The goal of this project is to build a regressor model that recommends the “crew” size for cruise ship using the cruise ship dataset cruise_ship_info.csv.

In [3]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
```

Read dataset and display columns

In [4]:

```
df=pd.read_csv('cruise_ship_info.csv')
```

Exploratory Data Analysis

In [5]:

```
df.head()
```

Out[5]:

	Ship_name	Cruise_line	Age	Tonnage	passengers	length	cabins	passenger_density	crew
0	Journey	Azamara	6	30.277	6.94	5.94	3.55	42.64	3.55
1	Quest	Azamara	6	30.277	6.94	5.94	3.55	42.64	3.55
2	Celebration	Carnival	26	47.262	14.86	7.22	7.43	31.80	6.70
3	Conquest	Carnival	11	110.000	29.74	9.53	14.88	36.99	19.10
4	Destiny	Carnival	17	101.353	26.42	8.92	13.21	38.36	10.00

This is a supervised learning problem since both target and feature are known to us.

We independent variables Ship_name,Cruise_line,age, tonnage, passengers, length, cabins and passenger_density and dependent variable is crew .how the independent variables influence the number of crew on board we will find out.

The target variable is continuous so this is falls under Regression.We have to find out the cousal effect relationship,Since regression analysis helps us to understand how the value of the dependent variable is changing corresponding to an independent variable.

In [6]:

```
df.tail()
```

Out[6]:

	Ship_name	Cruise_line	Age	Tonnage	passengers	length	cabins	passenger_density	crew
153	Taurus	Star	22	3.341	0.66	2.79	0.33	50.62	0.59
154	Virgo	Star	14	76.800	19.60	8.79	9.67	39.18	12.00
155	Spirit	Windstar	25	5.350	1.58	4.40	0.74	33.86	0.88
156	Star	Windstar	27	5.350	1.67	4.40	0.74	32.04	0.88
157	Surf	Windstar	23	14.745	3.08	6.17	1.56	47.87	1.80

Random sampling

In [7]:

```
df.sample(5)
```

Out[7]:

	Ship_name	Cruise_line	Age	Tonnage	passengers	length	cabins	passenger_density	crew
87	Insignia	Oceania	15	30.277	6.84	5.94	3.42	44.26	4.00
35	Atlantica	Costa	13	85.619	21.14	9.57	10.56	40.50	9.20
149	Aries	Star	22	3.341	0.66	2.80	0.33	50.62	0.59
70	Musica	MSC	7	89.600	25.50	9.61	12.75	35.14	9.87
73	Sinfonia	MSC	11	58.600	15.66	8.23	7.83	37.42	7.60

Checking how many rows and how many columns present in my dataset

In [8]:

```
df.shape
```

Out[8]:

```
(158, 9)
```

In [9]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 158 entries, 0 to 157
Data columns (total 9 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Ship_name          158 non-null    object 
 1   Cruise_line        158 non-null    object 
 2   Age                158 non-null    int64  
 3   Tonnage            158 non-null    float64
 4   passengers         158 non-null    float64
 5   length             158 non-null    float64
 6   cabins             158 non-null    float64
 7   passenger_density  158 non-null    float64
 8   crew               158 non-null    float64
dtypes: float64(6), int64(1), object(2)
memory usage: 11.2+ KB
```

Calculate basic statistics of the data

In [10]:

```
df.describe()
```

Out[10]:

	Age	Tonnage	passengers	length	cabins	passenger_density	crew
count	158.000000	158.000000	158.000000	158.000000	158.000000	158.000000	158.000000
mean	15.689873	71.284671	18.457405	8.130633	8.830000	39.900949	7.794177
std	7.615691	37.229540	9.677095	1.793474	4.471417	8.639217	3.503487
min	4.000000	2.329000	0.660000	2.790000	0.330000	17.700000	0.590000
25%	10.000000	46.013000	12.535000	7.100000	6.132500	34.570000	5.480000
50%	14.000000	71.899000	19.500000	8.555000	9.570000	39.085000	8.150000
75%	20.000000	90.772500	24.845000	9.510000	10.885000	44.185000	9.990000
max	48.000000	220.000000	54.000000	11.820000	27.000000	71.430000	21.000000

Checking the data type of each column

In [11]:

```
df.dtypes
```

Out[11]:

```
Ship_name             object
Cruise_line           object
Age                    int64
Tonnage              float64
passengers           float64
length               float64
cabins               float64
passenger_density    float64
```

```
crew                 float64
dtype: object
```

counts of unique values present in Ship_name attribute

In [12]:

```
df['Ship_name'].value_counts()
```

Out[12]:

```
Spirit          4
Legend          3
Star            3
Sea             2
Sun             2
               ..
Quest           1
Vision          1
Victory         1
Mediterranea    1
Artemis         1
Name: Ship_name, Length: 138, dtype: int64
```

In [13]:

```
df['Ship_name'].unique()
```

Out[13]:

```
array(['Journey', 'Quest', 'Celebration', 'Conquest', 'Destiny',
       'Ecstasy', 'Elation', 'Fantasy', 'Fascination', 'Freedom', 'Glory',
       'Holiday', 'Imagination', 'Inspiration', 'Legend', 'Liberty*',
       'Miracle', 'Paradise', 'Pride', 'Sensation', 'Spirit', 'Triumph',
       'Valor', 'Victory', 'Century', 'Constellation', 'Galaxy',
       'Infinity', 'Mercury', 'Millenium', 'Solstice', 'Summit',
       'Xpedition', 'Zenith', 'Allegra', 'Atlantica', 'Classica',
       'Europa', 'Fortuna', 'Magica', 'Marina', 'Mediterranea',
       'Romantica', 'Serena', 'Victoria', 'Serenity', 'Symphony',
       'QueenElizabethII', 'QueenMary2', 'QueenVictoria', 'Magic',
       'Wonder', 'Amsterdam', 'Eurodam', 'Maasdam', 'Noordam',
       'Oosterdam', 'Prinsendam', 'Rotterdam', 'Ryndam', 'Statendam',
       'Veendam', 'Volendam', 'Westerdam', 'Zaandam', 'Zuiderdam',
       'Armonia', 'Fantasia', 'Lirica', 'Melody', 'Musica', 'Opera',
       'Rhapsody', 'Sinfonia', 'Crown', 'Dawn', 'Dream', 'Gem', 'Jewel',
       'Majesty', 'PrideofAloha', 'PrideofAmerica', 'Sea', 'Star', 'Sun',
       'Wind', 'Insignia', 'Nautica', 'Regatta', 'MarcoPolo', 'Arcadia',
       'Artemis', 'Aurora', 'Oceana', 'Oriana', 'Ventura', 'Caribbean',
       'Coral', 'Diamond', 'Emerald', 'Golden', 'Grand', 'Island',
       'Pacific', 'Regal', 'Royal', 'Saphire', 'Tahitian', 'ExplorerII',
       'Mariner', 'Navigator', 'PaulGauguin', 'Voyager', 'Adventure',
       'Brilliance', 'Empress', 'Enchantment', 'Explorer', 'Grandeur',
       'Independence', 'Liberty', 'Monarch', 'Oasis', 'Radiance',
       'Serenade', 'Sovreign', 'Splendour', 'Vision', 'Cloud', 'Shadow',
       'Whisper', 'Aries', 'Gemini', 'Libra', 'Pisces', 'Taurus', 'Virgo',
       'Surf'], dtype=object)
```

In [14]:

```
df['Ship_name'].nunique()
```

Out[14]:

```
138
```

counts of unique values present in Cruise_line attribute

In [15]:

```
df['Cruise_line'].value_counts()
```

Out[15]:

```
Royal_Caribbean      23
Carnival             22
Princess             17
Holland_American     14
Norwegian            13
Costa                11
Celebrity            10
MSC                   8
P&O                   6
Star                  6
Regent_Seven_Seas     5
Silversea             4
Oceania               3
Cunard                3
Windstar              3
Seabourn              3
Disney                2
Azamara               2
Crystal               2
Orient                1
Name: Cruise_line, dtype: int64
```

Analyzing duplicate values

In [16]:

```
df.duplicated().sum()
```

Out[16]:

```
0
```

Checking Any missing values present in the data set or not

In [17]:

```
df.isnull().sum()
```

Out[17]:

```
Ship_name            0
Cruise_line          0
Age                  0
Tonnage              0
passengers           0
length               0
cabins               0
passenger_density    0
crew                 0
dtype: int64
```

In [18]:

```
df.columns
```

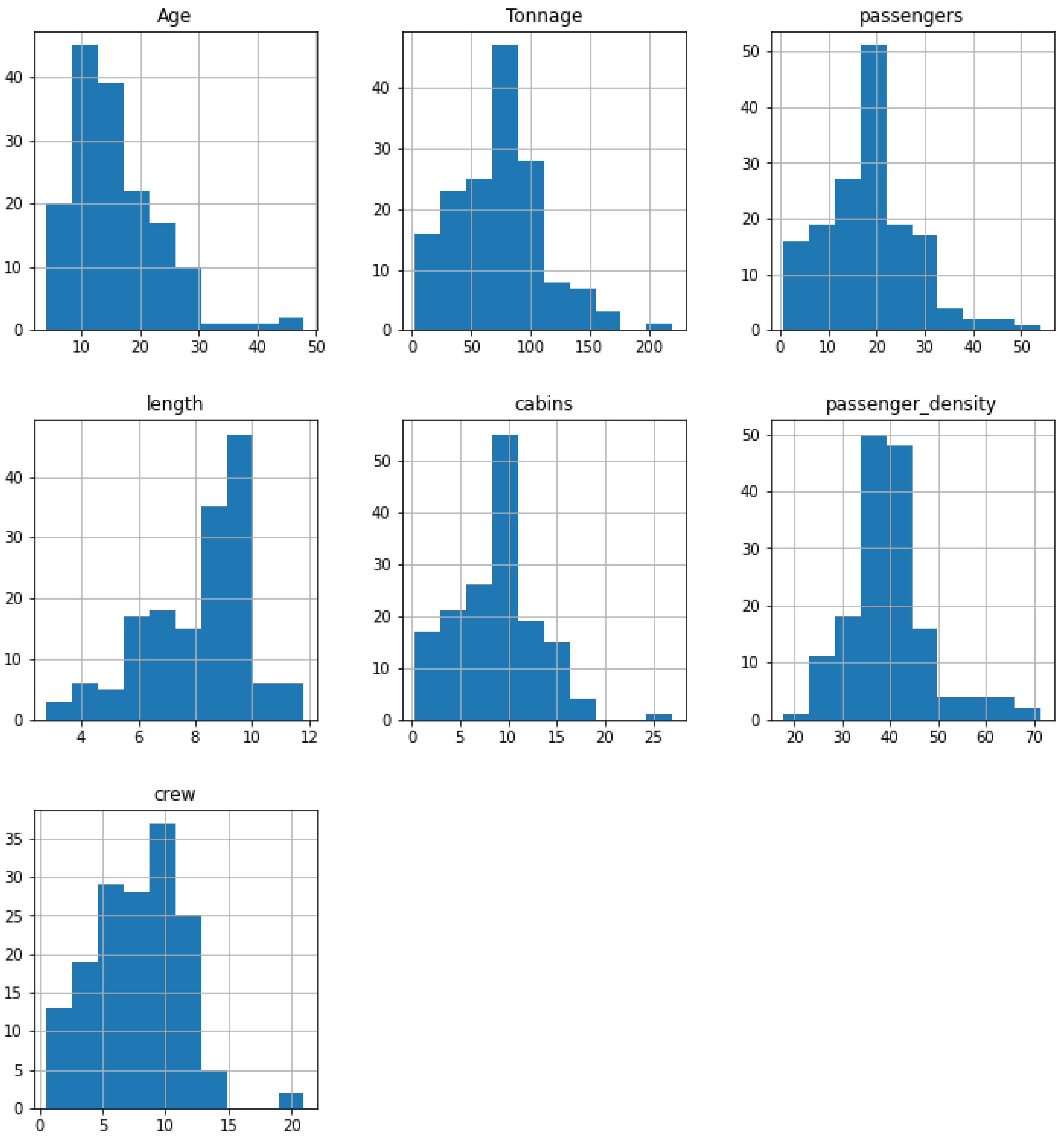
Out[18]:

```
Index(['Ship_name', 'Cruise_line', 'Age', 'Tonnage', 'passengers', 'length',
       'cabins', 'passenger_density', 'crew'],
      dtype='object')
```

Data visualization

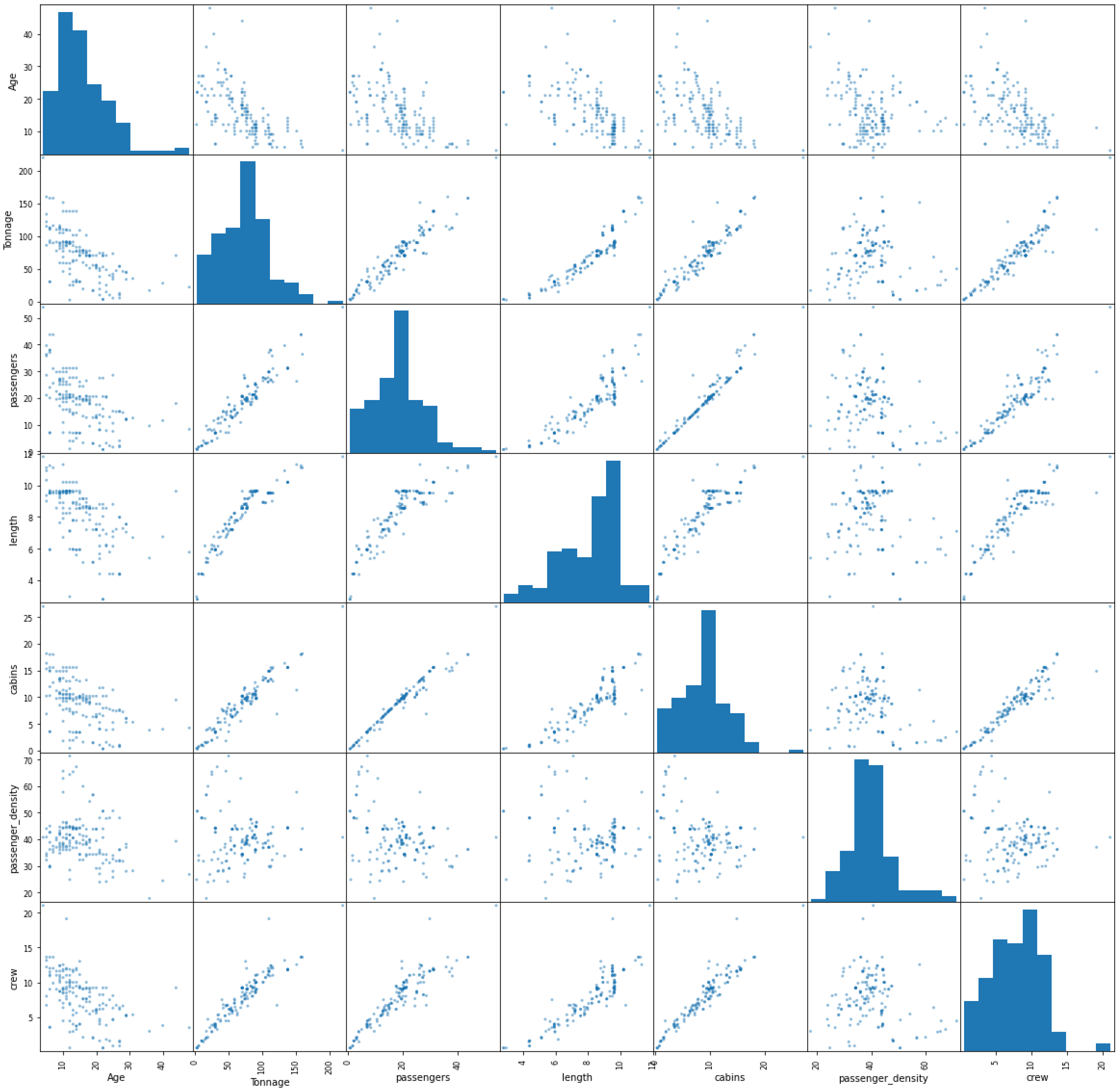
In [19]:

```
df.hist(bins=10,figsize=(12,13))
plt.show()
```



In [20]:

```
from pandas.plotting import scatter_matrix
scatter_matrix(df,figsize=(20,20));
```



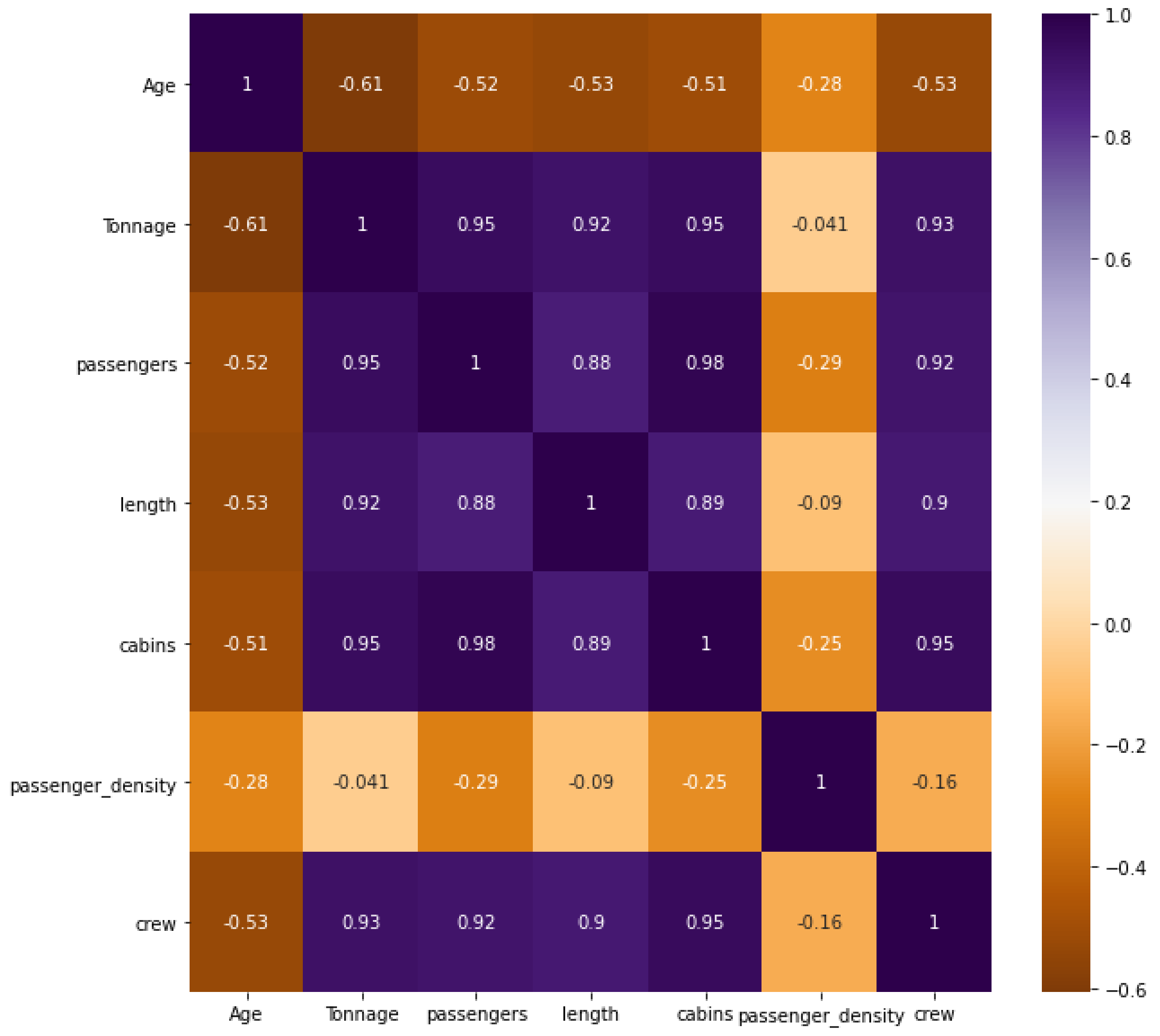
Correlation Analysis

In [21]:

```
cormat=df.corr()
top_corr_features=cormat.index
plt.figure(figsize=(10,10))

#Heat Map

g=sns.heatmap(df[top_corr_features].corr(),annot=True,cmap='PuOr')
```



We observe that variables are on different scales, for sample the Age variable ranges from about 4 years to 48 years, while the Tonnage variable ranges from 2 to 220. It is therefore important that when a regression model is built using these variables, variables be brought to same scale either by standardizing or normalizing the data.

From the covariance matrix plot above We also observe that the target variable 'crew' correlates well with 4 predictor variables - 'Tonnage', 'passengers', 'length', and 'cabins'.

In [22]:

```
df=df.drop(['passenger_density','Ship_name'],axis=1)
```

In [23]:

```
df.head()
```

Out[23]:

	Cruise_line	Age	Tonnage	passengers	length	cabins	crew
0	Azamara	6	30.277	6.94	5.94	3.55	3.55
1	Azamara	6	30.277	6.94	5.94	3.55	3.55
2	Carnival	26	47.262	14.86	7.22	7.43	6.70
3	Carnival	11	110.000	29.74	9.53	14.88	19.10
4	Carnival	17	101.353	26.42	8.92	13.21	10.00

Handling Categorical Data

In [24]:

```
df['Cruise_line'].value_counts()
```

Out[24]:

```
Royal_Caribbean      23
Carnival             22
Princess             17
Holland_American     14
Norwegian            13
Costa                11
Celebrity            10
MSC                   8
P&O                   6
Star                  6
Regent_Seven_Seas     5
Silversea             4
Oceania               3
Cunard                3
Windstar              3
Seabourn              3
Disney                2
Azamara               2
Crystal               2
Orient                1
Name: Cruise_line, dtype: int64
```

In [25]:

```
counts=df['Cruise_line'].value_counts()
```

In [26]:

```
df['Cruise_line'].nunique()
threshold=6
```

In [27]:

```
repl=counts[counts <= threshold].index
```

In [28]:

```
dummies=pd.get_dummies(df['Cruise_line'].replace(repl,'uncommon'),drop_first=True)
dummies
```

Out[28]:

	Celebrity	Costa	Holland_American	MSC	Norwegian	Princess	Royal_Caribbean	uncommon
0	0	0	0	0	0	0	0	1
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
...	...	...	...	...	...	...	...	...
153	0	0	0	0	0	0	0	1
154	0	0	0	0	0	0	0	1
155	0	0	0	0	0	0	0	1
156	0	0	0	0	0	0	0	1
157	0	0	0	0	0	0	0	1

158 rows × 8 columns

In [29]:

```
df=pd.concat([df,dummies],axis='columns')
df.head()
```

Out[29]:

	Cruise_line	Age	Tonnage	passengers	length	cabins	crew	Celebrity	Costa	Holland_American	MSC	Norwegian	Princess	Royal_Caribbean	uncommon
0	Azamara	6	30.277	6.94	5.94	3.55	3.55	0	0	0	0	0	0	0	1

	Cruise_line	Age	Tonnage	passengers	length	cabins	crew	Celebrity	Costa	Holland_American	MSC	Norwegian	Princess	Royal_Caribbean	uncommon
1	Azamara	6	30.277	6.94	5.94	3.55	3.55	0	0	0	0	0	0	0	1
2	Carnival	26	47.262	14.86	7.22	7.43	6.70	0	0	0	0	0	0	0	0
3	Carnival	11	110.000	29.74	9.53	14.88	19.10	0	0	0	0	0	0	0	0
4	Carnival	17	101.353	26.42	8.92	13.21	10.00	0	0	0	0	0	0	0	0

In [30]:

```
df=df.drop('Cruise_line',axis='columns')
df
```

Out[30]:

	Age	Tonnage	passengers	length	cabins	crew	Celebrity	Costa	Holland_American	MSC	Norwegian	Princess	Royal_Caribbean	uncommon
0	6	30.277	6.94	5.94	3.55	3.55	0	0	0	0	0	0	0	1
1	6	30.277	6.94	5.94	3.55	3.55	0	0	0	0	0	0	0	1
2	26	47.262	14.86	7.22	7.43	6.70	0	0	0	0	0	0	0	0
3	11	110.000	29.74	9.53	14.88	19.10	0	0	0	0	0	0	0	0
4	17	101.353	26.42	8.92	13.21	10.00	0	0	0	0	0	0	0	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
153	22	3.341	0.66	2.79	0.33	0.59	0	0	0	0	0	0	0	1
154	14	76.800	19.60	8.79	9.67	12.00	0	0	0	0	0	0	0	1
155	25	5.350	1.58	4.40	0.74	0.88	0	0	0	0	0	0	0	1
156	27	5.350	1.67	4.40	0.74	0.88	0	0	0	0	0	0	0	1
157	23	14.745	3.08	6.17	1.56	1.80	0	0	0	0	0	0	0	1

158 rows × 14 columns

Removing Outliers

In [31]:

```
def remove_outlier(df):
  for column_name in df.columns:
    Q1 = df[column_name].quantile(0.25)
    Q3 = df[column_name].quantile(0.75)
    IQR = Q3 - Q1
    lower_limit = Q1 - 1.5*IQR
    upper_limit = Q3 + 1.5*IQR
    print(lower_limit, upper_limit)
    dataset = df[(df[column_name] > lower_limit) | (df[column_name] < upper_limit)]
  return df
```

In [32]:

```
remove_outlier(df)
```

```
-5.0 35.0
-21.12625000000002 157.91175000000004
-5.929999999999996 43.309999999999995
3.4849999999999994 13.125
-0.996249999999999 18.013749999999998
-1.2849999999999993 16.755
0.0 0.0
0.0 0.0
0.0 0.0
0.0 0.0
0.0 0.0
0.0 0.0
0.0 0.0
-1.125 1.875
```

Out[32]:

	Age	Tonnage	passengers	length	cabins	crew	Celebrity	Costa	Holland_American	MSC	Norwegian	Princess	Royal_Caribbean	uncommon
0	6	30.277	6.94	5.94	3.55	3.55	0	0	0	0	0	0	0	1
1	6	30.277	6.94	5.94	3.55	3.55	0	0	0	0	0	0	0	1
2	26	47.262	14.86	7.22	7.43	6.70	0	0	0	0	0	0	0	0
3	11	110.000	29.74	9.53	14.88	19.10	0	0	0	0	0	0	0	0
4	17	101.353	26.42	8.92	13.21	10.00	0	0	0	0	0	0	0	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
153	22	3.341	0.66	2.79	0.33	0.59	0	0	0	0	0	0	0	1
154	14	76.800	19.60	8.79	9.67	12.00	0	0	0	0	0	0	0	1
155	25	5.350	1.58	4.40	0.74	0.88	0	0	0	0	0	0	0	1
156	27	5.350	1.67	4.40	0.74	0.88	0	0	0	0	0	0	0	1
157	23	14.745	3.08	6.17	1.56	1.80	0	0	0	0	0	0	0	1

158 rows × 14 columns

In [33]:

```
df = remove_outlier(df)
```

```
-5.0 35.0
-21.12625000000002 157.91175000000004
-5.929999999999996 43.309999999999995
3.4849999999999994 13.125
-0.996249999999999 18.013749999999998
-1.2849999999999993 16.755
0.0 0.0
0.0 0.0
0.0 0.0
0.0 0.0
0.0 0.0
0.0 0.0
0.0 0.0
-1.125 1.875
```

Spliting Data Frame

In [34]:

```
y=df['crew']
x=df.drop('crew',axis=1)
```

Spliting the data into train and test set

In [35]:

```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=7)
#80% for training 20% for testing
```

Feature Scaling

In [36]:

```
from sklearn.preprocessing import StandardScaler
st= StandardScaler()
x_train= st.fit_transform(x_train)
x_test= st.transform(x_test)
```

In [37]:

```
x_train.shape
```

Out[37]:

```
(126, 13)
```

In [38]:

```
x_test
```

Out[38]:

```
array([[ 0.91217288, -1.95382232, -1.96243281, -3.13023805, -2.04667747,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563, -0.26037782,
        -0.36760731, -0.42139067,  1.87082869],
       [ 0.63981794, -0.63766906, -0.17335943, -0.40537196, -0.08172024,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563,  3.84057287,
        -0.36760731, -0.42139067, -0.53452248],
       [ 1.59306021, -0.55129294, -0.44352866, -0.15243081, -0.37844981,
        -0.24253563, -0.29361011,  3.082207  , -0.24253563, -0.26037782,
        -0.36760731, -0.42139067, -0.53452248],
       [-0.17724686,  0.09353029,  0.09680979,  0.16374564,  0.21500933,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563,  3.84057287,
        -0.36760731, -0.42139067, -0.53452248],
       [ 0.91217288, -0.10794922, -0.34141745, -0.12368749, -0.26630005,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563, -0.26037782,
         2.7202941 , -0.42139067, -0.53452248],
       [ 1.32070528, -1.09591766, -0.91366565, -1.20443607, -0.89480599,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563,  3.84057287,
        -0.36760731, -0.42139067, -0.53452248],
       [-0.31342433, -1.20619153, -1.30509193, -1.32515798, -1.3247134 ,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563, -0.26037782,
        -0.36760731, -0.42139067,  1.87082869],
       [-0.4496018 , -0.65876348, -1.2880734 , -0.66406178, -1.29667596,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563, -0.26037782,
        -0.36760731, -0.42139067,  1.87082869],
       [-0.31342433, -1.352659  , -1.62631676, -1.30791199, -1.67050849,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563, -0.26037782,
        -0.36760731, -0.42139067,  1.87082869],
       [-0.17724686, -0.29793781, -0.50096621, -0.27315272, -0.44153405,
        -0.24253563, -0.29361011,  3.082207  , -0.24253563, -0.26037782,
        -0.36760731, -0.42139067, -0.53452248],
       [-0.8581342 ,  1.08985323,  0.81158822,  0.72711457,  1.00005765,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563, -0.26037782,
         2.7202941 , -0.42139067, -0.53452248],
       [ 0.36746301, -0.12715624, -0.03082921,  0.16374564,  0.0117379 ,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563, -0.26037782,
        -0.36760731, -0.42139067,  1.87082869],
       [ 0.23128554, -0.09346068,  0.14999271,  0.17524296,  0.25940195,
        -0.24253563, -0.29361011, -0.32444284, -0.24253563, -0.26037782,
        -0.36760731, -0.42139067, -0.53452248],
       [ 0.36746301, -0.08682704, -0.14995895, -0.05470354, -0.07938378,
         4.12310563, -0.29361011, -0.32444284, -0.24253563, -0.26037782,
        -0.36760731, -0.42139067, -0.53452248],
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        -0.36760731, -0.42139067,  1.87082869]])
```

In [39]:

```
y_train
```

Out[39]:

```
101    12.38
46      5.45
37      6.36
52      6.00
117     2.11
       ...  
92      5.20
103    11.00
151     6.80
67     13.13
25      9.99
Name: crew, Length: 126, dtype: float64
```

Model Building

In [40]:

```
from sklearn.linear_model import LinearRegression
model = LinearRegression()

model.fit(x_train,y_train)
y_train_pred = model.predict(x_train)
y_test_pred = model.predict(x_test)
```

In [41]:

```
model.score(x_train,y_train)
```

Out[41]:

```
0.931956461116654
```

In [42]:

```
model.score(x_test,y_test)
```

```
Out[42]: 0.9645147961329215
```

```
In [44]: from sklearn.svm import SVR
```

```
In [45]: model1 = SVR()

         model1.fit(x_train,y_train)
         y_train_pred1 = model.predict(x_train)
         y_test_pred1 = model.predict(x_test)
```

```
In [46]: model1.score(x_train,y_train)

Out[46]: 0.8953747662016067
```

```
In [47]: model1.score(x_test,y_test)

Out[47]: 0.6161130192800981
```

```
In [48]: from sklearn.neighbors import KNeighborsRegressor
         model2 =KNeighborsRegressor()

         model2.fit(x_train,y_train)
         y_train_pred2 = model.predict(x_train)
         y_test_pred2 = model.predict(x_test)
```

```
In [49]: model2.score(x_train,y_train)

Out[49]: 0.857572753171546
```

```
In [50]: model2.score(x_test,y_test)

Out[50]: 0.7532059869450326
```

```
In [51]: from sklearn.ensemble import RandomForestRegressor
         rf = RandomForestRegressor()
         rf.fit(x_train, y_train)

Out[51]: RandomForestRegressor()
```

```
In [52]: rf.score(x_train, y_train)

Out[52]: 0.9852516990250114
```

```
In [53]: rf.score(x_test, y_test)

Out[53]: 0.85147550527253
```

I have used Multiple Linear Regression,Support Vector Regression,K-Nearest Neighbor(KNN),Random Forest Regressor for my model building . Multiple Linear Regression model gives me highest accuracy for both training and test dataset.

```
In [ ]:
```