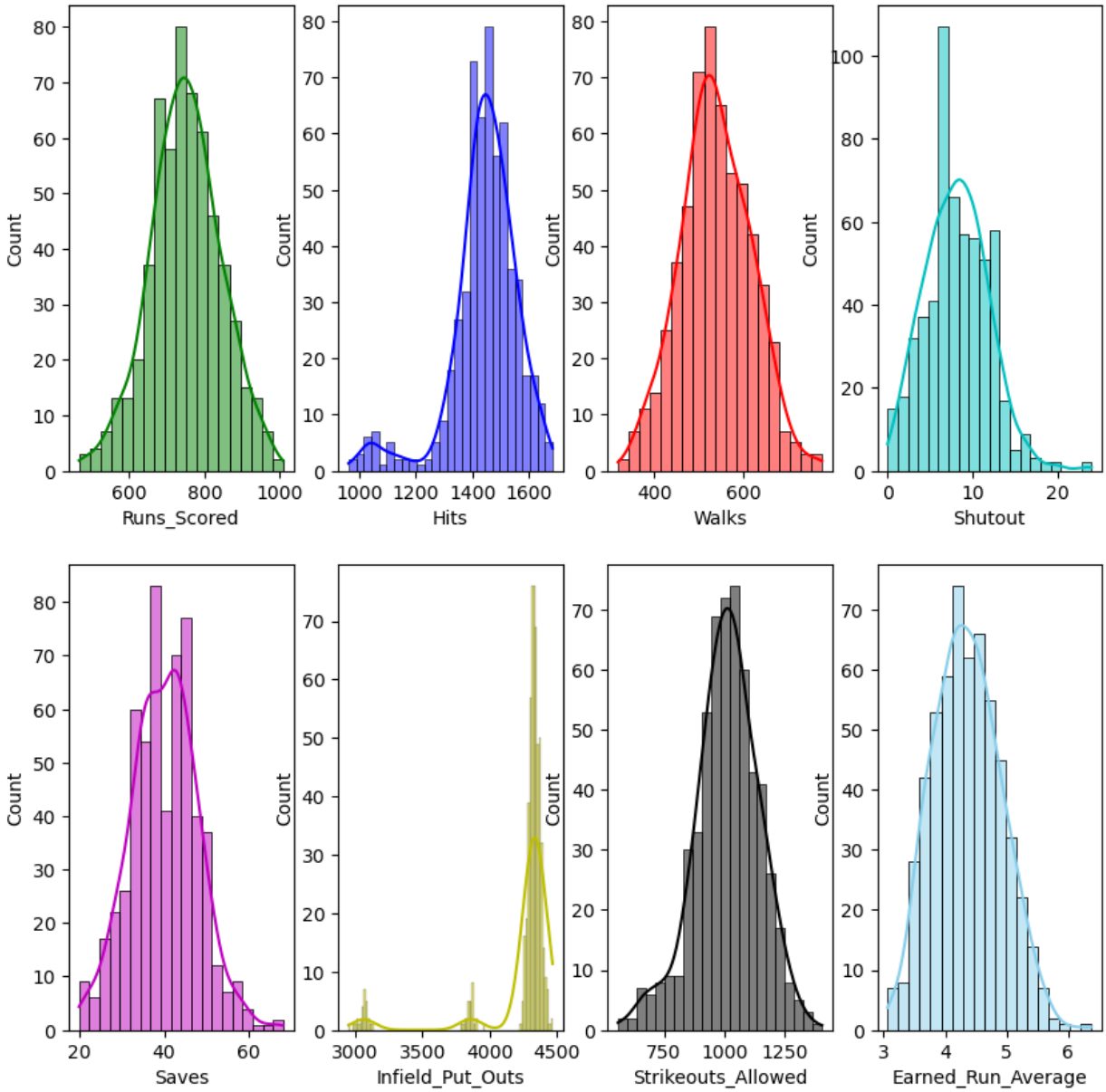
In [115…
```
plt.hist(df4['Strikeouts_Allowed'],bins = 35,
         alpha = 0.45, color = 'blue')
plt.show()
```



To get Histograms together for all top 8 variables of Period 4 :-

In [116…
```
fig, axs=plt.subplots(2,4,figsize=(10,10))

sns.histplot(data=df4,x='Runs_Scored',kde=True,ax=axs[0,0],color='g')

sns.histplot(data=df4,x='Hits',kde=True,ax=axs[0,1],color='b')

sns.histplot(data=df4,x='Walks',kde=True,ax=axs[0,2],color='r')

sns.histplot(data=df4,x='Shutout',kde=True,ax=axs[0,3],color='c')

sns.histplot(data=df4,x='Saves',kde=True,ax=axs[1,0],color='m')

sns.histplot(data=df4,x='Infield_Put_Outs',kde=True,ax=axs[1,1],color='y')

sns.histplot(data=df4,x='Strikeouts_Allowed',kde=True,ax=axs[1,2],color='k')

sns.histplot(data=df4,x='Earned_Run_Average',kde=True,ax=axs[1,3],color='skyblue')
```

Out[116]:
```
<Axes: xlabel='Earned_Run_Average', ylabel='Count'>
```

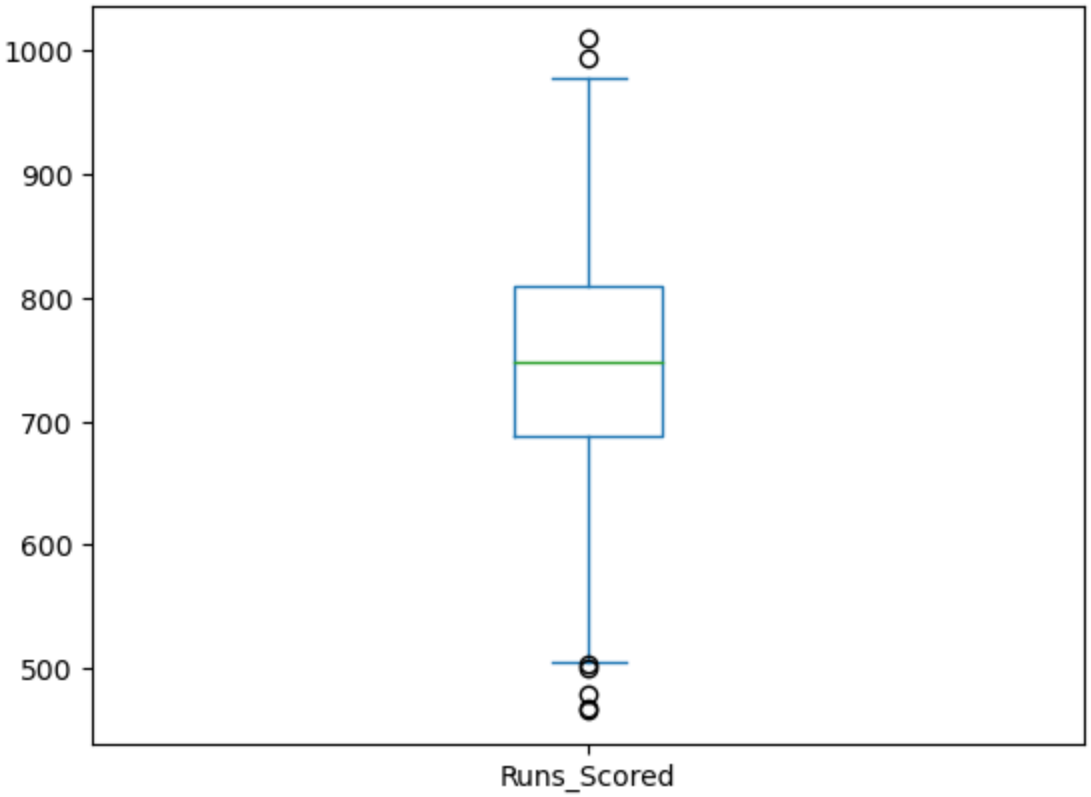


To get BoxPlot for each top 8 variables of Period 4:-

'Runs_Scored' BoxPlot:-

In [117…
```
df4['Runs_Scored'].plot(kind='box')
```

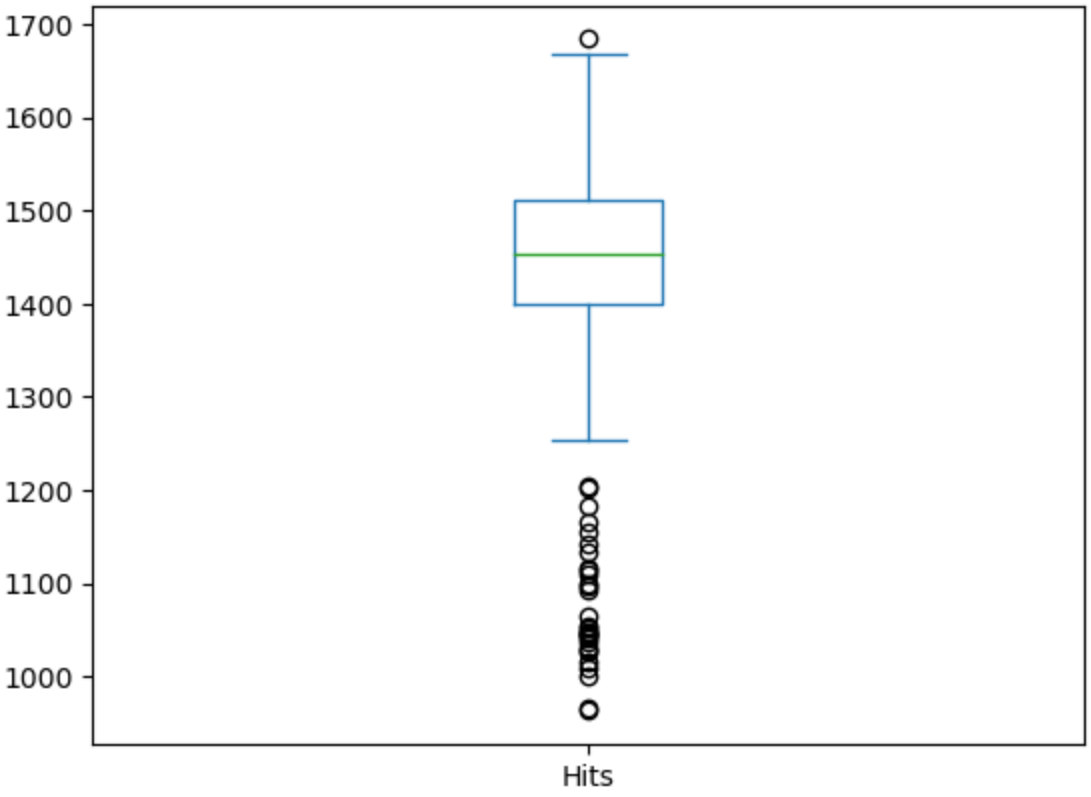
Out[117]:
```
<Axes: >
```



'Hits' BoxPlot:-

In [118…
```
df4['Hits'].plot(kind='box')
```

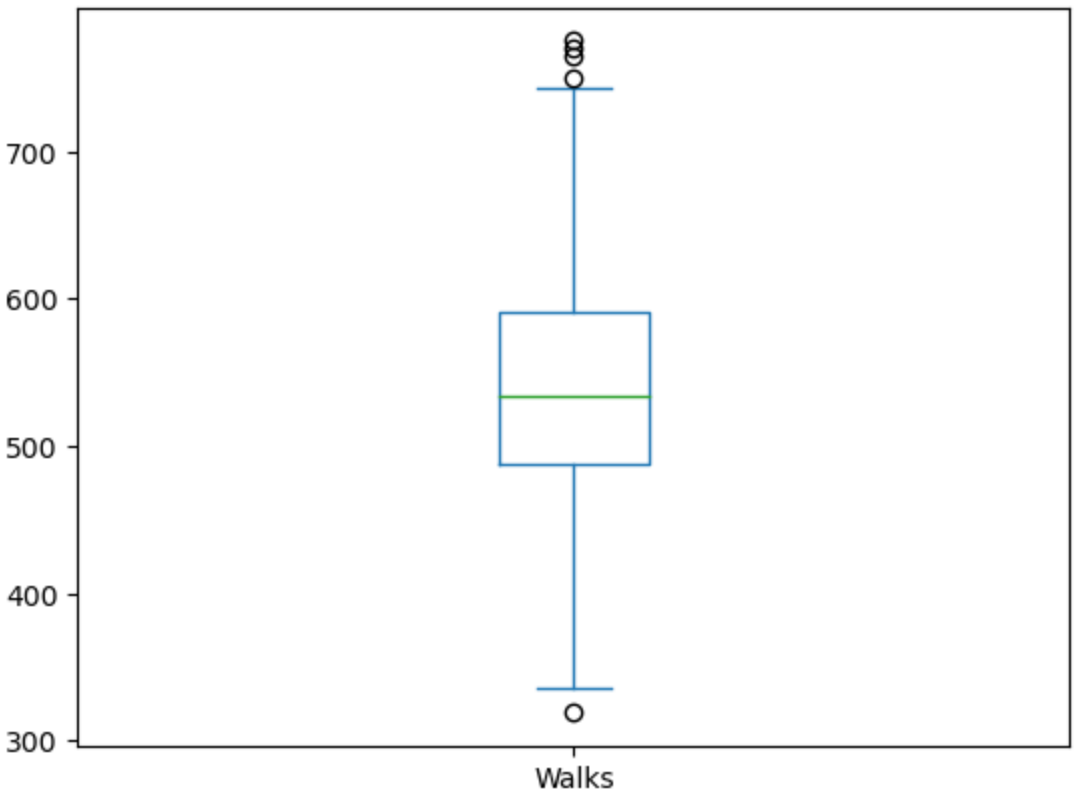
Out[118]:
```
<Axes: >
```



'Walks' BoxPlot:-

In [44]:
```
df4['Walks'].plot(kind='box')
```

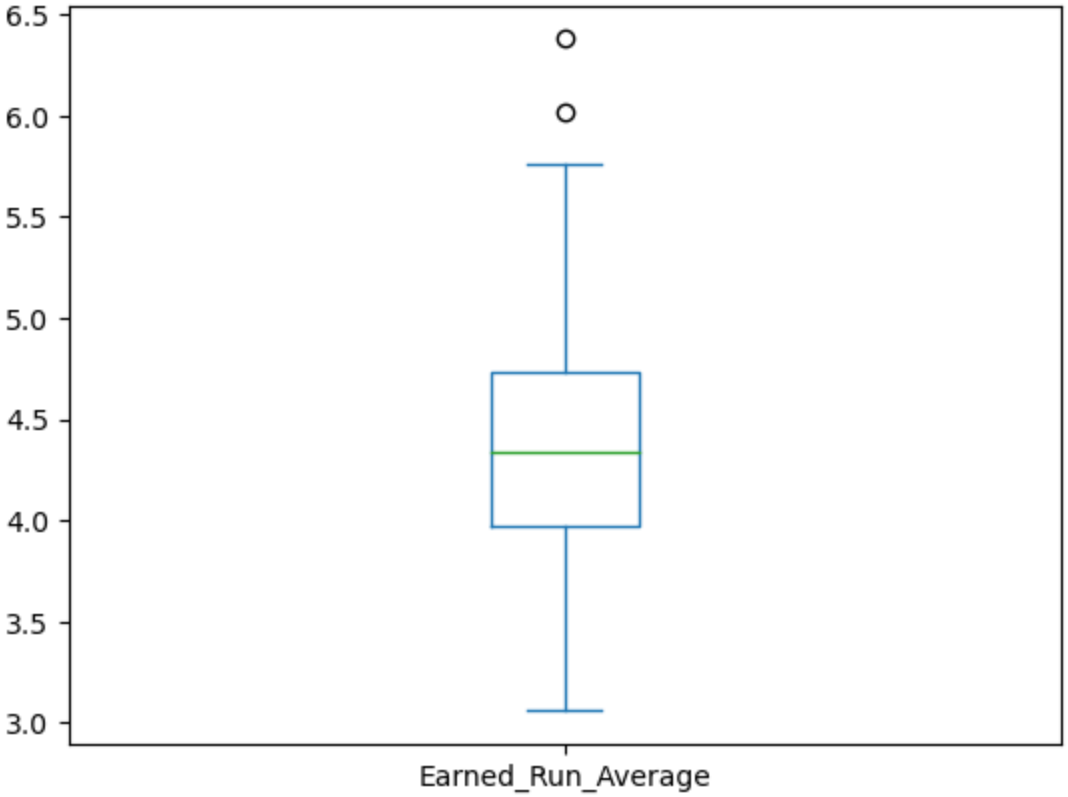
Out[44]: <Axes: >



'Earned_Run_Average' BoxPlot:-

In [119…
```
df4['Earned_Run_Average'].plot(kind='box')
```

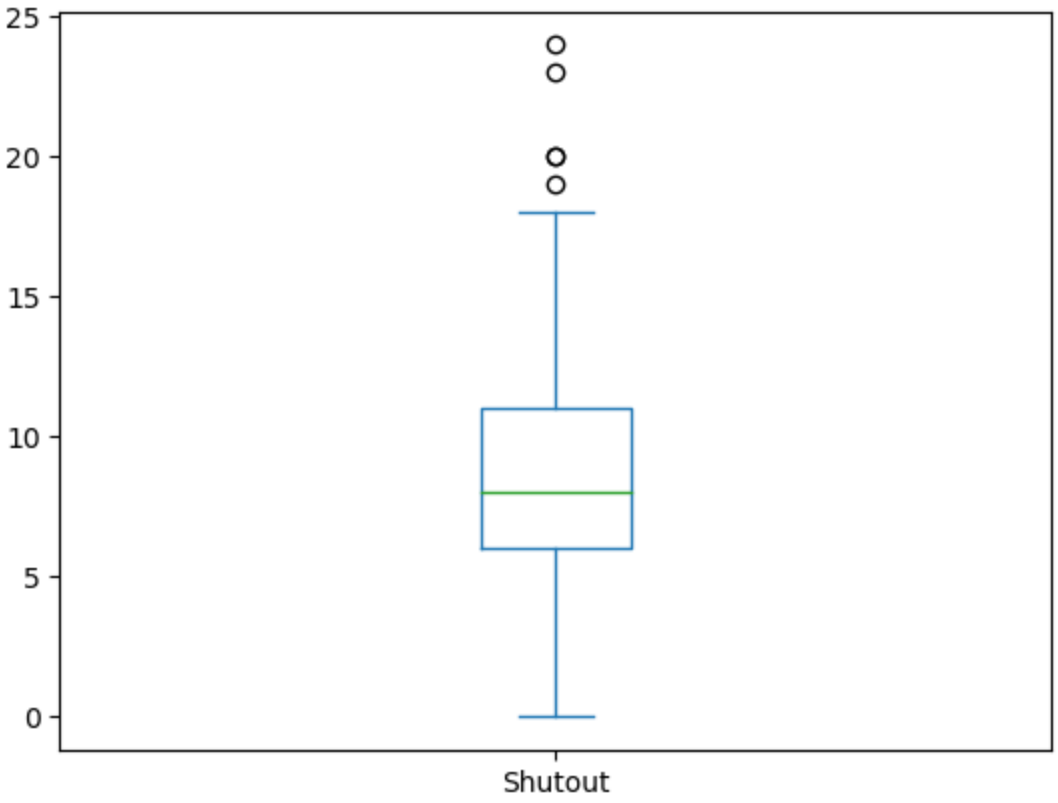
Out[119]: <Axes: >



'Shutout' BoxPlot:-

In [120…
```
df4['Shutout'].plot(kind='box')
```

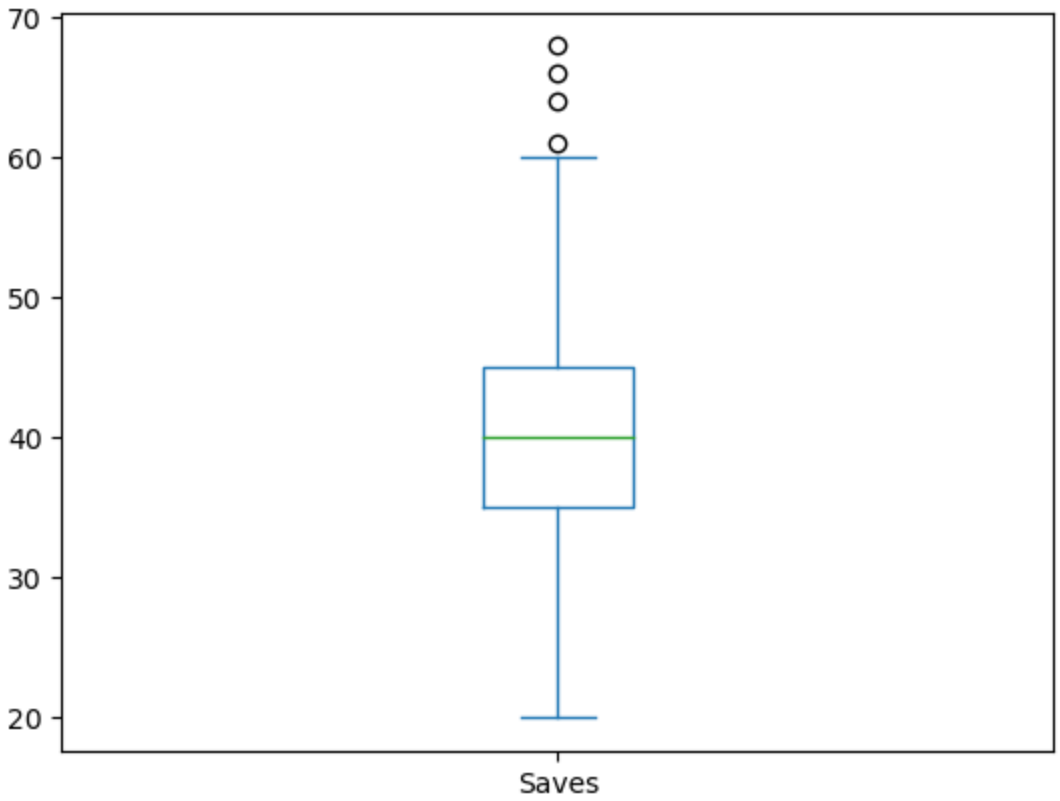
Out[120]:
```
<Axes: >
```



'Saves' BoxPlot:-

In [121…
```
df4['Saves'].plot(kind='box')
```

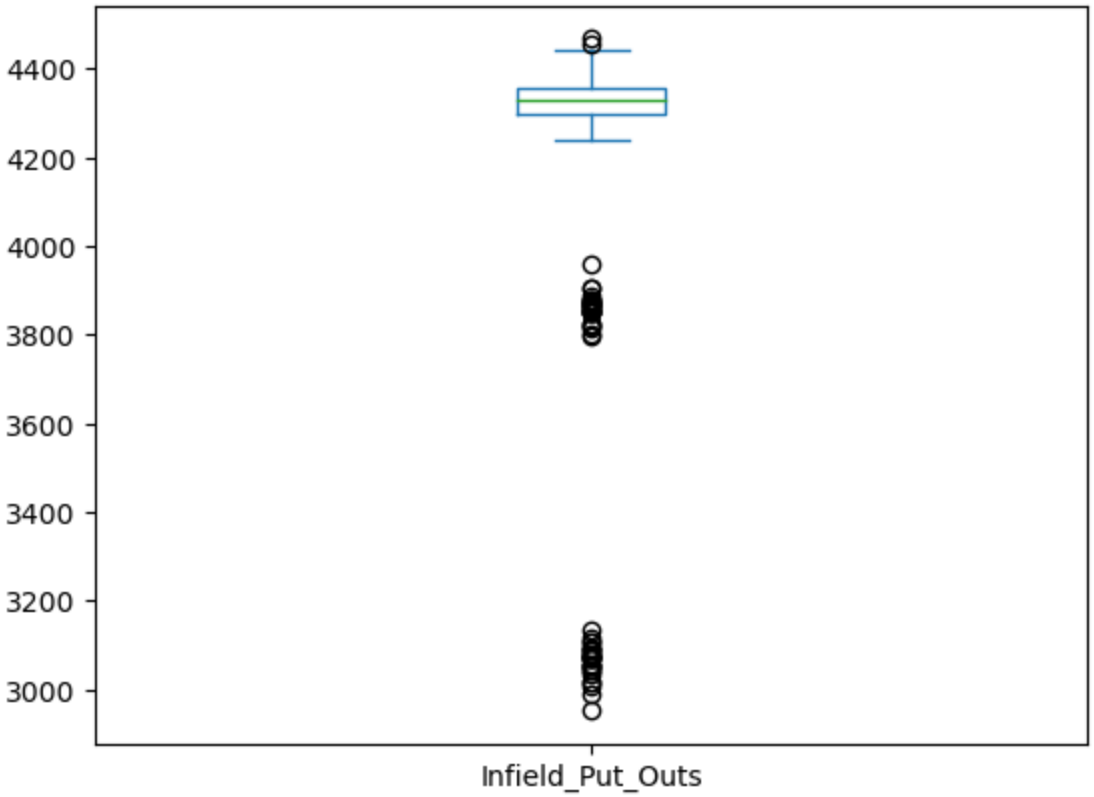
Out[121]:
```
<Axes: >
```



'Infield_Put_Outs' BoxPlot:-

In [123…
```
df4['Infield_Put_Outs'].plot(kind='box')
```

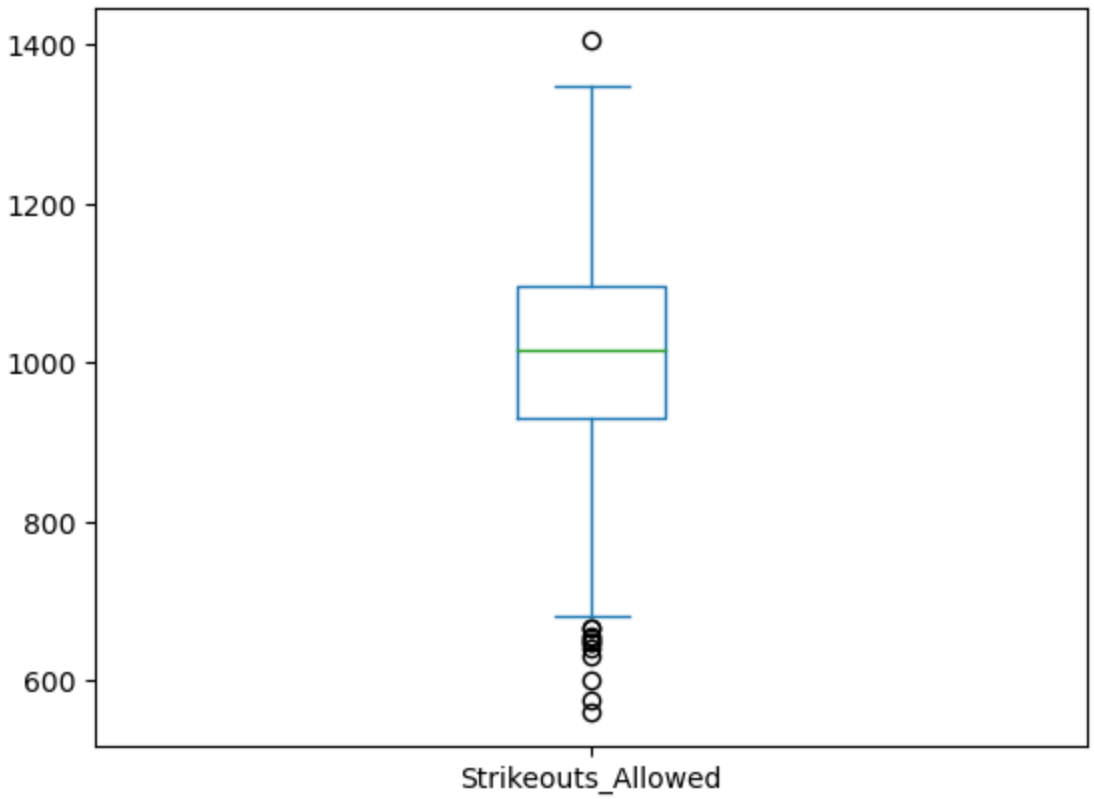
Out[123]:
```
<Axes: >
```



'Strikeouts_Allowed' BoxPlot:-

In [124…
```
df4['Strikeouts_Allowed'].plot(kind='box')
```

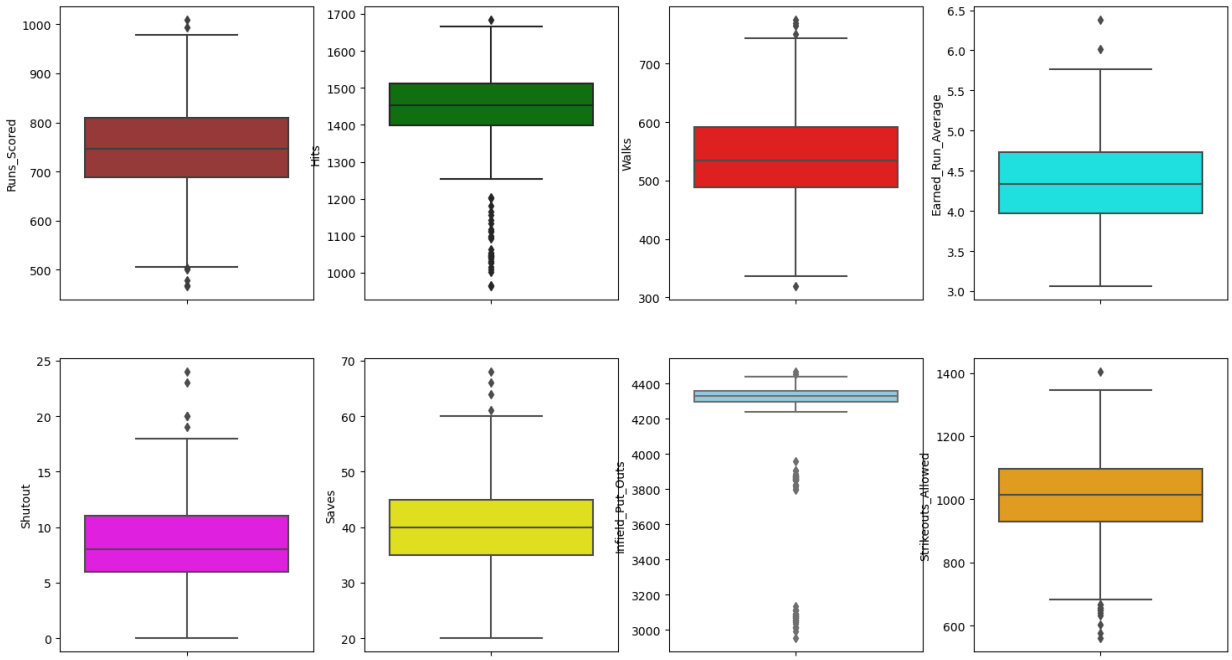
Out[124]:
```
<Axes: >
```



BoxPlot for top 8 variables of Period 4 all together in an one output:-

In [125…
```
fig, axes = plt.subplots(2, 4, figsize=(18, 10))
sns.boxplot(ax=axes[0, 0], data=df4, y='Runs_Scored', color='brown')
sns.boxplot(ax=axes[0, 1], data=df4,  y='Hits',color='green')
sns.boxplot(ax=axes[0, 2], data=df4,  y='Walks',color='red')
sns.boxplot(ax=axes[0, 3], data=df4, y='Earned_Run_Average',color='cyan')
sns.boxplot(ax=axes[1, 0], data=df4, y='Shutout',color='magenta')
sns.boxplot(ax=axes[1, 1], data=df4,  y='Saves',color='yellow')
sns.boxplot(ax=axes[1, 2], data=df4,  y='Infield_Put_Outs',color='skyblue')
sns.boxplot(ax=axes[1, 3], data=df4,  y='Strikeouts_Allowed',color='orange')
```

Out[125]:
```
<Axes: ylabel='Strikeouts_Allowed'>
```



Comment on Visual Shape of each Distribution Variable:-

1. Runs_Scored:- In my guess, It is Symmetric (Bell Shaped)

2. Hits :- Skewed Left (negatively skewed)

3. Walks :- Symmetric (Bell Shaped)

4. Earned_Run_Average :- Symmetric (Bell Shaped)

5. Shutout :- Symmetric (Bell Shaped) or Skewed Right

6. Saves :- Symmetric (Bell Shaped)

7. Infield_put_outs:- Skewed Left (negatively skewed)

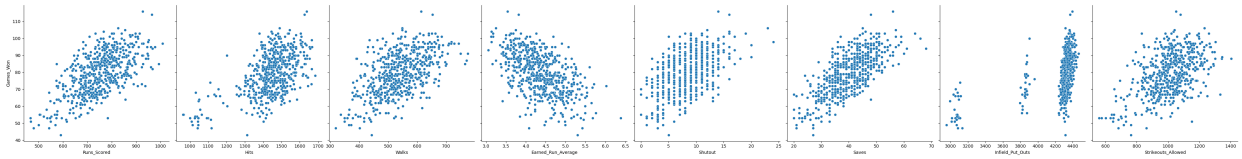
8. Strikeouts_Allowed :- Symmetric (Bell Shaped)

To get paired scattered plots :-

In [126…
```
warnings.filterwarnings("ignore", category=UserWarning)
```

In [127…
```
sns.pairplot(df4,x_vars=['Runs_Scored','Hits','Walks','Earned_Run_Average','Shutout','
```

Out[127]: <seaborn.axisgrid.PairGrid at 0x24fd1266850>

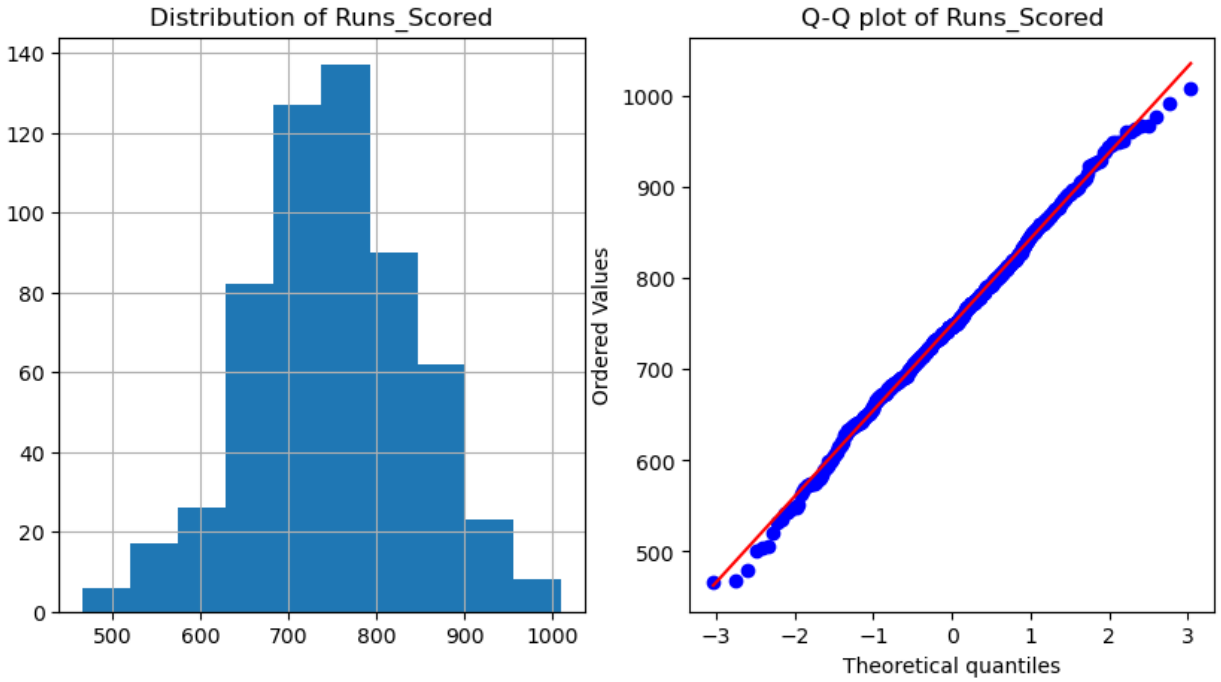


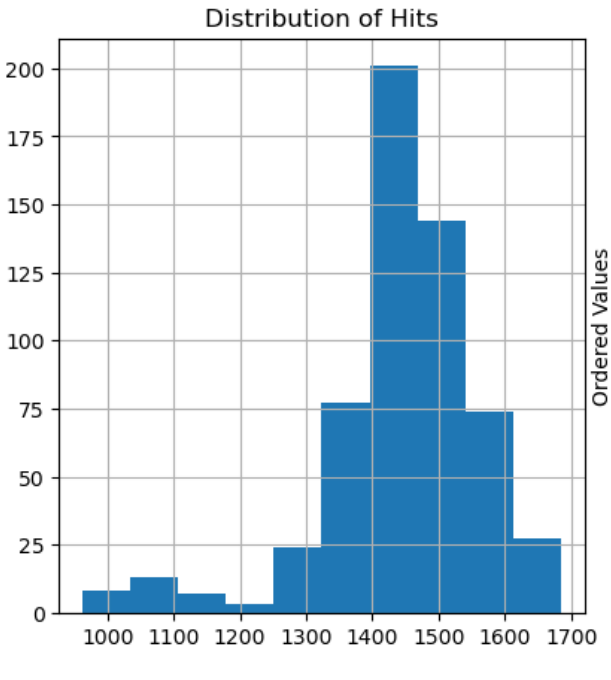
In [128…
```
warnings.resetwarnings()
```

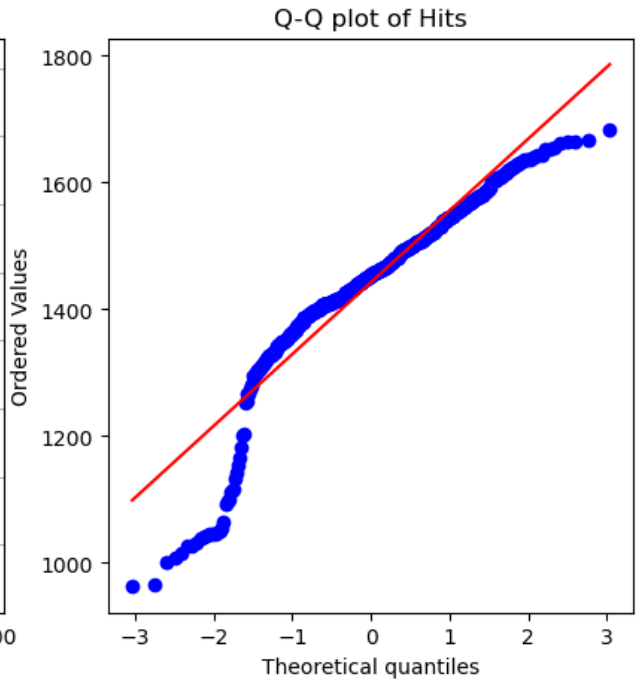
To get QQ plot of df4 :-

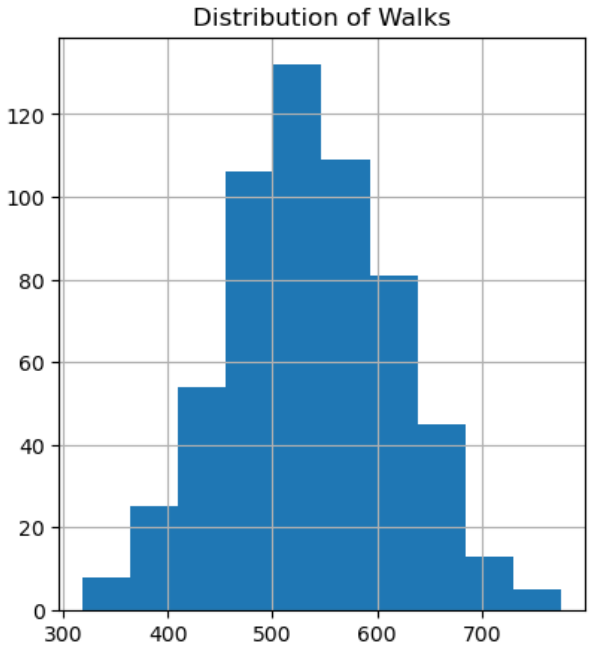
In [129…
```
import pylab
import scipy.stats as stats
```

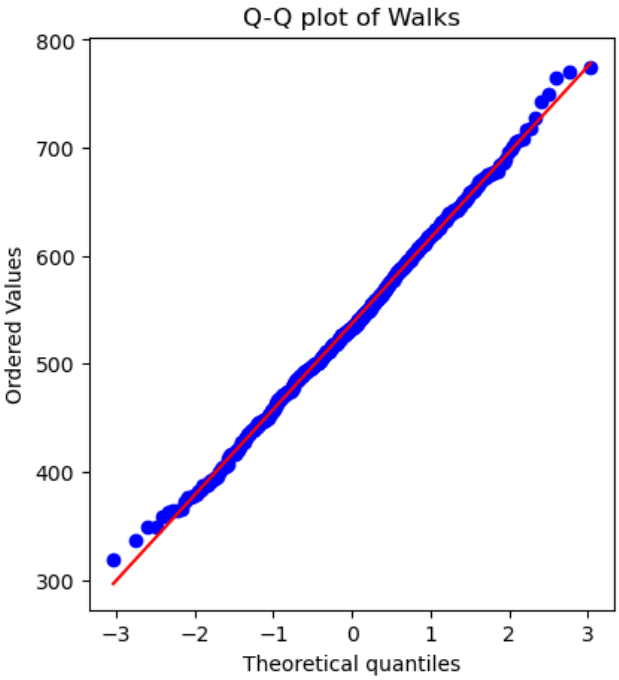
In [130…
```
for var in ['Runs_Scored', 'Hits', 'Walks', 'Shutout', 'Saves', 'Infield_Put_Outs','St
    plt.figure(figsize=(10,5))

    plt.subplot(1, 2, 1)
    df4[var].hist()
    plt.title('Distribution of '+ var)

    plt.subplot(1, 2, 2)
    stats.probplot(df4[var], dist="norm", plot=pylab)
    plt.title('Q-Q plot of '+ var)

    plt.show()
```

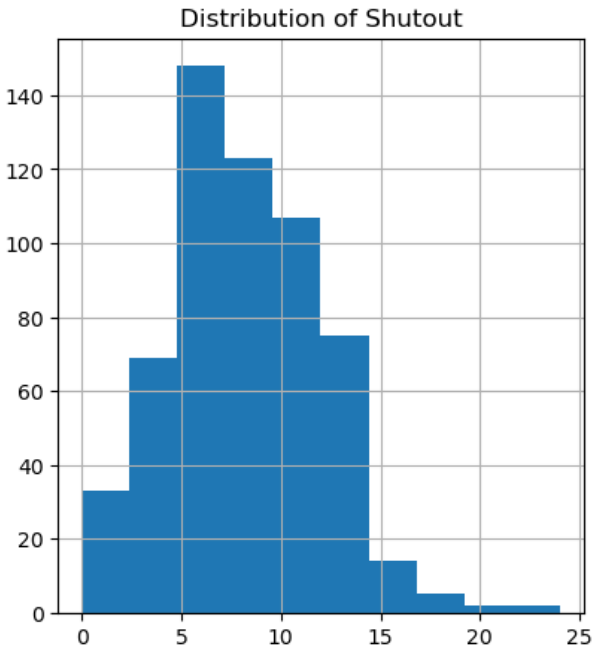


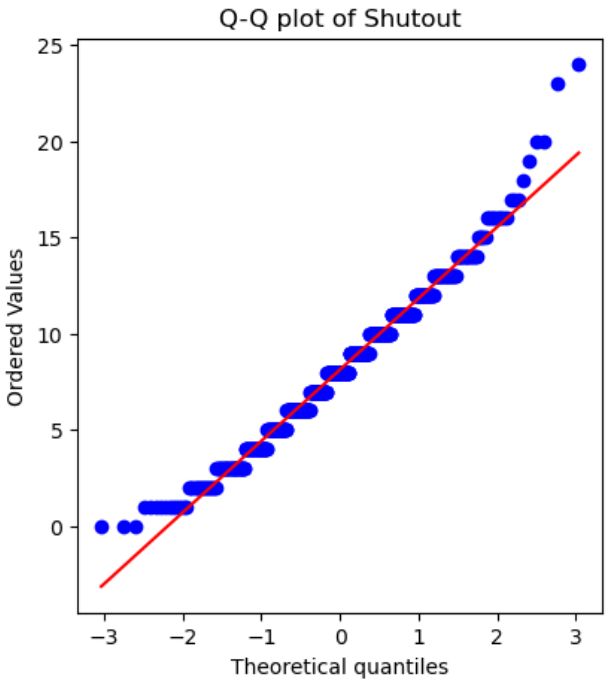

Distribution of Hits
200
175
150
125
100
75
50
25
0
1000 1100 1200 1300 1400 1500 1600 1700

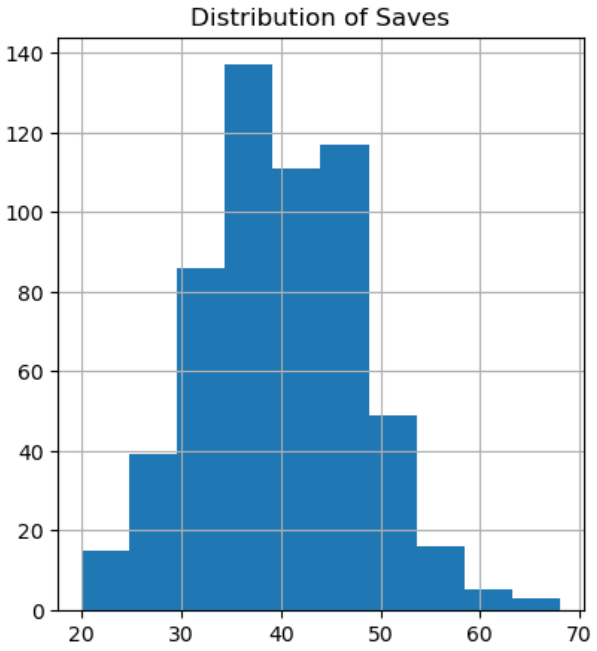

Q-Q plot of Hits
Ordered Values
1800
1600
1400
1200
1000
−3 −2 −1 0 1 2 3
Theoretical quantiles

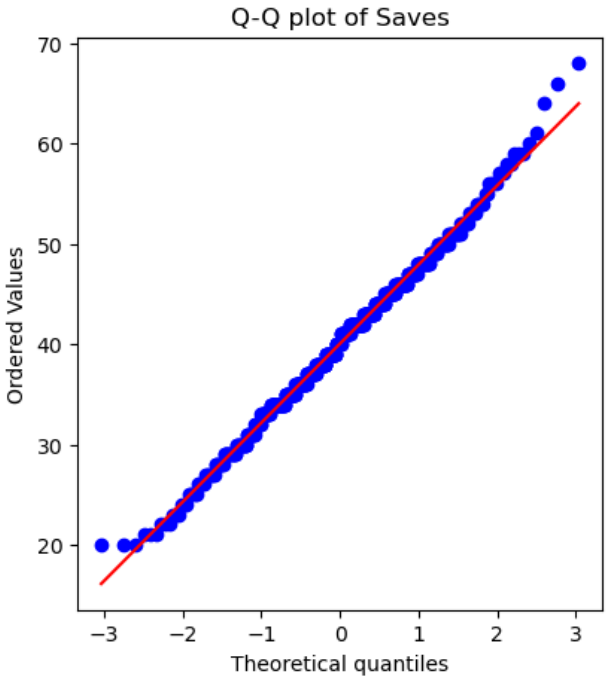

Distribution of Walks
120
100
80
60
40
20
0
300 400 500 600 700

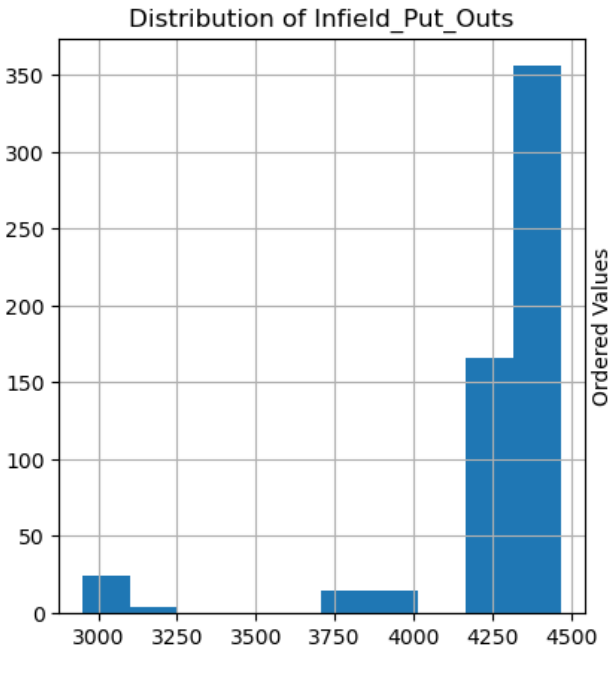

Q-Q plot of Walks
Ordered Values
800
700
600
500
400
300
−3 −2 −1 0 1 2 3
Theoretical quantiles

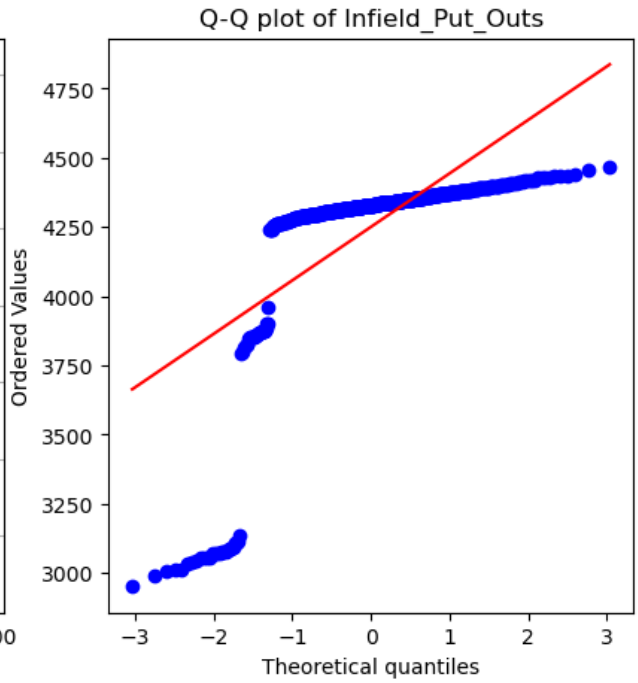

Distribution of Shutout
0
20
40
60
80
100
120
140
0
5
10
15
20
25

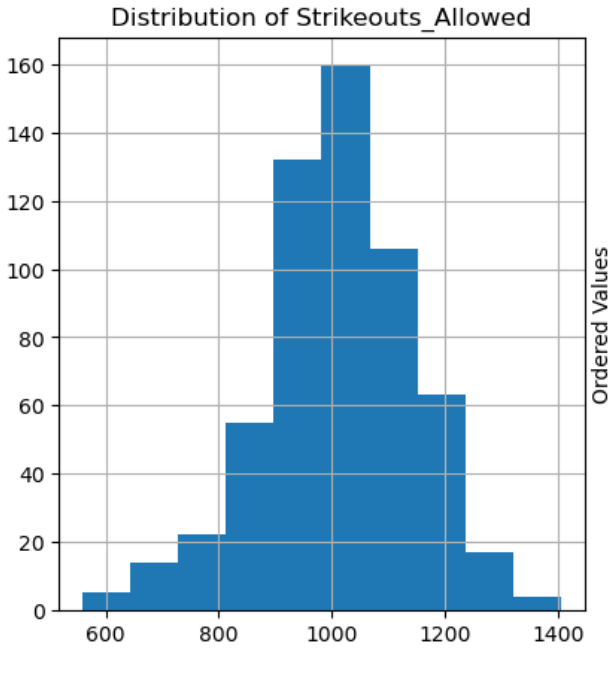

Q-Q plot of Shutout
Ordered Values
Theoretical quantiles
25
20
15
10
5
0
−3
−2
−1
0
1
2
3

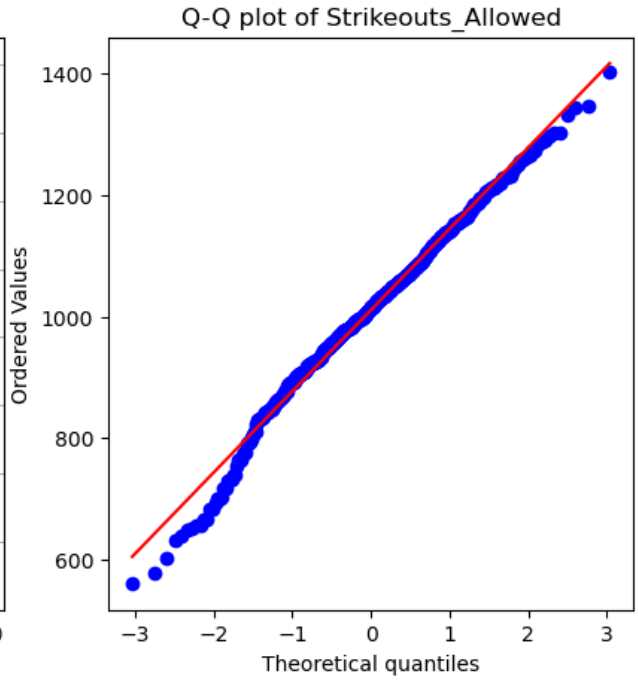

Distribution of Saves
0
20
40
60
80
100
120
140
20
30
40
50
60
70

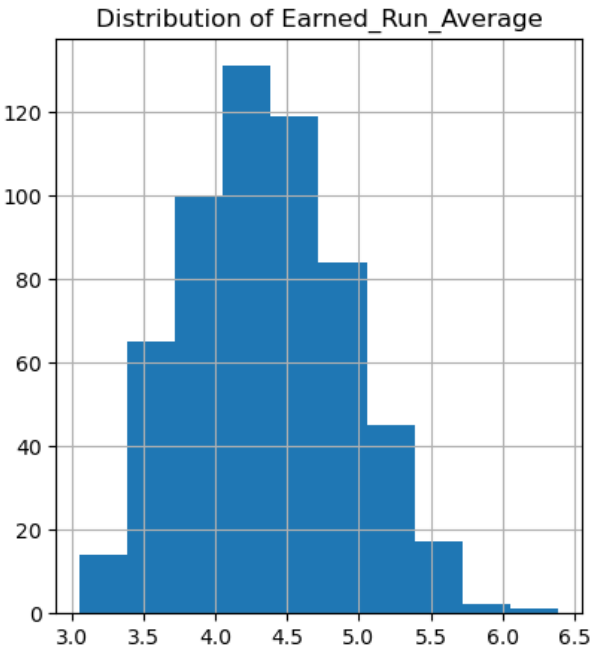

Q-Q plot of Saves
Ordered Values
Theoretical quantiles
70
60
50
40
30
20
−3
−2
−1
0
1
2
3

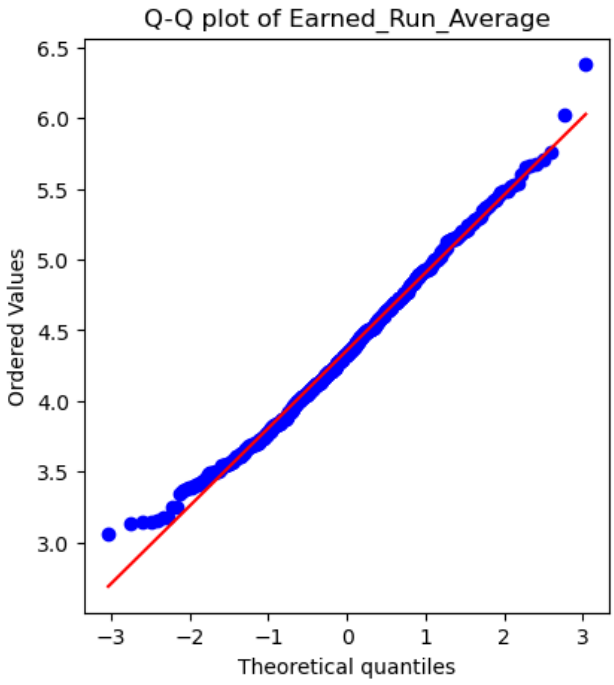

Distribution of Infield_Put_Outs
350
300
250
200
150
100
50
0
3000
3250
3500
3750
4000
4250
4500


Q-Q plot of Infield_Put_Outs
Ordered Values
4750
4500
4250
4000
3750
3500
3250
3000
−3
−2
−1
0
1
2
3
Theoretical quantiles


Distribution of Strikeouts_Allowed
160
140
120
100
80
60
40
20
0
600
800
1000
1200
1400


Q-Q plot of Strikeouts_Allowed
Ordered Values
1400
1200
1000
800
600
−3
−2
−1
0
1
2
3
Theoretical quantiles





Model Validation :-

Train/Test data of df4 dataframe(train test split is a model validation process that allows you to simulate how your model would perform with new or unseen data) :-

In [131…
```
x_train,x_test,y_train,y_test=train_test_split(df4,df4['Games_Won'],train_size=0.7,rar
```

In [132…
```
x_train.describe()
```

Out[132]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	Runs_Scored
count	404.000000	404.000000	404.000000	404.000000	404.000000	404.000000	404.000000
mean	1999.539604	3.175743	158.898515	79.418317	79.163366	79.690594	751.759901
std	5.602721	1.574078	10.393838	5.328025	12.240073	12.393900	95.483252
min	1990.000000	1.000000	112.000000	44.000000	43.000000	40.000000	466.000000
25%	1995.000000	2.000000	162.000000	81.000000	70.000000	71.000000	687.500000
50%	2000.000000	3.000000	162.000000	81.000000	79.000000	79.000000	749.500000
75%	2004.000000	4.000000	162.000000	81.000000	88.000000	88.000000	810.250000
max	2009.000000	7.000000	163.000000	84.000000	116.000000	119.000000	1009.000000

8 rows × 32 columns

In [133…
```
x_test.describe()
```

Out[133]:

	Year	Final_Standing	Games_Played	Unnamed: 7	Games_Won	Games_Lost	Runs_Scored
count	174.000000	174.000000	174.000000	174.000000	174.000000	174.000000	174.000000
mean	2000.252874	3.005747	158.477011	79.229885	79.833333	78.609195	743.971264
std	5.939421	1.548809	11.602623	5.870867	12.621242	12.163963	91.236175
min	1990.000000	1.000000	112.000000	53.000000	47.000000	46.000000	479.000000
25%	1995.000000	2.000000	162.000000	81.000000	71.000000	70.000000	690.000000
50%	2001.000000	3.000000	162.000000	81.000000	79.000000	78.500000	743.000000
75%	2005.000000	4.000000	162.000000	81.000000	88.750000	88.000000	807.250000
max	2009.000000	7.000000	163.000000	84.000000	114.000000	106.000000	965.000000

8 rows × 32 columns

To get the Summary of final model:-

In [134…

```
lm1=smf.ols(formula='Games_Won ~ Runs_Scored+Earned_Run_Average+Shutout+Saves', data=d
lm1.summary()
```

Out[134]:

OLS Regression Results

Dep. Variable:	Games_Won	**R-squared:**	0.923
Model:	OLS	**Adj. R-squared:**	0.923
Method:	Least Squares	**F-statistic:**	1722.
Date:	Tue, 19 Dec 2023	**Prob (F-statistic):**	1.24e-317
Time:	01:12:43	**Log-Likelihood:**	-1530.8
No. Observations:	578	**AIC:**	3072.
Df Residuals:	573	**BIC:**	3093.
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	47.6309	2.142	22.234	0.000	43.423	51.838
Runs_Scored	0.0867	0.002	49.455	0.000	0.083	0.090
Earned_Run_Average	-11.7491	0.388	-30.249	0.000	-12.512	-10.986
Shutout	0.2443	0.050	4.838	0.000	0.145	0.344
Saves	0.3989	0.023	17.536	0.000	0.354	0.444

Omnibus:	0.497	**Durbin-Watson:**	2.073
Prob(Omnibus):	0.780	**Jarque-Bera (JB):**	0.365
Skew:	0.048	**Prob(JB):**	0.833
Kurtosis:	3.077	**Cond. No.**	1.15e+04

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.15e+04. This might indicate that there are strong multicollinearity or other numerical problems.

To do the model testing :-

In [135…

```
lm1_predict=lm1.predict(x_test)
predict_values=pd.concat([x_test['Games_Won'],lm1_predict],axis=1)
predict_values.columns=['actual_Games_Won','predicted_Games_Won']
predict_values['residual']=predict_values['actual_Games_Won']-predict_values['predicte
predict_values.head()
```

Out[135]:

	actual_Games_Won	predicted_Games_Won	residual
2239	98	98.077729	-0.077729
2466	86	86.556862	-0.556862
2397	84	85.419498	-1.419498
2457	92	91.598573	0.401427
2527	88	88.178492	-0.178492

In [136…

```
mae=metrics.mean_absolute_error(predict_values['actual_Games_Won'], predict_values['pr
mse=metrics.mean_squared_error(predict_values['actual_Games_Won'], predict_values['pre
rmse=np.sqrt(metrics.mean_squared_error(predict_values['actual_Games_Won'], predict_va
print('Mean Absolute Error', mae)
print('Mean Suare Error ', mse)
print('Root Mean Squared Error', rmse)
```

```
Mean Absolute Error 2.624246108829727
Mean Suare Error  10.819095853248406
Root Mean Squared Error 3.289239403456125
```

To get Predictions, MSE,RMSE, MAE of df5 dataframe(New York Yankees) for 2012 year :-

In [137…

```
df5=df[(df['Year']==2012)&(df['Team_Name'] == 'New York Yankees')]
```

In [138…

```
df5.head()
```

Out[138]:

	Year	League	Team	Franchise	Division	Final_Standing	Games_Played	Unnamed: 7	Games_Wo
2702	2012	AL	NYA	NYY	E	1	162	81.0	9

1 rows × 43 columns

In [139…

```
lm1_predict=lm1.predict(df5)
predict_values=pd.concat([df5['Games_Won'],lm1_predict],axis=1)
predict_values.columns=['actual_Games_Won','predicted_Games_Won']
predict_values['residual']=predict_values['actual_Games_Won']-predict_values['predicte
predict_values.head()
```

Out[139]:

	actual_Games_Won	predicted_Games_Won	residual
2702	95	94.770908	0.229092

In [140…

```
mae=metrics.mean_absolute_error(predict_values['actual_Games_Won'], predict_values['pr
mse=metrics.mean_squared_error(predict_values['actual_Games_Won'], predict_values['pre
rmse=np.sqrt(metrics.mean_squared_error(predict_values['actual_Games_Won'], predict_va
print('Mean Absolute Error', mae)
print('Mean Suare Error ', mse)
print('Root Mean Squared Error', rmse)
```

```
Mean Absolute Error 0.22909190363127152
Mean Suare Error  0.052483100309399795
Root Mean Squared Error 0.22909190363127152
```

To get Prediction, MSE,RMSE, MAE of df6 dataframe(Toronto Blue Jays) for 2012 year:-

In [141…
```
df6=df[(df['Year']==2012)&(df['Team_Name'] == 'Toronto Blue Jays')]
```

In [142…
```
df6.head()
```

Out[142]:

	Year	League	Team	Franchise	Division	Final_Standing	Games_Played	Unnamed: 7	Games_Wo
2713	2012	AL	TOR	TOR	E	4	162	81.0	7

1 rows × 43 columns

In [143…
```
lm1_predict=lm1.predict(df6)
predict_values=pd.concat([df6['Games_Won'],lm1_predict],axis=1)
predict_values.columns=['actual_Games_Won','predicted_Games_Won']
predict_values['residual']=predict_values['actual_Games_Won']-predict_values['predicte
predict_values.head()
```

Out[143]:

	actual_Games_Won	predicted_Games_Won	residual
2713	73	69.453986	3.546014

In [144…
```
mae=metrics.mean_absolute_error(predict_values['actual_Games_Won'], predict_values['pr
mse=metrics.mean_squared_error(predict_values['actual_Games_Won'], predict_values['pre
rmse=np.sqrt(metrics.mean_squared_error(predict_values['actual_Games_Won'], predict_va
print('Mean Absolute Error', mae)
print('Mean Suare Error ', mse)
print('Root Mean Squared Error', rmse)
```

```
Mean Absolute Error 3.546013580817828
Mean Suare Error  12.574212315344473
Root Mean Squared Error 3.546013580817828
```

To get Predictions, MSE,RMSE, MAE of df7 dataframe(New York Yankees) for 2015 year:-

In [145…
```
df7=df[(df['Year']==2015)&(df['Team_Name'] == 'New York Yankees')]
```

In [146…
```
df7.head()
```

Out[146]:

	Year	League	Team	Franchise	Division	Final_Standing	Games_Played	Unnamed: 7	Games_Wo
2781	2015	AL	NYA	NYY	E	2	162	81.0	8

1 rows × 43 columns

In [147…
```
lm1_predict=lm1.predict(df7)
predict_values=pd.concat([df7['Games_Won'],lm1_predict],axis=1)
predict_values.columns=['actual_Games_Won','predicted_Games_Won']
predict_values['residual']=predict_values['actual_Games_Won']-predict_values['predicte
predict_values.head()
```

Out[147]:

	actual_Games_Won	predicted_Games_Won	residual
2781	87	86.651881	0.348119

In [149…
```
mae=metrics.mean_absolute_error(predict_values['actual_Games_Won'], predict_values['pr
mse=metrics.mean_squared_error(predict_values['actual_Games_Won'], predict_values['pre
rmse=np.sqrt(metrics.mean_squared_error(predict_values['actual_Games_Won'], predict_va
print('Mean Absolute Error', mae)
print('Mean Suare Error ', mse)
print('Root Mean Squared Error', rmse)
```

```
Mean Absolute Error 0.34811948991549
Mean Suare Error  0.12118717925902096
Root Mean Squared Error 0.34811948991549
```

To get Predictions, MSE,RMSE, MAE of df8 dataframe(Toronto Blue Jays) for 2015 year:-

In [150…
```
df8=df[(df['Year']==2015)&(df['Team_Name'] == 'Toronto Blue Jays')]
```

In [151…
```
df8.head()
```

Out[151]:

	Year	League	Team	Franchise	Division	Final_Standing	Games_Played	Unnamed: 7	Games_Wo
2780	2015	AL	TOR	TOR	E	1	162	81.0	9

1 rows × 43 columns

In [152…
```
lm1_predict=lm1.predict(df8)
predict_values=pd.concat([df8['Games_Won'],lm1_predict],axis=1)
predict_values.columns=['actual_Games_Won','predicted_Games_Won']
predict_values['residual']=predict_values['actual_Games_Won']-predict_values['predicte
predict_values.head()
```

Out[152]:

	actual_Games_Won	predicted_Games_Won	residual
2780	93	96.247373	-3.247373

In [153…
```
mae=metrics.mean_absolute_error(predict_values['actual_Games_Won'], predict_values['pr
mse=metrics.mean_squared_error(predict_values['actual_Games_Won'], predict_values['pre
rmse=np.sqrt(metrics.mean_squared_error(predict_values['actual_Games_Won'], predict_va
print('Mean Absolute Error', mae)
print('Mean Suare Error ', mse)
print('Root Mean Squared Error', rmse)
```

```
Mean Absolute Error 3.247372624478146
Mean Suare Error  10.545428962210082
Root Mean Squared Error 3.247372624478146
```

To find an accuracy with percentage :-

In [154…

```
accuracy = 100 - np.mean(rmse)
print('Accuracy is :' , round(accuracy,2), '%')
```

```
Accuracy is : 96.75 %
```