In [126]:

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.utils import shuffle
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error
from sklearn.ensemble import RandomForestRegressor
```

In [127]:

```
data = pd.read_csv('games.csv')
print(data.shape)
```

```
(81312, 20)
```

In [128]:

```
data.head(5)
```

Out[128]:

	id	type	name	yearpublished	minplayers	maxplayers	playingtime	minplaytime	maxplaytime	minage	users_rated	average_rati
0	12333	boardgame	Twilight Struggle	2005.0	2.0	2.0	180.0	180.0	180.0	13.0	20113	8.337
1	120677	boardgame	Terra Mystica	2012.0	2.0	5.0	150.0	60.0	150.0	12.0	14383	8.287
2	102794	boardgame	Caverna: The Cave Farmers	2013.0	1.0	7.0	210.0	30.0	210.0	12.0	9262	8.289
3	25613	boardgame	Through the Ages: A Story of Civilization	2006.0	2.0	4.0	240.0	240.0	240.0	12.0	13294	8.204
4	3076	boardgame	Puerto Rico	2002.0	2.0	5.0	150.0	90.0	150.0	12.0	39883	8.142

In [129]:
```
data.dtypes
```

Out[129]:
```
id                        int64
type                     object
name                     object
yearpublished           float64
minplayers              float64
maxplayers              float64
playingtime             float64
minplaytime             float64
maxplaytime             float64
minage                  float64
users_rated               int64
average_rating          float64
bayes_average_rating    float64
total_owners              int64
total_traders             int64
total_wanters             int64
total_wishers             int64
total_comments            int64
total_weights             int64
average_weight          float64
dtype: object
```

In [130]:
```python
data.describe(include='all')
```

Out[130]:

	id	type	name	yearpublished	minplayers	maxplayers	playingtime	minplaytime	maxplaytime	minage	us
count	81312.000000	81312	81271	81309.000000	81309.000000	81309.000000	81309.000000	81309.000000	81309.000000	81309.000000	8131
unique	NaN	2	76035	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
top	NaN	boardgame		NaN	NaN	NaN	NaN	NaN	NaN	NaN	
freq	NaN	70820	16	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
mean	72278.150138	NaN	NaN	1806.630668	1.992018	5.637703	51.634788	49.276833	51.634788	6.983975	16
std	58818.237742	NaN	NaN	588.517834	0.931034	56.076890	345.699969	334.483934	345.699969	5.035138	114
min	1.000000	NaN	NaN	-3500.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	
25%	21339.750000	NaN	NaN	1984.000000	2.000000	2.000000	8.000000	10.000000	8.000000	0.000000	
50%	43258.000000	NaN	NaN	2003.000000	2.000000	4.000000	30.000000	30.000000	30.000000	8.000000	
75%	128836.500000	NaN	NaN	2010.000000	2.000000	6.000000	60.000000	60.000000	60.000000	12.000000	1
max	184451.000000	NaN	NaN	2018.000000	99.000000	11299.000000	60120.000000	60120.000000	60120.000000	120.000000	5368

In [131]:

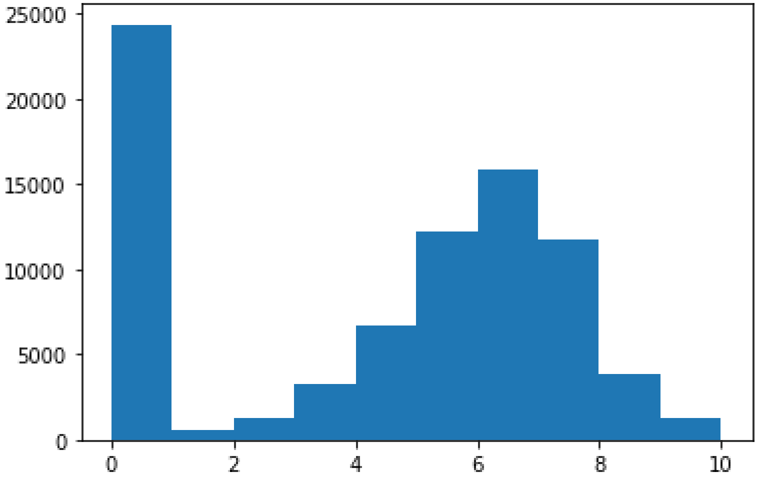
```
data.isnull().sum()
```

Out[131]:

```
id                       0
type                     0
name                    41
yearpublished            3
minplayers               3
maxplayers               3
playingtime              3
minplaytime              3
maxplaytime              3
minage                   3
users_rated              0
average_rating           0
bayes_average_rating     0
total_owners             0
total_traders            0
total_wanters            0
total_wishers            0
total_comments           0
total_weights            0
average_weight           0
dtype: int64
```

In [132]:
```
plt.hist(data["average_rating"])
```

Out[132]:
```
(array([24380.,   606.,  1325.,  3303.,  6687., 12277., 15849., 11737.,
         3860.,  1288.]),
 array([ 0.,  1.,  2.,  3.,  4.,  5.,  6.,  7.,  8.,  9., 10.]),
 <a list of 10 Patch objects>)
```



In [133]:

```
data[data["average_rating"] == 0].iloc[0]
```

Out[133]:

```
id                                318
type                        boardgame
name                       Looney Leo
yearpublished                       0
minplayers                          0
maxplayers                          0
playingtime                         0
minplaytime                         0
maxplaytime                         0
minage                              0
users_rated                         0
average_rating                      0
bayes_average_rating                0
total_owners                        0
total_traders                       0
total_wanters                       0
total_wishers                       1
total_comments                      0
total_weights                       0
average_weight                      0
Name: 13048, dtype: object
```

In [134]:

```
data[data["average_rating"] > 0].iloc[0]
```

Out[134]:

```
id                                 12333
type                           boardgame
name                   Twilight Struggle
yearpublished                       2005
minplayers                             2
maxplayers                             2
playingtime                          180
minplaytime                          180
maxplaytime                          180
minage                                13
users_rated                        20113
average_rating                   8.33774
bayes_average_rating             8.22186
total_owners                       26647
total_traders                        372
total_wanters                       1219
total_wishers                       5865
total_comments                      5347
total_weights                       2562
average_weight                    3.4785
Name: 0, dtype: object
```

In [135]:

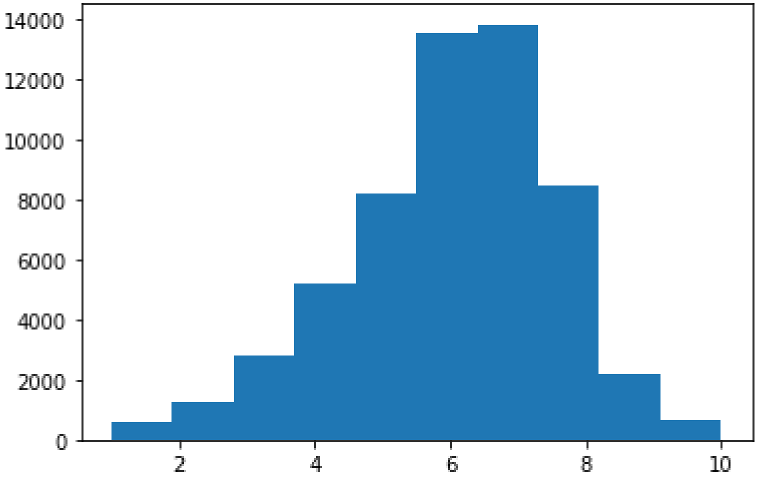
```
data = data[data["users_rated"] > 0]
```

In [136]:

```
data = data.dropna(axis=0)
```

In [137]:
```
plt.hist(data["average_rating"])
```

Out[137]:
```
(array([  602.,  1231.,  2824.,  5206.,  8223., 13593., 13849.,  8470.,
         2224.,   672.]),
 array([ 1. ,  1.9,  2.8,  3.7,  4.6,  5.5,  6.4,  7.3,  8.2,  9.1, 10. ]),
 <a list of 10 Patch objects>)
```



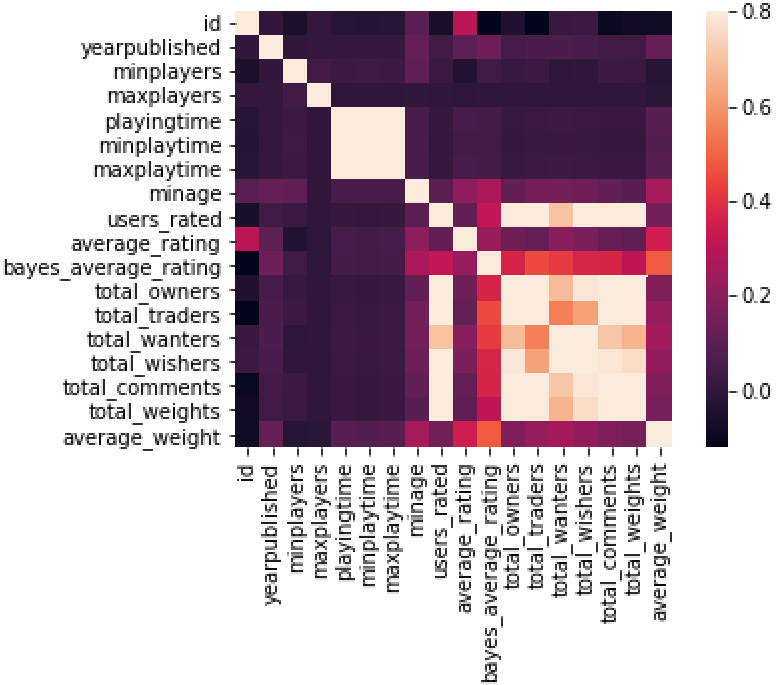
In [138]:
```
corr = data.corr()
```

In [139]:
```
fig = plt.figure(figsize = (12,9))
```

```
<Figure size 864x648 with 0 Axes>
```

In [140]:
```
sns.heatmap(corr, vmax=0.8, square = True)
```

Out[140]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x17a5cd1aa48>
```



In [141]:
```
data.columns
```

Out[141]:
```
Index(['id', 'type', 'name', 'yearpublished', 'minplayers', 'maxplayers',
       'playingtime', 'minplaytime', 'maxplaytime', 'minage', 'users_rated',
       'average_rating', 'bayes_average_rating', 'total_owners',
       'total_traders', 'total_wanters', 'total_wishers', 'total_comments',
       'total_weights', 'average_weight'],
      dtype='object')
```

In [142]:
```
columns = data.columns.tolist()
columns = [c for c in columns if c not in["bayes_average_rating","average_rating","type","name","id"]]
target_variable = "average_rating"
```

In [143]:

```
# Shuffling the Dataset
data = shuffle(data, random_state = 42)

#creating 4 divisions
div = int(data.shape[0]/4)

# 3 parts to train set and 1 part to test set
train = data.loc[:3*div+1,:]
test = data.loc[3*div+1:]
```

In [144]:

```
train.head()
```

Out[144]:

	id	type	name	yearpublished	minplayers	maxplayers	playingtime	minplaytime	maxplaytime	minage	users_rated	average_
10853	2361	boardgame	U.F.O.s	1992.0	3.0	6.0	45.0	45.0	45.0	10.0	36	5
17538	9649	boardgame	Jack Diamond Electronic Blackjack	2001.0	1.0	7.0	10.0	10.0	10.0	18.0	8	5
12089	26205	boardgame	Monopoly: Euro	2000.0	2.0	6.0	120.0	120.0	120.0	8.0	84	5
54056	93164	boardgame	Spline	2011.0	2.0	2.0	10.0	10.0	10.0	6.0	18	5
70120	152096	boardgame	The Bitcoin Harvest	2013.0	2.0	12.0	15.0	15.0	15.0	7.0	2	7

In [145]:

```
test.head()
```

Out[145]:

	id	type	name	yearpublished	minplayers	maxplayers	playingtime	minplaytime	maxplaytime	minage	users_rated	average_
42670	40143	boardgame	Game of 31	1800.0	2.0	2.0	3.0	3.0	3.0	0.0	4	3
46993	58979	boardgame	Gameplan	2003.0	2.0	0.0	0.0	0.0	0.0	8.0	1	4
73293	162074	boardgame	Darkfast Dungeons	2015.0	1.0	6.0	120.0	120.0	120.0	0.0	3	7
3764	4854	boardgame	7th Fleet	1987.0	2.0	2.0	120.0	120.0	120.0	12.0	314	7
4234	1681	boardgame	Tokyo Express	1988.0	1.0	2.0	180.0	180.0	180.0	12.0	223	6

In [146]:

```
# Initialize the model class.
model = LinearRegression()
# Fit the model to the training data.
model.fit(train[columns], train[target_variable])

# Generate our predictions for the test set.
predictions = model.predict(test[columns])

# Compute error between our test predictions and the actual values.
mean_squared_error(predictions, test[target_variable])
```

Out[146]:

```
2.1365835060240927
```

In [147]:

```
# Initialize the model with some parameters.
model = RandomForestRegressor(n_estimators=100, min_samples_leaf=10, random_state=1)
# Fit the model to the data.
model.fit(train[columns], train[target_variable])
# Make predictions.
predictions = model.predict(test[columns])
# Compute the error.
mean_squared_error(predictions, test[target_variable])
```

Out[147]:

```
1.477357198219484
```

In [ ]: