logistic Regression Project:Asteroid Classification

Data Acquisition

In [1]:
```
#Import Libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

In [2]:
```
#Load dataset
data=pd.read_csv(r"C:\Users\DD\Desktop\Asteroid\nasa.csv")
```

In [3]:
```
#read the data
data
```

Out[3]:

	Neo Reference ID	Name	Absolute Magnitude	Est Dia in KM(min)	Est Dia in KM(max)	Est Dia in M(min)	Est Dia in M(max)	Est Dia in Miles(min)	Est Dia in Miles(max)	Est Dia in Feet(min)	...	Asc Node Longitude
0	3703080	3703080	21.600	0.127220	0.284472	127.219878	284.472297	0.079051	0.176763	417.388066	...	314.373913
1	3723955	3723955	21.300	0.146068	0.326618	146.067964	326.617897	0.090762	0.202951	479.225620	...	136.717242
2	2446862	2446862	20.300	0.231502	0.517654	231.502122	517.654482	0.143849	0.321655	759.521423	...	259.475979
3	3092506	3092506	27.400	0.008801	0.019681	8.801465	19.680675	0.005469	0.012229	28.876199	...	57.173266
4	3514799	3514799	21.600	0.127220	0.284472	127.219878	284.472297	0.079051	0.176763	417.388066	...	84.629307
...	...	...	...	...	...	...	...	...	...	...	...	...
4682	3759007	3759007	23.900	0.044112	0.098637	44.111820	98.637028	0.027410	0.061290	144.723824	...	164.183305
4683	3759295	3759295	28.200	0.006089	0.013616	6.089126	13.615700	0.003784	0.008460	19.977449	...	345.225230
4684	3759714	3759714	22.700	0.076658	0.171412	76.657557	171.411509	0.047633	0.106510	251.501181	...	37.026468
4685	3759720	3759720	21.800	0.116026	0.259442	116.025908	259.441818	0.072095	0.161210	380.662441	...	163.802909
4686	3772978	3772978	19.109	0.400641	0.895860	400.640618	895.859655	0.248946	0.556661	1314.437764	...	187.642183

4687 rows × 40 columns

Information about data set

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

Out[4]:
```
(4687, 40)
```

In [5]:
```
#top 10 rows
data.head(10)
```

Out[5]:

	Neo Reference ID	Name	Absolute Magnitude	Est Dia in KM(min)	Est Dia in KM(max)	Est Dia in M(min)	Est Dia in M(max)	Est Dia in Miles(min)	Est Dia in Miles(max)	Est Dia in Feet(min)	...	Asc Node Longitude	
0	3703080	3703080	21.6	0.127220	0.284472	127.219878	284.472297	0.079051	0.176763	417.388066	...	314.373913	60
1	3723955	3723955	21.3	0.146068	0.326618	146.067964	326.617897	0.090762	0.202951	479.225620	...	136.717242	42
2	2446862	2446862	20.3	0.231502	0.517654	231.502122	517.654482	0.143849	0.321655	759.521423	...	259.475979	64
3	3092506	3092506	27.4	0.008801	0.019681	8.801465	19.680675	0.005469	0.012229	28.876199	...	57.173266	51
4	3514799	3514799	21.6	0.127220	0.284472	127.219878	284.472297	0.079051	0.176763	417.388066	...	84.629307	49
5	3671135	3671135	19.6	0.319562	0.714562	319.561887	714.562102	0.198566	0.444008	1048.431420	...	178.971951	55
6	2495323	2495323	19.6	0.319562	0.714562	319.561887	714.562102	0.198566	0.444008	1048.431420	...	178.971953	55
7	2153315	2153315	19.2	0.384198	0.859093	384.197891	859.092601	0.238729	0.533815	1260.491809	...	112.562984	50
8	2162463	2162463	17.8	0.732074	1.636967	732.073989	1636.967205	0.454890	1.017164	2401.817627	...	80.211132	44
9	2306383	2306383	21.5	0.133216	0.297879	133.215567	297.879063	0.082776	0.185093	437.058960	...	2.613682	29

10 rows × 40 columns

In [6]:
```
#bottom 10 rows
data.tail(10)
```

Out[6]:

	Neo Reference ID	Name	Absolute Magnitude	Est Dia in KM(min)	Est Dia in KM(max)	Est Dia in M(min)	Est Dia in M(max)	Est Dia in Miles(min)	Est Dia in Miles(max)	Est Dia in Feet(min)	...	Asc Node Longitude
4677	3759644	3759644	24.500	0.033462	0.074824	33.462237	74.823838	0.020792	0.046493	109.784247	...	4.970984
4678	3358223	3358223	22.700	0.076658	0.171412	76.657557	171.411509	0.047633	0.106510	251.501181	...	231.238901
4679	3394709	3394709	26.300	0.014607	0.032662	14.606796	32.661790	0.009076	0.020295	47.922562	...	43.263028
4680	3608620	3608620	23.600	0.050647	0.113250	50.647146	113.250461	0.031471	0.070371	166.165182	...	175.870458
4681	3662283	3662283	20.700	0.192555	0.430566	192.555078	430.566244	0.119648	0.267541	631.742403	...	145.035928
4682	3759007	3759007	23.900	0.044112	0.098637	44.111820	98.637028	0.027410	0.061290	144.723824	...	164.183305
4683	3759295	3759295	28.200	0.006089	0.013616	6.089126	13.615700	0.003784	0.008460	19.977449	...	345.225230
4684	3759714	3759714	22.700	0.076658	0.171412	76.657557	171.411509	0.047633	0.106510	251.501181	...	37.026468
4685	3759720	3759720	21.800	0.116026	0.259442	116.025908	259.441818	0.072095	0.161210	380.662441	...	163.802909
4686	3772978	3772978	19.109	0.400641	0.895860	400.640618	895.859655	0.248946	0.556661	1314.437764	...	187.642183

10 rows × 40 columns

In [7]:
```
#describe the data
data.describe(include='all')
```

Out[7]:

	Neo Reference ID	Name	Absolute Magnitude	Est Dia in KM(min)	Est Dia in KM(max)	Est Dia in M(min)	Est Dia in M(max)	Est Dia in Miles(min)	Est Dia in Miles(max)	
count	4.687000e+03	4.687000e+03	4687.000000	4687.000000	4687.000000	4687.000000	4687.000000	4687.000000	4687.000000	468
unique	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
top	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
freq	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
mean	3.272298e+06	3.272298e+06	22.267865	0.204604	0.457509	204.604203	457.508906	0.127135	0.284283	67
std	5.486011e+05	5.486011e+05	2.890972	0.369573	0.826391	369.573402	826.391249	0.229642	0.513496	12
min	2.000433e+06	2.000433e+06	11.160000	0.001011	0.002260	1.010543	2.259644	0.000628	0.001404	
25%	3.097594e+06	3.097594e+06	20.100000	0.033462	0.074824	33.462237	74.823838	0.020792	0.046493	10
50%	3.514799e+06	3.514799e+06	21.900000	0.110804	0.247765	110.803882	247.765013	0.068850	0.153954	36
75%	3.690060e+06	3.690060e+06	24.500000	0.253837	0.567597	253.837029	567.596853	0.157727	0.352688	83
max	3.781897e+06	3.781897e+06	32.100000	15.579552	34.836938	15579.552410	34836.938250	9.680682	21.646663	511

11 rows × 40 columns

In [8]:
```
#it will display information about that object, including its data type, attributes, and methods, if available
#This information is provided interactively to help you understand the object better.

data.info
```

Out[8]:
```
<bound method DataFrame.info of       Neo Reference ID     Name  Absolute Magnitude  Est Dia in KM(min)  \
0              3703080  3703080              21.600            0.127220
1              3723955  3723955              21.300            0.146068
2              2446862  2446862              20.300            0.231502
3              3092506  3092506              27.400            0.008801
4              3514799  3514799              21.600            0.127220
...                ...      ...                 ...                 ...
4682           3759007  3759007              23.900            0.044112
4683           3759295  3759295              28.200            0.006089
4684           3759714  3759714              22.700            0.076658
4685           3759720  3759720              21.800            0.116026
4686           3772978  3772978              19.109            0.400641

      Est Dia in KM(max)  Est Dia in M(min)  Est Dia in M(max)  \
0               0.284472         127.219878         284.472297
1               0.326618         146.067964         326.617897
2               0.517654         231.502122         517.654482
3               0.019681           8.801465          19.680675
4               0.284472         127.219878         284.472297
...                  ...                ...                ...
4682            0.098637          44.111820          98.637028
4683            0.013616           6.089126          13.615700
4684            0.171412          76.657557         171.411509
4685            0.259442         116.025908         259.441818
4686            0.895860         400.640618         895.859655

      Est Dia in Miles(min)  Est Dia in Miles(max)  Est Dia in Feet(min)  ...  \
0                  0.079051               0.176763            417.388066  ...
1                  0.090762               0.202951            479.225620  ...
2                  0.143849               0.321655            759.521423  ...
3                  0.005469               0.012229             28.876199  ...
4                  0.079051               0.176763            417.388066  ...
...                     ...                    ...                   ...  ...
4682               0.027410               0.061290            144.723824  ...
4683               0.003784               0.008460             19.977449  ...
4684               0.047633               0.106510            251.501181  ...
4685               0.072095               0.161210            380.662441  ...
4686               0.248946               0.556661           1314.437764  ...

      Asc Node Longitude Orbital Period  Perihelion Distance  Perihelion Arg  \
0             314.373913     609.599786             0.808259       57.257470
1             136.717242     425.869294             0.718200      313.091975
2             259.475979     643.580228             0.950791      248.415038
```

```
3              57.173266     514.082140            0.983902       18.707701
4              84.629307     495.597821            0.967687      158.263596
...                  ...           ...                 ...            ...
4682          164.183305     457.179984            0.741558      276.395697
4683          345.225230     407.185767            0.996434       42.111064
4684           37.026468     690.054279            0.965760      274.692712
4685          163.802909     662.048343            1.185467      180.346090
4686          187.642183     653.679098            0.876110      222.436688

      Aphelion Dist  Perihelion Time  Mean Anomaly  Mean Motion  Equinox  \
0          2.005764      2458161.642    264.837533     0.590551    J2000
1          1.497352      2457794.969    173.741112     0.845330    J2000
2          1.966857      2458120.468    292.893654     0.559371    J2000
3          1.527904      2457902.337     68.741007     0.700277    J2000
4          1.483543      2457814.455    135.142133     0.726395    J2000
...             ...              ...           ...          ...      ...
4682       1.581299      2457708.228    304.306024     0.787436    J2000
4683       1.153835      2458087.617    282.978786     0.884117    J2000
4684       2.090708      2458300.480    203.501147     0.521698    J2000
4685       1.787733      2458288.261    203.524965     0.543767    J2000
4686       2.071980      2458318.587    184.820424     0.550729    J2000

      Hazardous
0          True
1         False
2          True
3         False
4          True
...          ...
4682      False
4683      False
4684      False
4685      False
4686      False

[4687 rows x 40 columns]>
```

In [9]:
```
#it provides a concise summary of the DataFrame's structure,
#including the number of non-null values, data types of columns, and memory usage.
#It's a useful method for quickly assessing the basic characteristics of your data.

data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4687 entries, 0 to 4686
Data columns (total 40 columns):
 #   Column                         Non-Null Count  Dtype  
---  ------                         --------------  -----  
 0   Neo Reference ID               4687 non-null   int64  
 1   Name                           4687 non-null   int64  
 2   Absolute Magnitude             4687 non-null   float64
 3   Est Dia in KM(min)             4687 non-null   float64
 4   Est Dia in KM(max)             4687 non-null   float64
 5   Est Dia in M(min)              4687 non-null   float64
 6   Est Dia in M(max)              4687 non-null   float64
 7   Est Dia in Miles(min)          4687 non-null   float64
 8   Est Dia in Miles(max)          4687 non-null   float64
 9   Est Dia in Feet(min)           4687 non-null   float64
 10  Est Dia in Feet(max)           4687 non-null   float64
 11  Close Approach Date            4687 non-null   object 
 12  Epoch Date Close Approach      4687 non-null   float64
 13  Relative Velocity km per sec   4687 non-null   float64
 14  Relative Velocity km per hr    4687 non-null   float64
 15  Miles per hour                 4687 non-null   float64
 16  Miss Dist.(Astronomical)       4687 non-null   float64
 17  Miss Dist.(lunar)              4687 non-null   float64
 18  Miss Dist.(kilometers)         4687 non-null   float64
 19  Miss Dist.(miles)              4687 non-null   float64
 20  Orbiting Body                  4687 non-null   object 
 21  Orbit ID                       4677 non-null   float64
 22  Orbit Determination Date       4609 non-null   object 
 23  Orbit Uncertainity             4442 non-null   float64
 24  Minimum Orbit Intersection     4371 non-null   float64
 25  Jupiter Tisserand Invariant    4323 non-null   float64
 26  Epoch Osculation               4211 non-null   float64
 27  Eccentricity                   4123 non-null   float64
 28  Semi Major Axis                4061 non-null   float64
 29  Inclination                    4034 non-null   float64
 30  Asc Node Longitude             4197 non-null   float64
 31  Orbital Period                 3784 non-null   float64
 32  Perihelion Distance            3822 non-null   float64
 33  Perihelion Arg                 3836 non-null   float64
 34  Aphelion Dist                  4193 non-null   float64
 35  Perihelion Time                4390 non-null   float64
 36  Mean Anomaly                   4534 non-null   float64
 37  Mean Motion                    4577 non-null   float64
```

```
 38  Equinox                   4642 non-null   object
 39  Hazardous                 4687 non-null   bool
dtypes: bool(1), float64(33), int64(2), object(4)
memory usage: 1.4+ MB
```

In [10]:
```
#any null value present
data.isnull().values.any()
```

Out[10]: True

In [11]:
```
# check the null values entirely present in the dataset
data.isnull()
```

Out[11]:

	Neo Reference ID	Name	Absolute Magnitude	Est Dia in KM(min)	Est Dia in KM(max)	Est Dia in M(min)	Est Dia in M(max)	Est Dia in Miles(min)	Est Dia in Miles(max)	Est Dia in Feet(min)	...	Asc Node Longitude	Orbital Period	Perih Dist
0	False	False	False	False	False	False	False	False	False	False	...	False	False	I
1	False	False	False	False	False	False	False	False	False	False	...	False	False	I
2	False	False	False	False	False	False	False	False	False	False	...	False	False	I
3	False	False	False	False	False	False	False	False	False	False	...	False	False	I
4	False	False	False	False	False	False	False	False	False	False	...	False	False	I
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
4682	False	False	False	False	False	False	False	False	False	False	...	False	False	I
4683	False	False	False	False	False	False	False	False	False	False	...	False	False	I
4684	False	False	False	False	False	False	False	False	False	False	...	False	False	I
4685	False	False	False	False	False	False	False	False	False	False	...	False	False	I
4686	False	False	False	False	False	False	False	False	False	False	...	False	False	I

4687 rows × 40 columns

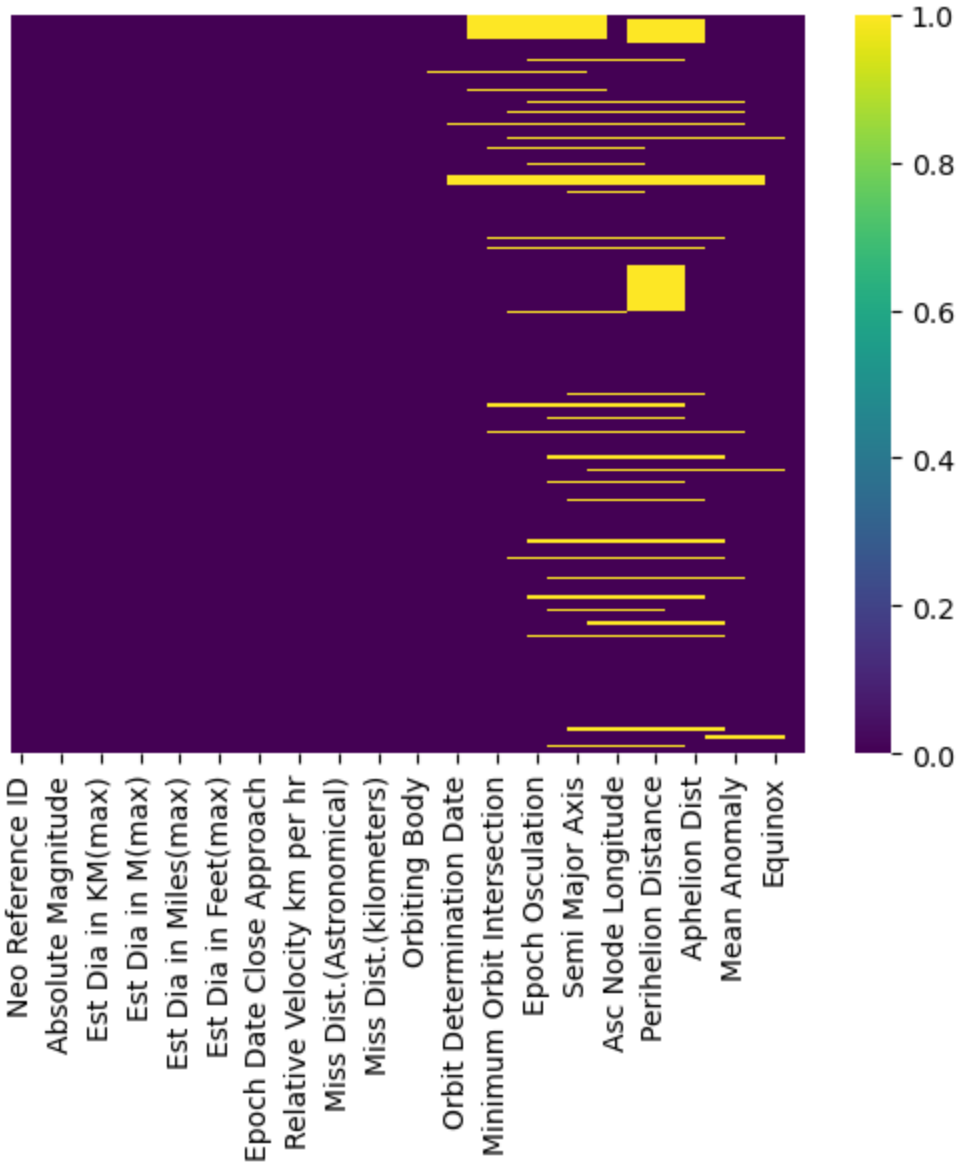
In [12]:
```
# number of null values in each column
data.isnull().sum()
```

Out[12]:

```
Neo Reference ID                0
Name                            0
Absolute Magnitude              0
Est Dia in KM(min)              0
Est Dia in KM(max)              0
Est Dia in M(min)               0
Est Dia in M(max)               0
Est Dia in Miles(min)           0
Est Dia in Miles(max)           0
Est Dia in Feet(min)            0
Est Dia in Feet(max)            0
Close Approach Date             0
Epoch Date Close Approach       0
Relative Velocity km per sec    0
Relative Velocity km per hr     0
Miles per hour                  0
Miss Dist.(Astronomical)        0
Miss Dist.(lunar)               0
Miss Dist.(kilometers)          0
Miss Dist.(miles)               0
Orbiting Body                   0
Orbit ID                       10
Orbit Determination Date       78
Orbit Uncertainity            245
Minimum Orbit Intersection    316
Jupiter Tisserand Invariant   364
Epoch Osculation              476
Eccentricity                  564
Semi Major Axis               626
Inclination                   653
Asc Node Longitude            490
Orbital Period                903
Perihelion Distance           865
Perihelion Arg                851
Aphelion Dist                 494
Perihelion Time               297
Mean Anomaly                  153
Mean Motion                   110
Equinox                        45
Hazardous                       0
dtype: int64
```

In [13]:
```
# to illustrate null values using heatmap
sns.heatmap(data.isnull(), yticklabels=False,cmap="viridis")
```

Out[13]: <Axes: >



Filling missing values

In [14]:
```
# there is no need to fill the some data because there is no value for me so drop the data
data.drop(["Miss Dist.(Astronomical)","Miss Dist.(lunar)","Miss Dist.(miles)"
           ,"Relative Velocity km per sec","Est Dia in M(max)"
           ,"Relative Velocity km per hr","Est Dia in Feet(max)",
           "Est Dia in Feet(min)", "Est Dia in Miles(max)",
           "Est Dia in Miles(min)","Est Dia in KM(max)","Est Dia in KM(min)"
           ,"Neo Reference ID","Orbit ID","Name","Close Approach Date",
           "Equinox","Epoch Date Close Approach","Orbiting Body","Orbit Determination Date"], axis=1, inplace=
```

In [15]:
```
data.isnull().sum()
```

Out[15]:
```
Absolute Magnitude              0
Est Dia in M(min)               0
Miles per hour                  0
Miss Dist.(kilometers)          0
Orbit Uncertainity            245
Minimum Orbit Intersection    316
Jupiter Tisserand Invariant   364
Epoch Osculation              476
Eccentricity                  564
Semi Major Axis               626
Inclination                   653
Asc Node Longitude            490
Orbital Period                903
Perihelion Distance           865
Perihelion Arg                851
Aphelion Dist                 494
Perihelion Time               297
Mean Anomaly                  153
Mean Motion                   110
Hazardous                       0
dtype: int64
```

In [16]:
```
#fill my important data
data['Orbit Uncertainity']=data['Orbit Uncertainity'].fillna(data['Orbit Uncertainity'].mean())
data['Minimum Orbit Intersection']=data['Minimum Orbit Intersection'].fillna(data['Minimum Orbit Intersection'
data['Jupiter Tisserand Invariant']=data['Jupiter Tisserand Invariant'].fillna(data['Jupiter Tisserand Invaria
data['Epoch Osculation']=data['Epoch Osculation'].fillna(data['Epoch Osculation'].mean())
data["Eccentricity"].fillna(data["Eccentricity"].mean(),inplace=True)
data['Semi Major Axis']=data['Semi Major Axis'].fillna(data['Semi Major Axis'].mean())
data['Inclination']=data['Inclination'].fillna(data['Inclination'].mean())
data['Asc Node Longitude']=data['Asc Node Longitude'].fillna(data['Asc Node Longitude'].mean())
```

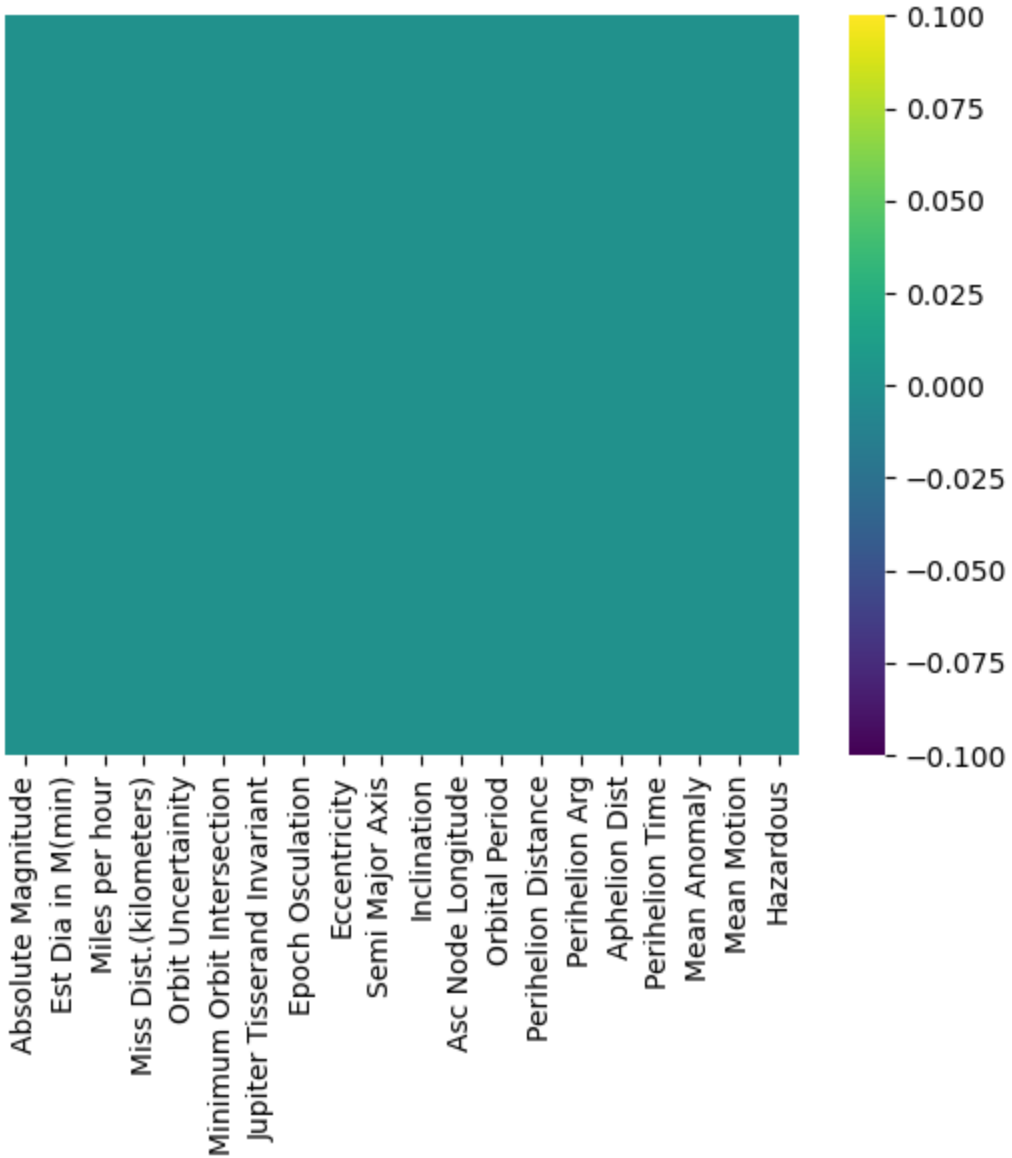
In [17]:
```
data['Orbital Period']=data['Orbital Period'].fillna(data['Orbital Period'].mean())
data['Perihelion Distance']=data['Perihelion Distance'].fillna(data['Perihelion Distance'].mean())
data['Perihelion Arg']=data['Perihelion Arg'].fillna(data['Perihelion Arg'].mean())
data['Aphelion Dist']=data['Aphelion Dist'].fillna(data['Aphelion Dist'].mean())
data['Perihelion Time']=data['Perihelion Time'].fillna(data['Perihelion Time'].mean())
data['Mean Anomaly']=data['Mean Anomaly'].fillna(data['Mean Anomaly'].mean())
data['Mean Motion']=data['Mean Motion'].fillna(data['Mean Motion'].mean())
```

In [18]:
```
data.isnull().sum()
```

Out[18]:
```
Absolute Magnitude            0
Est Dia in M(min)             0
Miles per hour                0
Miss Dist.(kilometers)        0
Orbit Uncertainity            0
Minimum Orbit Intersection    0
Jupiter Tisserand Invariant   0
Epoch Osculation              0
Eccentricity                  0
Semi Major Axis               0
Inclination                   0
Asc Node Longitude            0
Orbital Period                0
Perihelion Distance           0
Perihelion Arg                0
Aphelion Dist                 0
Perihelion Time               0
Mean Anomaly                  0
Mean Motion                   0
Hazardous                     0
dtype: int64
```

In [19]:
```
# to illustrate null values using heatmap
sns.heatmap(data.isnull(), yticklabels=False,cmap='viridis')
```

Out[19]: <Axes: >



In [20]:
```
cat_data=data.select_dtypes(include=object)     # show catogorical data column
num_data=data.select_dtypes(exclude=object)
```

In [21]:
```
cat_data
```

Out[21]:

0
1
2
3
4
...
4682
4683
4684
4685
4686

4687 rows × 0 columns

In [22]:
```
num_data
```

Out[22]:

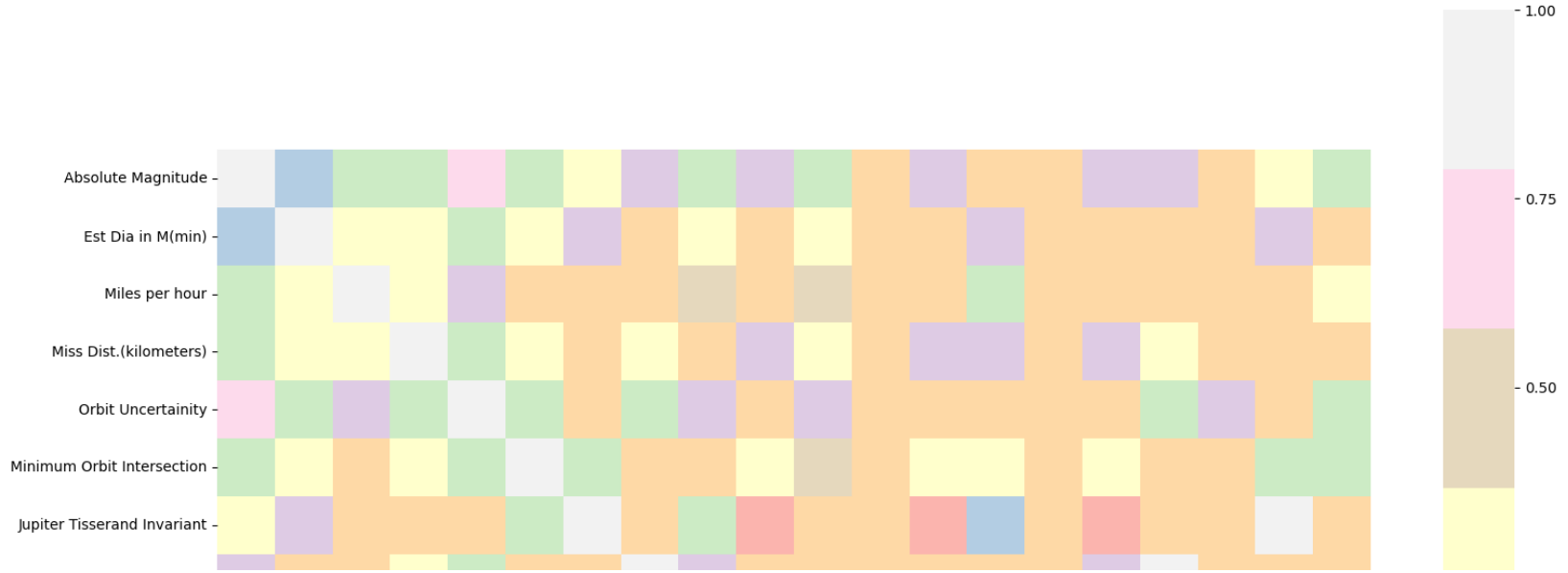
	Absolute Magnitude	Est Dia in M(min)	Miles per hour	Miss Dist. (kilometers)	Orbit Uncertainity	Minimum Orbit Intersection	Jupiter Tisserand Invariant	Epoch Osculation	Eccentricity	Semi Major Axis	Inc
0	21.600	127.219878	13680.509940	6.275369e+07	5.000000	0.025282	4.634000	2.458000e+06	0.425549	1.407011	6
1	21.300	146.067964	40519.173110	5.729815e+07	3.000000	0.186935	5.457000	2.458000e+06	0.351674	1.107776	28
2	20.300	231.502122	16979.661800	7.622912e+06	3.576317	0.082211	5.047591	2.457718e+06	0.381689	1.398264	13
3	27.400	8.801465	24994.839860	4.268362e+07	3.576317	0.082211	5.047591	2.457718e+06	0.381689	1.398264	13
4	21.600	127.219878	22012.954980	6.101082e+07	3.576317	0.082211	5.047591	2.457718e+06	0.381689	1.398264	13
...	...	...	...	...	...	...	...	...	...	...	
4682	23.900	44.111820	49556.875550	6.187511e+06	8.000000	0.019777	5.156000	2.457638e+06	0.361512	1.161429	39
4683	28.200	6.089126	7214.337772	9.677324e+05	6.000000	0.006451	5.742000	2.458000e+06	0.073200	1.075134	5
4684	22.700	76.657557	16086.983630	9.126775e+06	6.000000	0.059972	4.410000	2.458000e+06	0.368055	1.528234	4
4685	21.800	116.025908	25393.489070	3.900908e+07	5.000000	0.177510	4.477000	2.458000e+06	0.202565	1.486600	21
4686	19.109	400.640618	80409.512650	6.916986e+07	6.000000	0.051777	4.108000	2.458000e+06	0.405642	1.474045	53

4687 rows × 20 columns

Data Visualization

In [23]:
```
#Examaning a correlation matrix of all the features
corrmat = data.corr()
plt.subplots(figsize=(18,18))
sns.heatmap(corrmat,cmap="Pastel1", square=True)
```

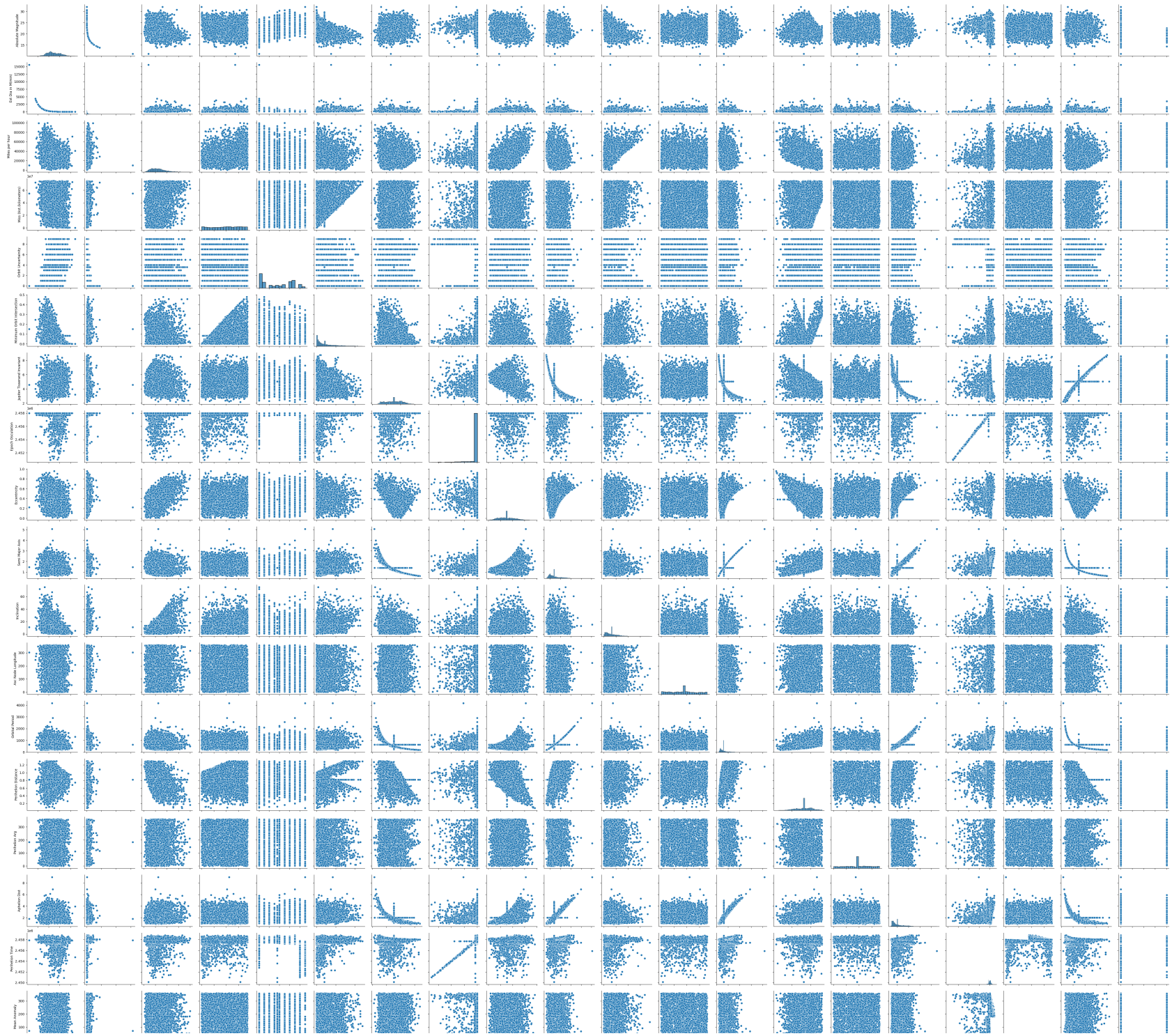
Out[23]: <Axes: >

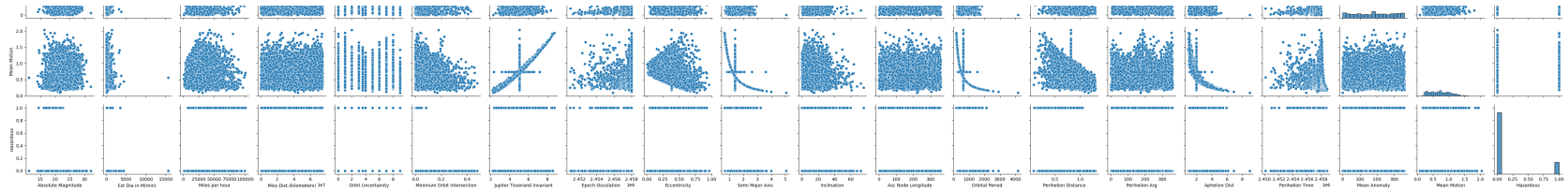


In [24]:
```
sns.pairplot(data)
```

```
<__array_function__ internals>:180: RuntimeWarning: Converting input from bool to <class 'numpy.uint8'> for
compatibility.
```

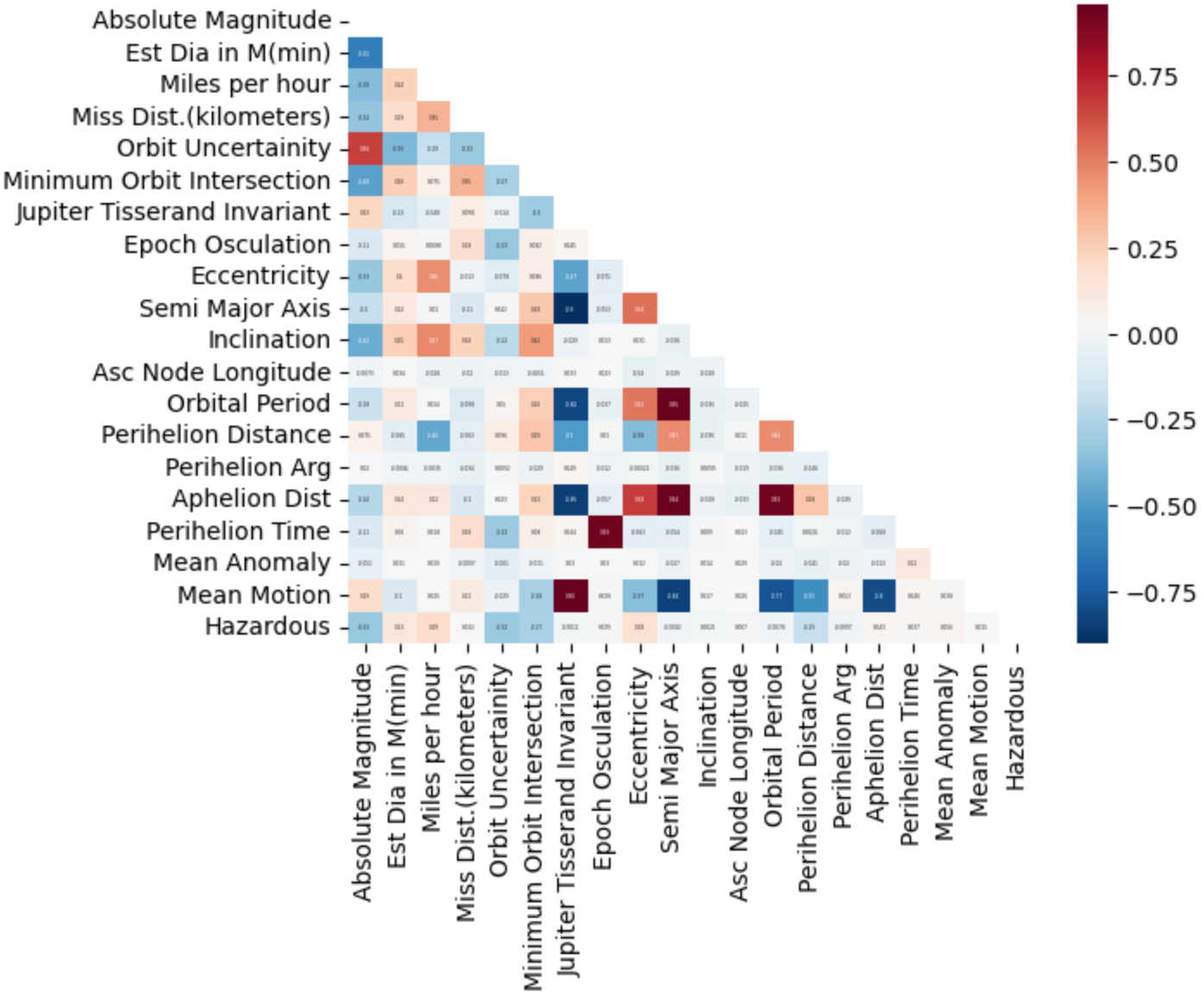
Out[24]:
```
<seaborn.axisgrid.PairGrid at 0x1f472fe1150>
```



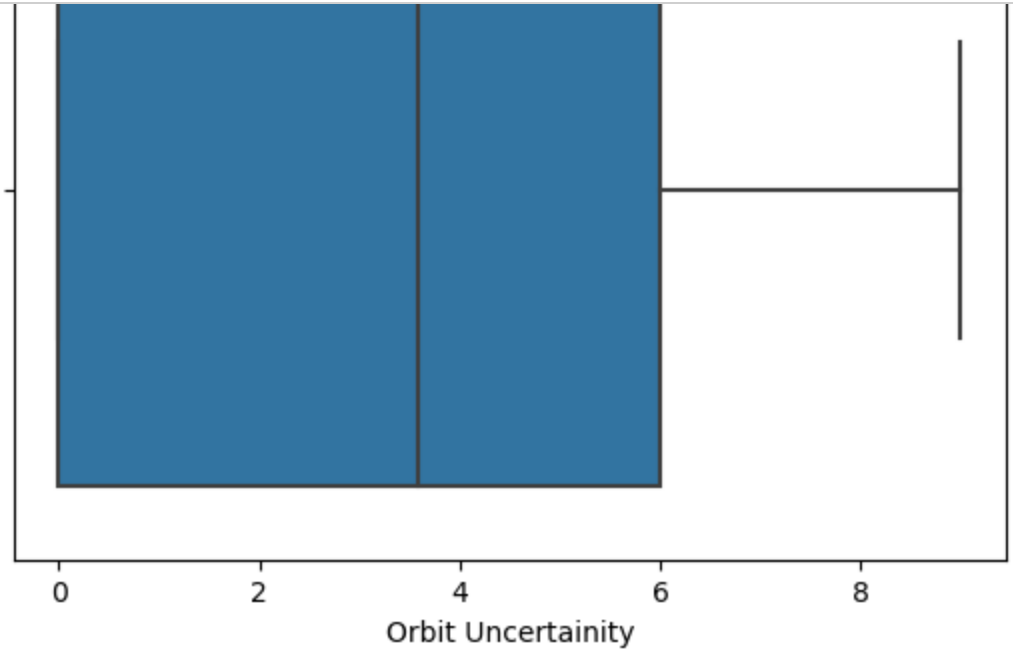

Min(MOID)
Hazardous
Absolute Magnitude
Est Dia in M(min)
Miles per hour
Miss Dist.(kilometers) 3e7
Orbit Uncertainty
Minimum Orbit Intersection
Jupiter Tisserand Invariant
Epoch Osculation 2.452 2.454 2.456 2.458 3e9
Eccentricity
Semi Major Axis
Inclination
Asc Node Longitude
Orbital Period
Perihelion Distance
Perihelion Arg
Aphelion Dist
Perihelion Time 2.450 2.452 2.454 2.456 2.458 3e9
Mean Anomaly
Mean Motion
Hazardous

In [25]:
```
corr=num_data.corr()
msk = np.triu(np.ones_like(corr))
sns.heatmap(corr,cmap=plt.cm.RdBu_r,annot=True,annot_kws={'size':2},mask=msk)
```

Out[25]: <Axes: >

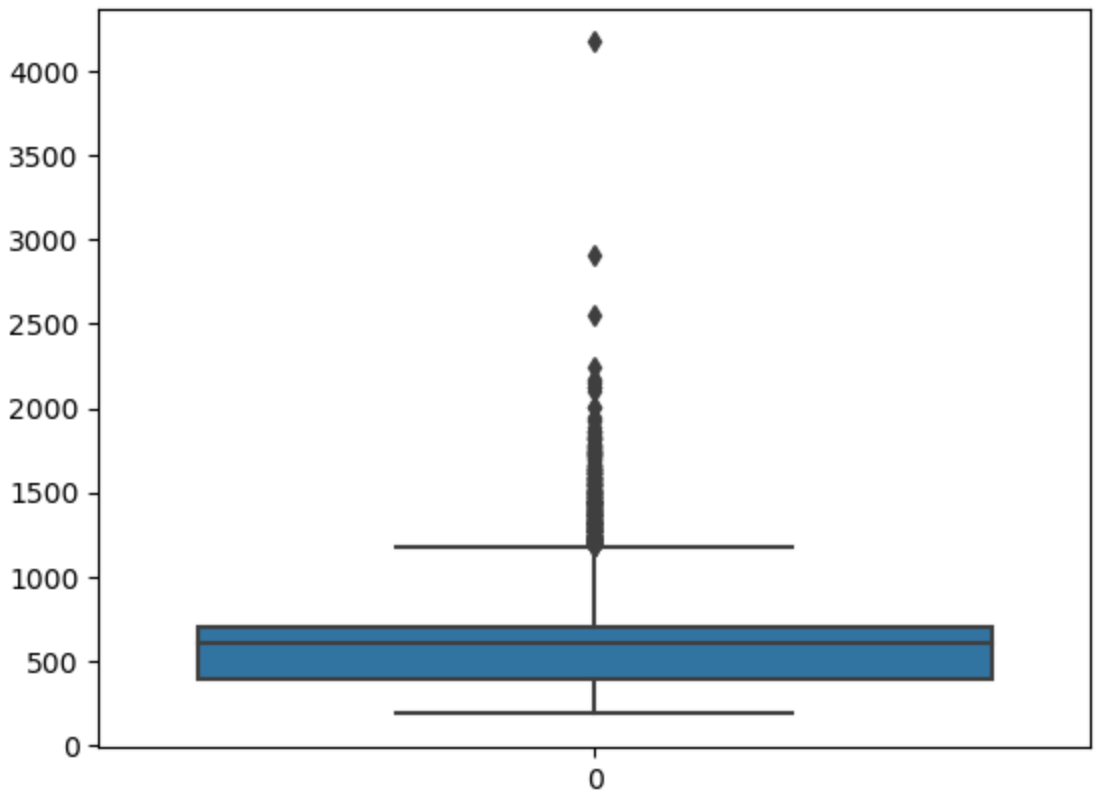


In [67]:
```
for i in num_data.columns:
    sns.boxplot(x=data[i])  # Use data instead of num_data here
    plt.show()
```

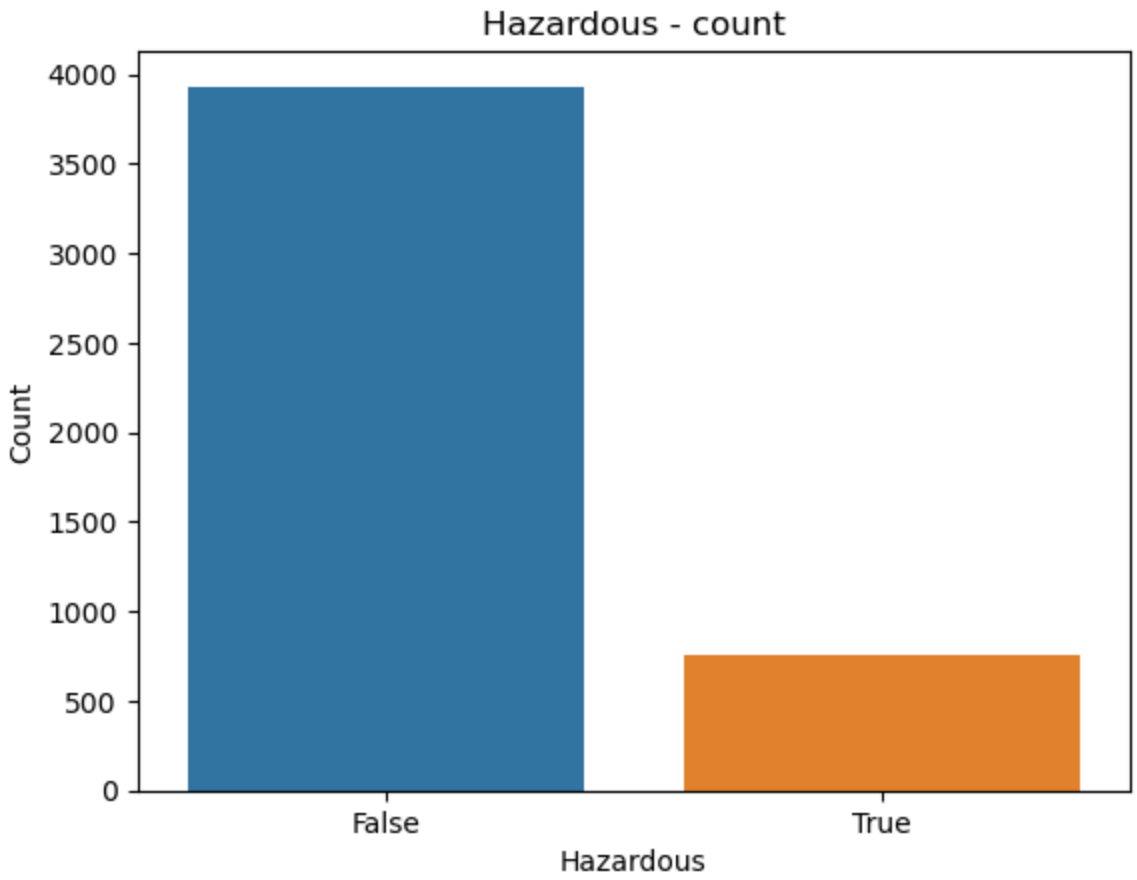


In [27]:
```
sns.boxplot(data['Orbital Period'])
```

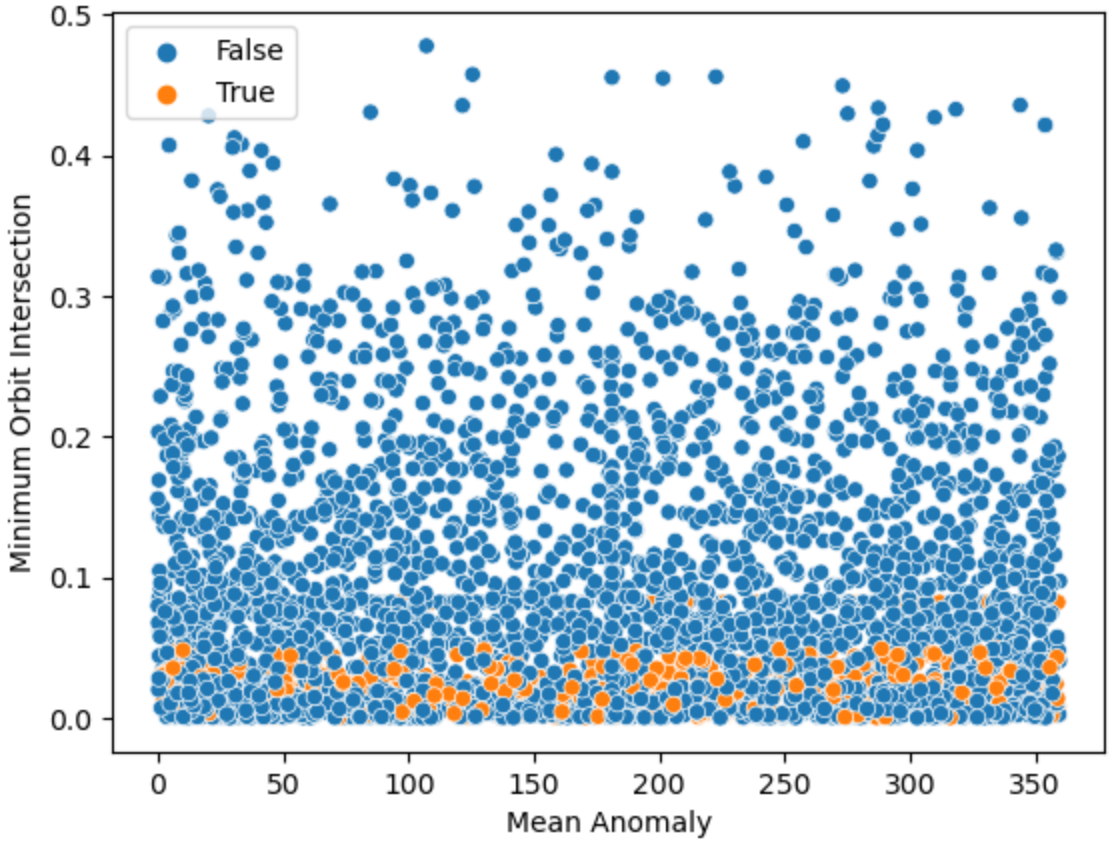
Out[27]: <Axes: >



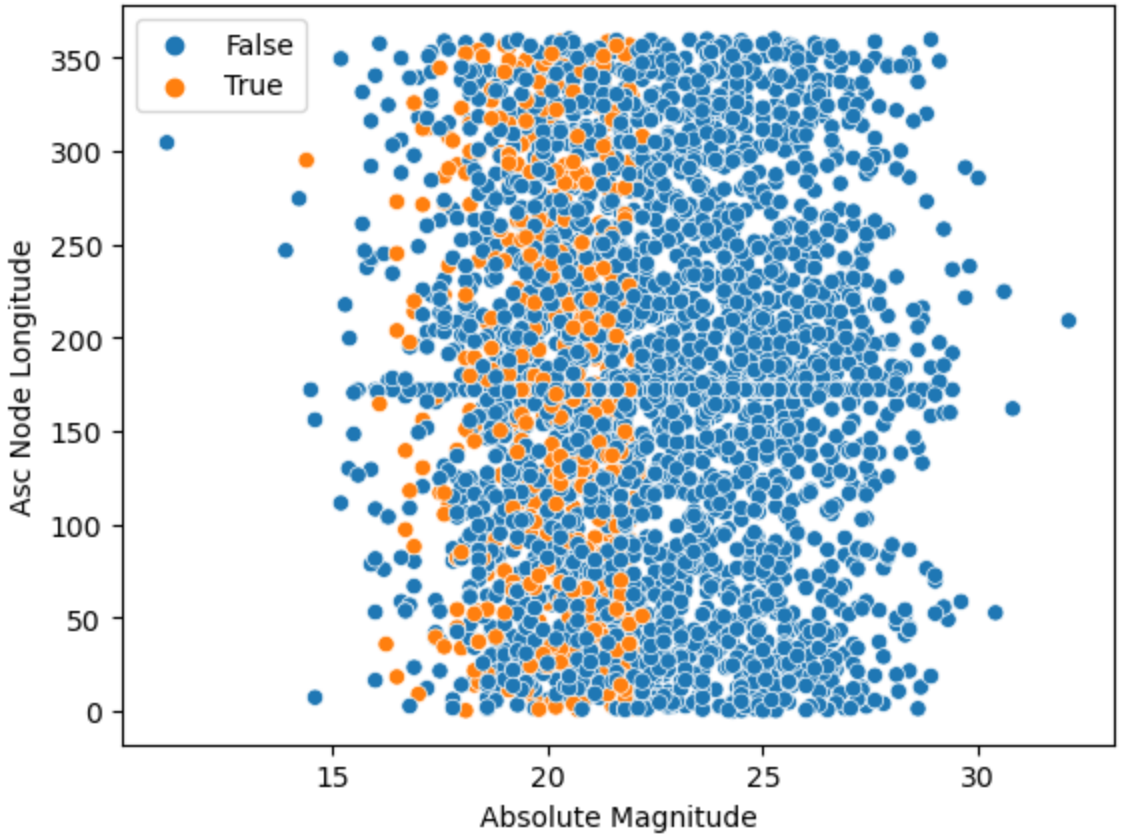
In [28]:
```
a=data.groupby("Hazardous")["Hazardous"].count()
sns.barplot(x=a.index,y=a.values)
plt.title("Hazardous - count")
plt.xlabel("Hazardous")
plt.ylabel("Count")
plt.show()
```



In [29]:
```
sns.scatterplot(x='Mean Anomaly',y='Minimum Orbit Intersection',color="b",hue="Hazardous",data=data)
plt.legend()
plt.show()
```

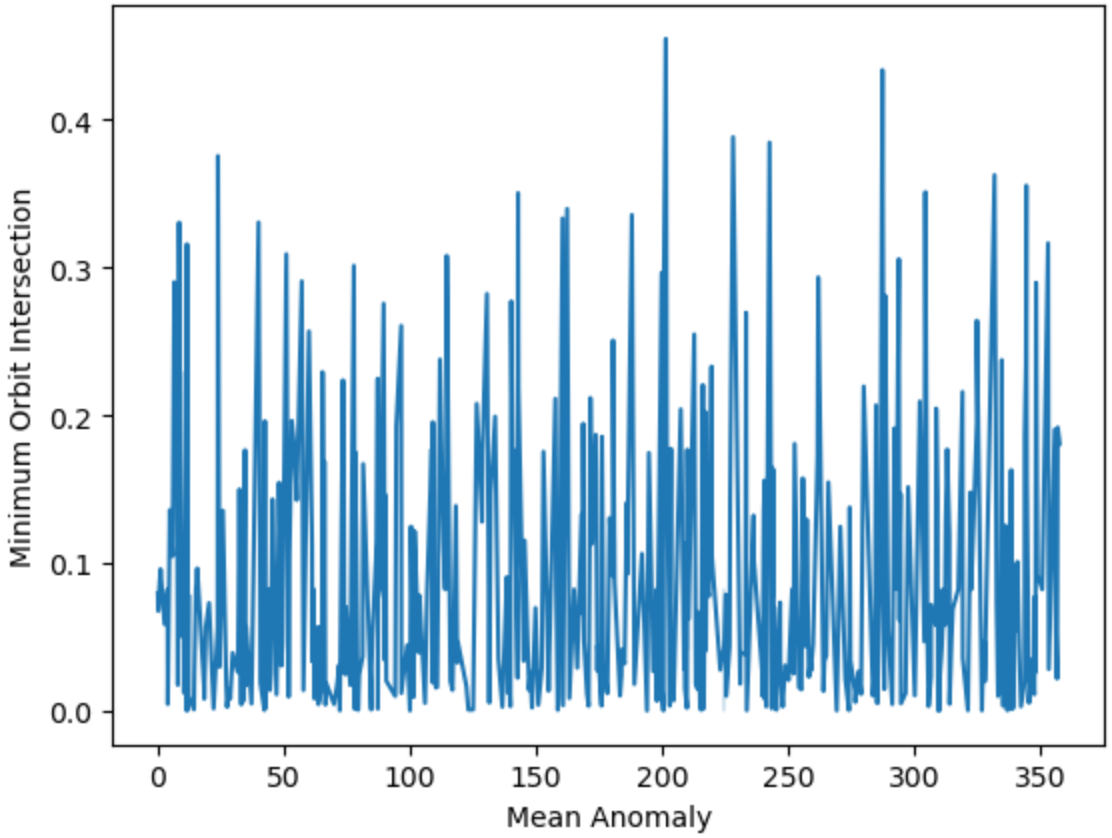


In [30]:
```
sns.scatterplot(x='Absolute Magnitude',y='Asc Node Longitude',color="b",hue="Hazardous",data=data)
plt.legend()
plt.show()
```

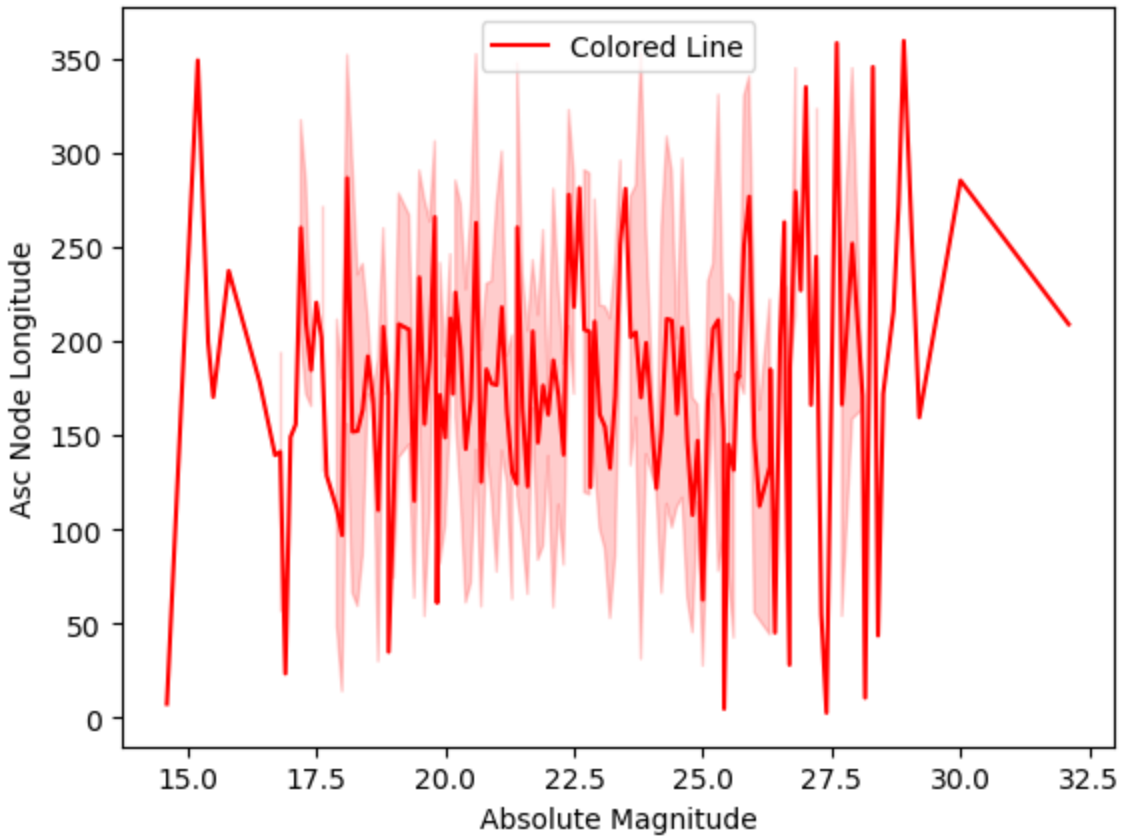


In [31]:
```
x=data.sample(500)
sns.lineplot(x='Mean Anomaly',y="Minimum Orbit Intersection",data=x)
```

Out[31]: <Axes: xlabel='Mean Anomaly', ylabel='Minimum Orbit Intersection'>

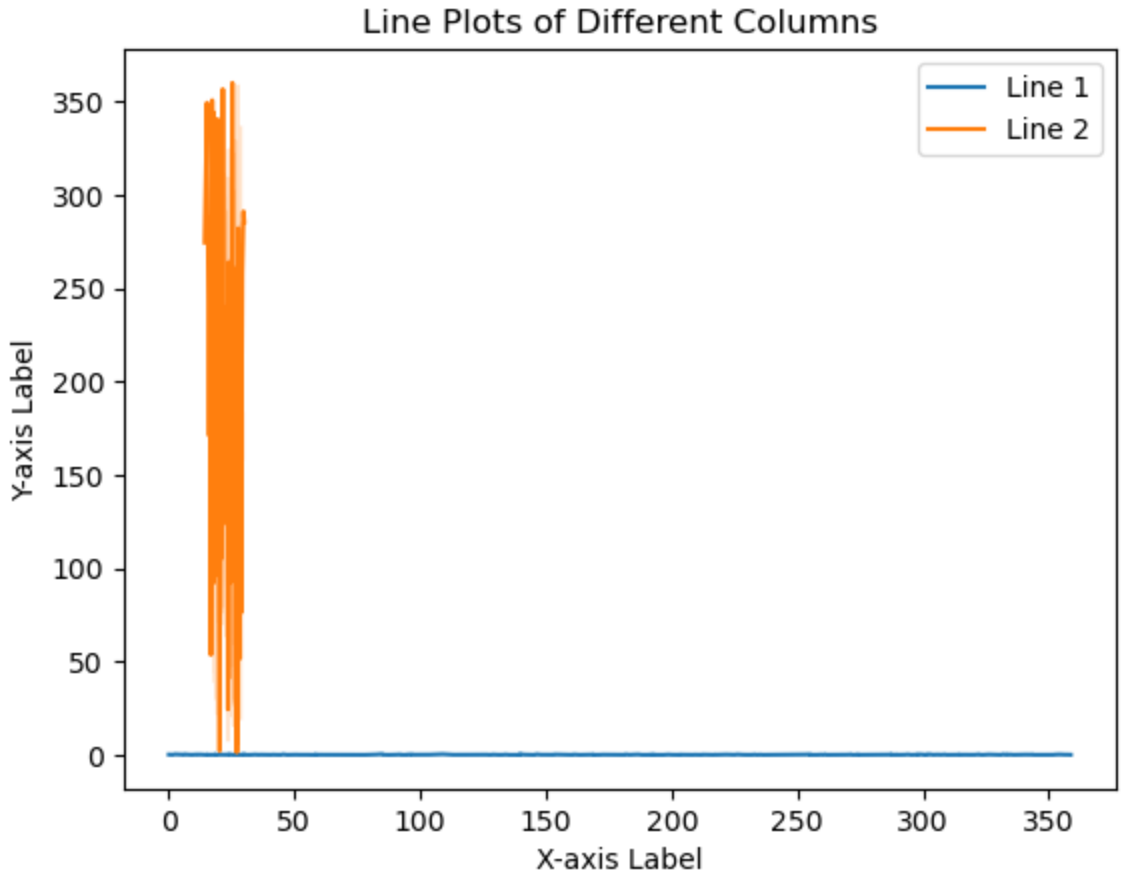


In [32]:
```
sns.lineplot(x='Absolute Magnitude',y="Asc Node Longitude",data=x,color='red', label='Colored Line')
plt.show()
```



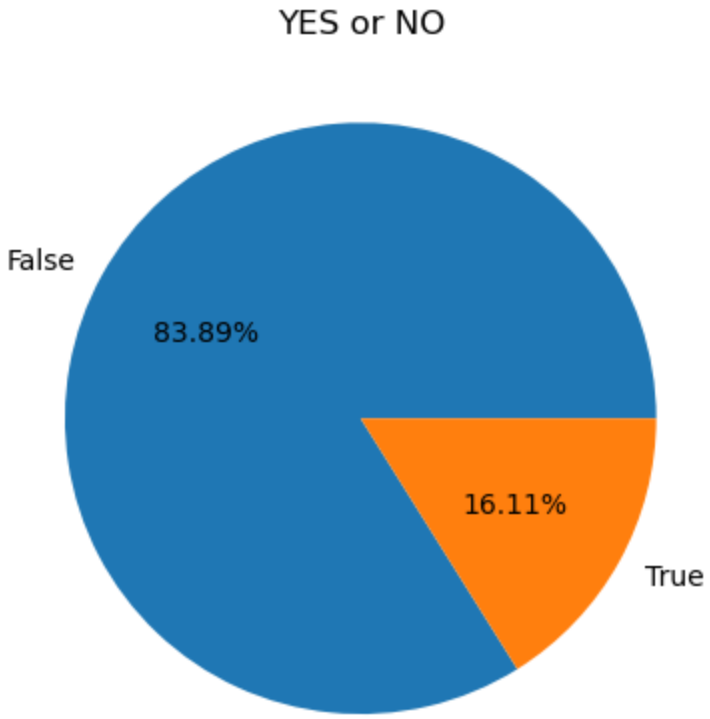
In [33]:
```
x = data.sample(500)
sns.lineplot(x='Mean Anomaly', y="Minimum Orbit Intersection", data=x, label='Line 1')# Create the first line
sns.lineplot(x='Absolute Magnitude', y="Asc Node Longitude", data=x, label='Line 2')# Create the second line p

plt.xlabel('X-axis Label')
plt.ylabel('Y-axis Label')
plt.title('Line Plots of Different Columns')
plt.legend()
plt.show()
```

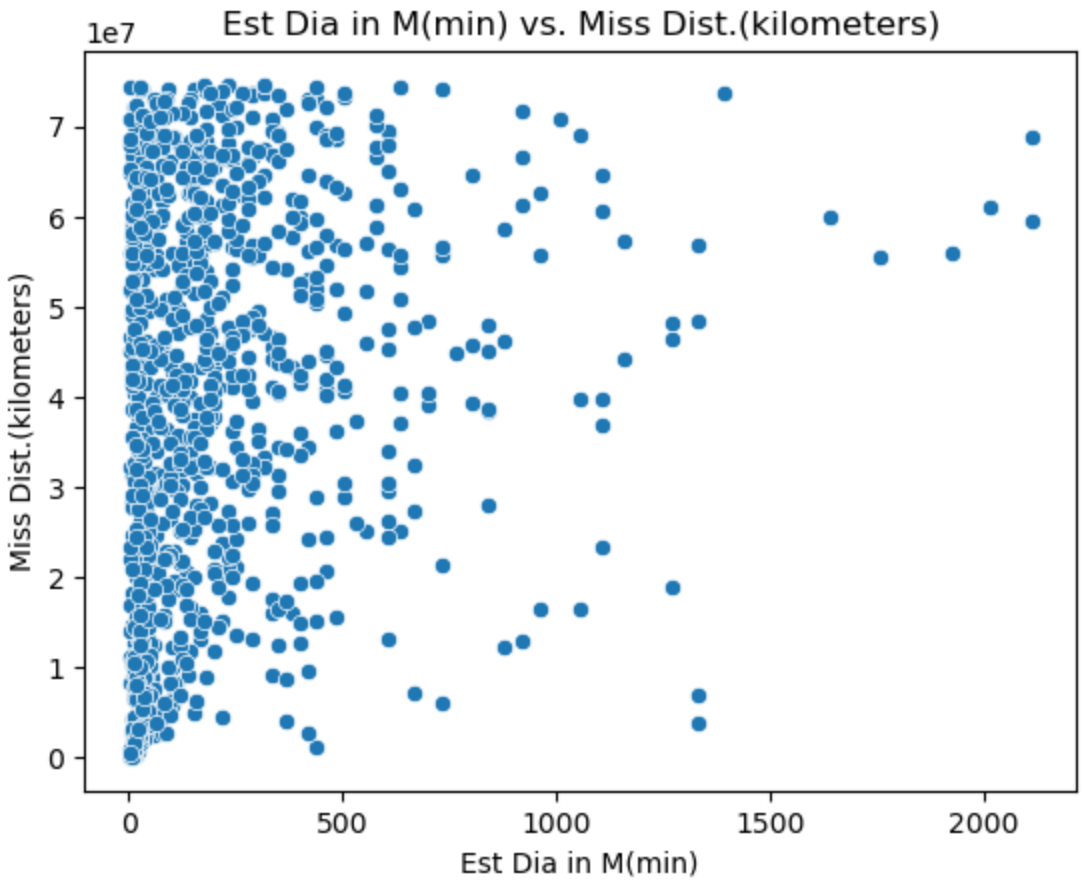


In [34]:
```
b=data.groupby("Hazardous")["Hazardous"].count()
plt.pie(b,labels=b.index,autopct="%.2f%%")
plt.title("YES or NO")
```

Out[34]:
```
Text(0.5, 1.0, 'YES or NO')
```

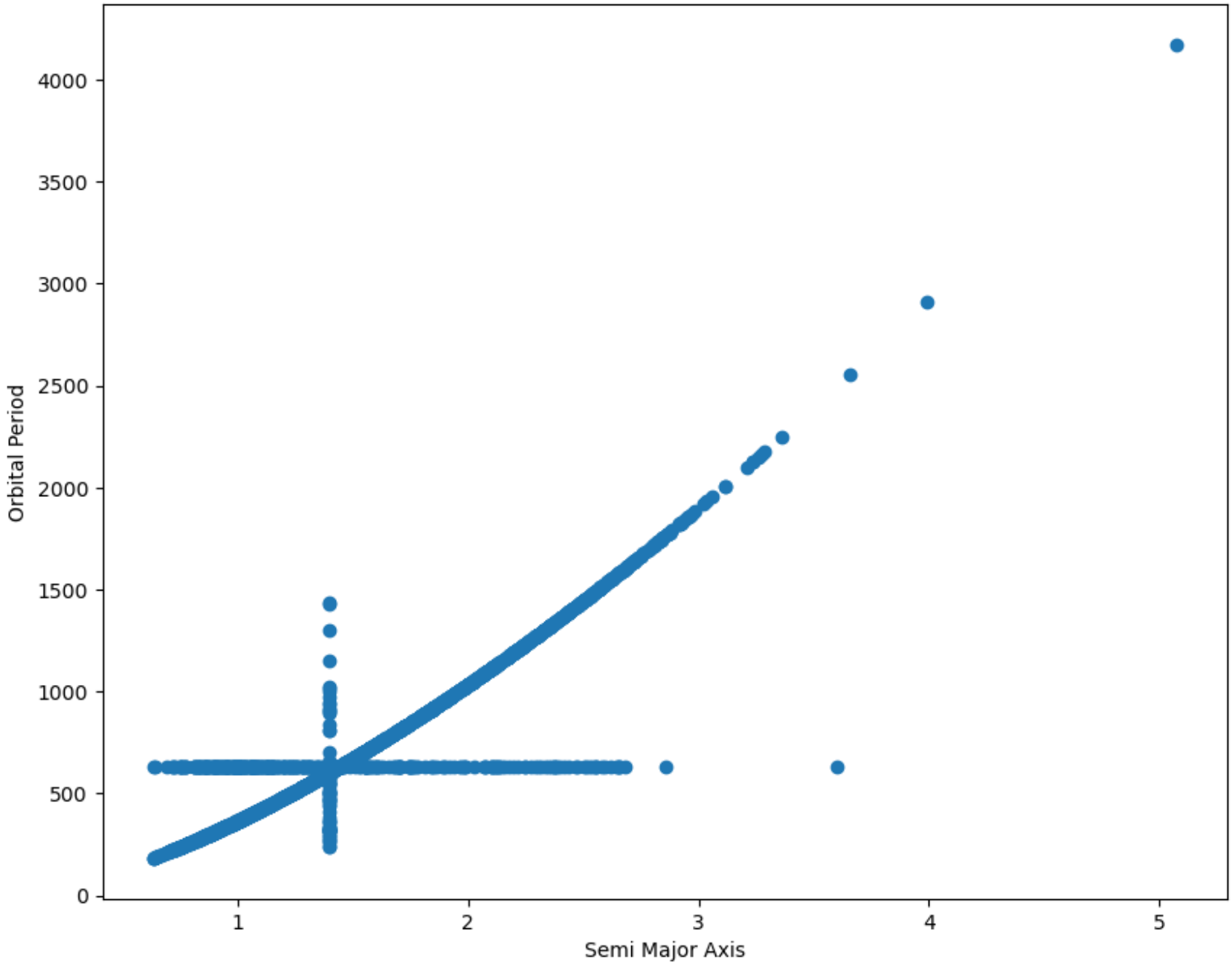


In [35]:
```
x = data.sample(1000)
sns.scatterplot(x='Est Dia in M(min)', y='Miss Dist.(kilometers)', data=x)
plt.xlabel('Est Dia in M(min)')
plt.ylabel('Miss Dist.(kilometers)')
plt.title('Est Dia in M(min) vs. Miss Dist.(kilometers)')
plt.show()
```



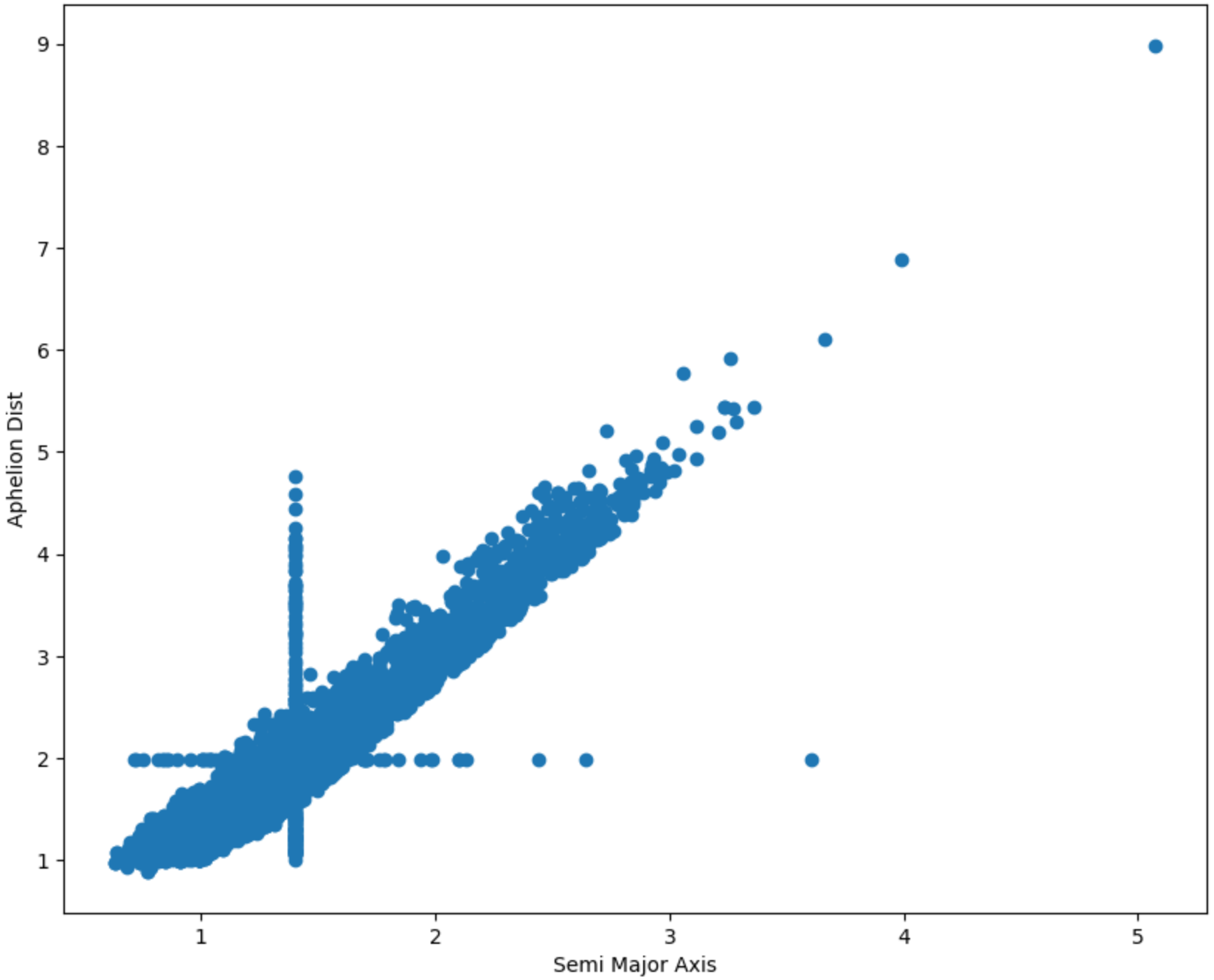
In [36]:
```
plt.figure(figsize=(10, 8))

plt.scatter(data['Semi Major Axis'], data['Orbital Period'])
plt.xlabel('Semi Major Axis')
plt.ylabel('Orbital Period');
```


Orbital Period
Semi Major Axis
0
500
1000
1500
2000
2500
3000
3500
4000
1
2
3
4
5

In [37]:
```
plt.figure(figsize=(10, 8))

plt.scatter(data['Semi Major Axis'], data['Aphelion Dist'])
plt.xlabel('Semi Major Axis')
plt.ylabel('Aphelion Dist');
```


Aphelion Dist
Semi Major Axis
1
2
3
4
5
6
7
8
9

Logistic Regression

In [38]:
```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import mean_absolute_error,mean_squared_error,r2_score
from sklearn.preprocessing import OneHotEncoder,StandardScaler
from sklearn.compose import ColumnTransformer
import joblib
import warnings
warnings.filterwarnings("ignore")
```

In [39]:
```
X = data.drop(columns=['Hazardous'])
Y = data.Hazardous.astype(int)
```

In [40]:
```
X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size=0.2, random_state=88)
```

In [41]:
```
log=LogisticRegression()
log.fit(X_train, y_train)
```

Out[41]:
```
LogisticRegression()
```

In [42]:
```
print("Train Score",log.score(X_train, y_train))
```

```
Train Score 0.8362229927980794
```

In [43]:
```
print("Test Score",log.score(X_test, y_test))
```

```
Test Score 0.8454157782515992
```

In [44]:
```
pred_train = log.predict(X_train)
pred_test = log.predict(X_test)
```

In [45]:
```
from sklearn import metrics
print(metrics.classification_report(y_train,pred_train))
```

```
              precision    recall  f1-score   support

           0       0.84      1.00      0.91      3140
           1       0.33      0.01      0.02       609

    accuracy                           0.84      3749
   macro avg       0.59      0.50      0.46      3749
weighted avg       0.76      0.84      0.77      3749
```

In [46]:
```
print(metrics.classification_report(y_train,pred_train))
```

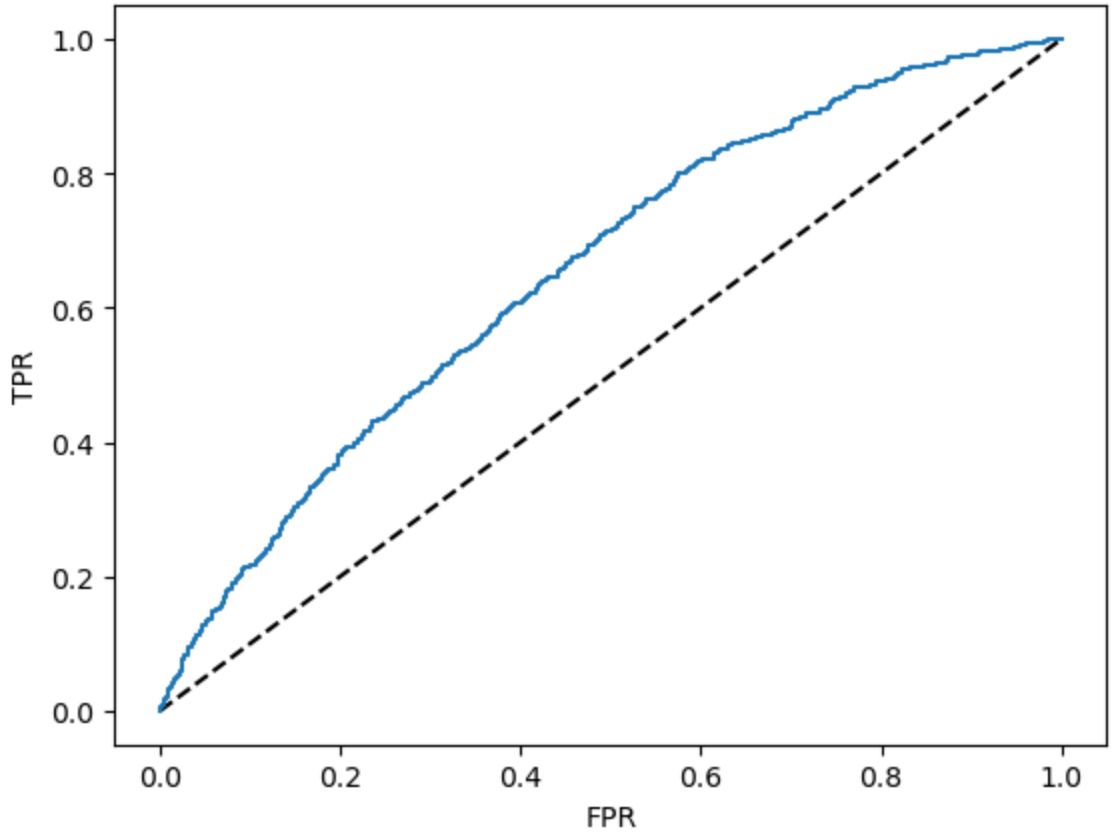
```
              precision    recall  f1-score   support

           0       0.84      1.00      0.91      3140
           1       0.33      0.01      0.02       609

    accuracy                           0.84      3749
   macro avg       0.59      0.50      0.46      3749
weighted avg       0.76      0.84      0.77      3749
```

In [47]:
```
roc=log.predict_proba(X_train)[:,1]

fpr,tpr,threshold  = metrics.roc_curve(y_train, roc)
plt.plot([0,1],[0,1],'k--')
plt.plot(fpr,tpr,label='logistic')
plt.ylabel("TPR")
plt.xlabel("FPR")
plt.show()
```



In [48]:
```
metrics.roc_auc_score(y_train,roc)
```

Out[48]:
```
0.6541652285777039
```

In [49]:
```
from sklearn.metrics import matthews_corrcoef

mcc=matthews_corrcoef(y_test,pred_test)
print("MCC ",mcc)
```

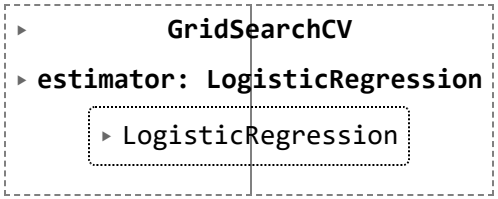
```
MCC  0.07984604966767538
```

In [50]:
```
param_grid={
    'penalty':['l1','l2'],#lasso ridge
    'C':[0.1,0.5,1,5,10]
}
```

In [51]:
```
from sklearn.model_selection import GridSearchCV
grid=GridSearchCV(estimator=log,param_grid=param_grid,cv=5)
```

In [52]:
```
grid.fit(X_train,y_train)
```

Out[52]:



In [53]:
```
best_param=grid.best_params_
best_model=grid.best_estimator_
```

In [54]:
```
y_pred=best_model.predict(X_test)
```

In [55]:
```
from sklearn.metrics import accuracy_score , precision_score,recall_score,f1_score,roc_auc_score
```

In [56]:
```
acc=accuracy_score(y_test,y_pred)
pre=precision_score(y_test,y_pred)
rec=recall_score(y_test,y_pred)
f1=f1_score(y_test,y_pred)
roc_auc=roc_auc_score(y_test,y_pred)
```

In [57]:
```
print("Best Param: ",best_param)
print("Accuracy: ",acc)
print("Precision: ",pre)
print("Recall: ",rec)
print("f1 Scoer: ",f1)
print("AUC ROC: ",roc_auc)
```

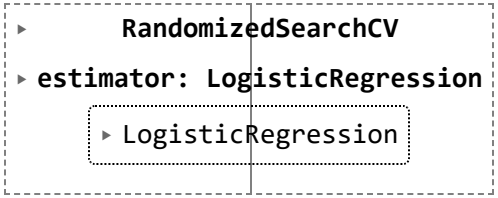
```
Best Param:  {'C': 0.1, 'penalty': 'l2'}
Accuracy:  0.8454157782515992
Precision:  0.6666666666666666
Recall:  0.0136986301369863
f1 Scoer:  0.02684563758389262
AUC ROC:  0.50621800193718
```

In [59]:
```
from scipy.stats import loguniform
from sklearn.model_selection import RandomizedSearchCV
```

In [60]:
```
logistic_random_param={'C':loguniform(1e-4,1e0),
                       'max_iter':(np.arange(100,800,10))}
grid=RandomizedSearchCV(estimator=log, param_distributions=logistic_random_param, cv=5)
```

In [61]:
```
grid.fit(X_train,y_train)
```

Out[61]:



In [62]:
```
best_param = grid.best_params_
best_model = grid.best_estimator_
y_pred = best_model.predict(X_test)
```

In [63]:
```
acc=accuracy_score(y_test,y_pred)
pre=precision_score(y_test,y_pred)
rec=recall_score(y_test,y_pred)
f1=f1_score(y_test,y_pred)
roc_auc=roc_auc_score(y_test,y_pred)
```

In [64]:
```
print('Best Param:',best_param)
print('Accuracy:',acc)
print('Precision:',pre)
print('Recall:',rec)
print('F1Score:',f1)
print('ROC_AUC',roc_auc)
```

```
Best Param: {'C': 0.1565287725242802, 'max_iter': 550}
Accuracy: 0.8454157782515992
Precision: 0.6666666666666666
Recall: 0.0136986301369863
F1Score: 0.02684563758389262
ROC_AUC 0.50621800193718
```

In [ ]: