Model creation and Prediction:

Programmer: Souparna Bose

Import required libraries

In [1]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

%matplotlib inline
```

Load dataset into a pandas DataFrame

In [2]:
```
df = pd.read_csv('trainingData.csv')
```

Display all columns in dataset

In [5]:
```
pd.set_option('display.max_column',None)
df.head()
```

Out[5]:

	Id	city	age	sex	social_class	primary_business	secondary_business	annual_income	monthly_
0	1	Dhanbad	22	F	Mochi	Tailoring	Others	36000.0	
1	2	Manjapra	21	F	OBC	Tailoring	none	94000.0	
2	3	Dhanbad	24	M	Nai	Beauty salon	Others	48000.0	
3	4	NaN	26	F	OBC	Tailoring	none	7000.0	
4	5	Nuapada	23	F	OBC	General store	Agriculture	36000.0	

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

Out[6]:
```
(40000, 21)
```

Drop redundant features from dataset for model training

In [8]:
```
df.drop(['Id','city','age','sex','social_class','primary_business','secondary_business'
```

In [9]:
```
df.head()
```

Out[9]:

	annual_income	monthly_expenses	home_ownership	occupants_count	house_area	sanitary_availabilit
0	36000.0	5000.0	1.0	4	70.0	1.
1	94000.0	3600.0	1.0	4	80.0	1.
2	48000.0	4000.0	1.0	4	50.0	1.
3	7000.0	5000.0	1.0	5	50.0	1.

	annual_income	monthly_expenses	home_ownership	occupants_count	house_area	sanitary_availabilit
4	36000.0	3500.0	1.0	1	112.0	1.(

In [10]:
```
df.drop(['occupants_count','sanitary_availability','water_availabity','loan_purpose','l
```

Final dataset having only relevant features for model prediction

In [11]:
```
df.head()
```

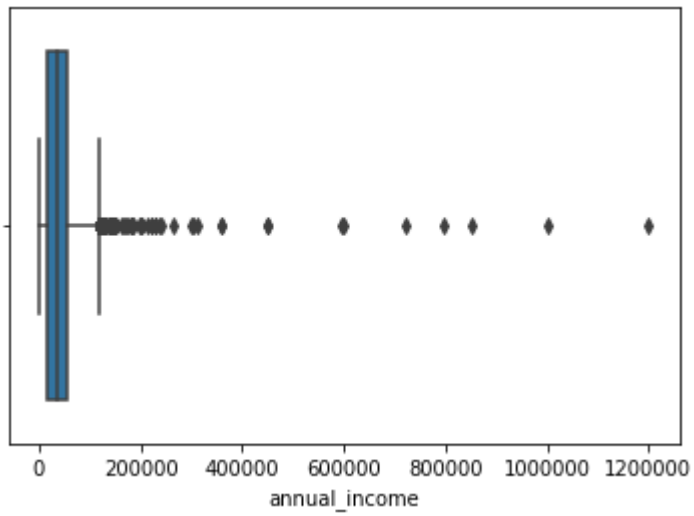
Out[11]:

	annual_income	monthly_expenses	home_ownership	house_area	loan_amount
0	36000.0	5000.0	1.0	70.0	5000.0
1	94000.0	3600.0	1.0	80.0	7500.0
2	48000.0	4000.0	1.0	50.0	5000.0
3	7000.0	5000.0	1.0	50.0	7500.0
4	36000.0	3500.0	1.0	112.0	5000.0

Checking for outliers in the dataset with the help of boxplots

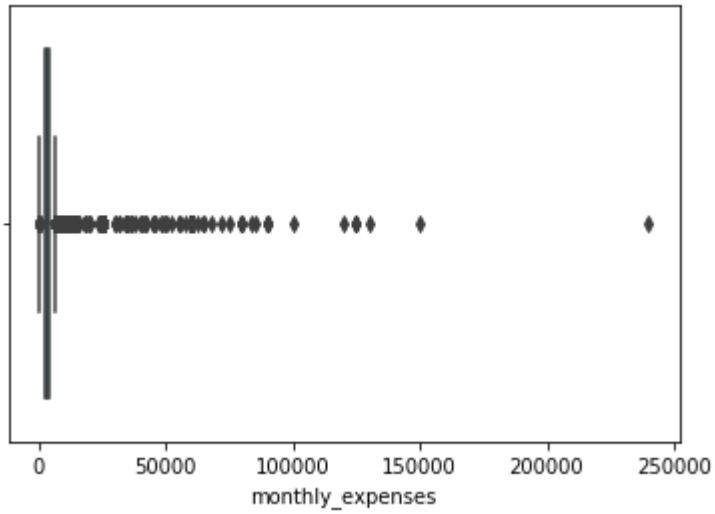
In [12]:
```
sns.boxplot(x=df['annual_income'])
```

Out[12]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2052a3f1e88>
```



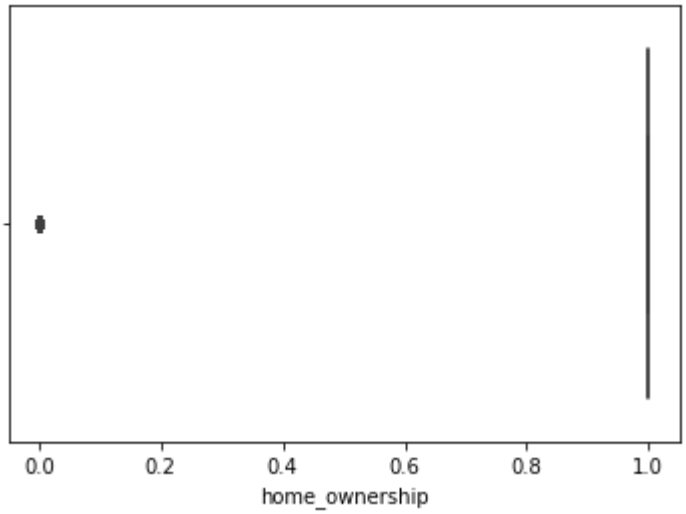
In [13]:
```
sns.boxplot(x=df['monthly_expenses'])
```

Out[13]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2052c7c25c8>
```



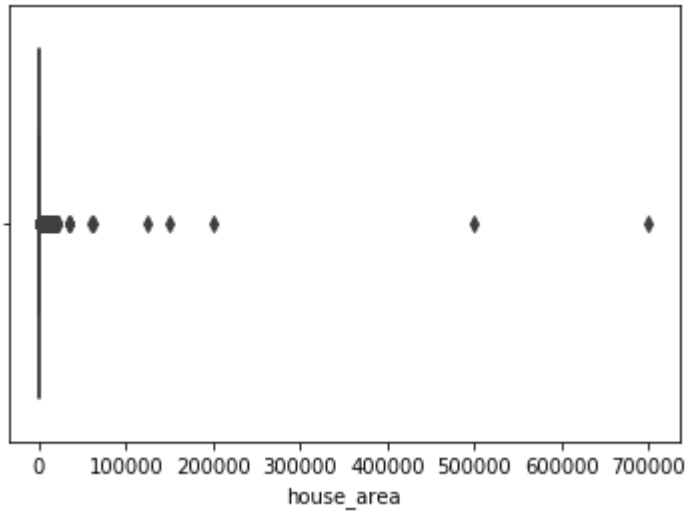
In [14]:
```
sns.boxplot(x=df['home_ownership'])
```

Out[14]: <matplotlib.axes._subplots.AxesSubplot at 0x2052c823608>



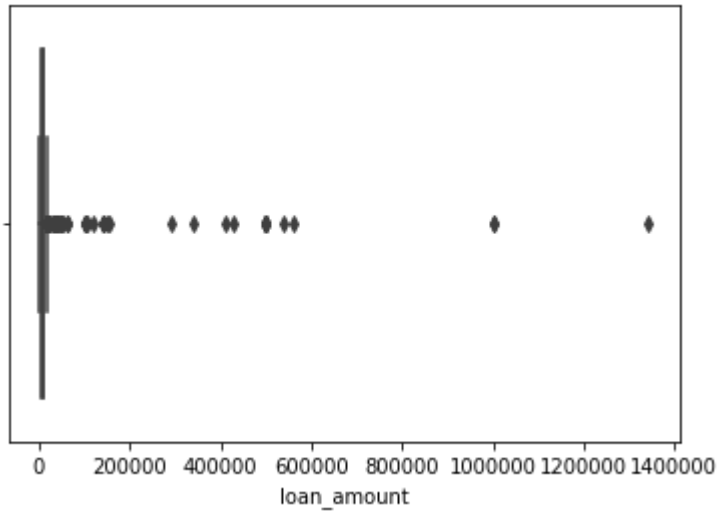
In [15]:
```
sns.boxplot(x=df['house_area'])
```

Out[15]: <matplotlib.axes._subplots.AxesSubplot at 0x2052c382548>



In [16]:
```
sns.boxplot(x=df['loan_amount'])
```

Out[16]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2052cf3dd48>
```



Checking for missing values in the dataset

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

Out[18]:
```
annual_income         0
monthly_expenses    120
home_ownership      379
house_area            0
loan_amount           0
dtype: int64
```

Calculating Z score for all features in the dataset

In [19]:
```
from scipy import stats

z = np.abs(stats.zscore(df))
print(z)
```

```
[[0.05707326        nan        nan 0.10502915 0.25098556]
 [1.96110726        nan        nan 0.10285375 0.06711834]
 [0.36048133        nan        nan 0.10937994 0.25098556]
 ...
 [0.36048133        nan        nan 0.01026684 0.03034489]
 [0.36048133        nan        nan 0.01026684 0.03034489]
 [1.19559052        nan        nan 0.01026684 0.03034489]]
```

Since the no of missing values are very small compared to the dataset, we are going to drop those for training our model

In [22]:
```
df.dropna(inplace=True)
```

Re-checking for missing values

In [23]:
```
df.isnull().sum()
```

Out[23]:
```
annual_income       0
monthly_expenses    0
home_ownership      0
house_area          0
```

```
loan_amount         0
dtype: int64
```

Checking and printing outlier data

In [30]:
```
z = np.abs(stats.zscore(df))

threshold = 3
print(np.where(z > 3))
print('\n')
print(np.where(z > 3))
```

```
(array([   14,    15,    20, ..., 39591, 39593, 39593], dtype=int64), array([2, 2, 2,
..., 4, 1, 4], dtype=int64))


(array([   14,    15,    20, ..., 39591, 39593, 39593], dtype=int64), array([2, 2, 2,
..., 4, 1, 4], dtype=int64))
```

Shape of dataset after removing missing values

In [31]:
```
df.shape
```

Out[31]: (39607, 5)

In [33]:
```
new_df = df[(z>3).all(axis=1)]
```

In [34]:
```
new_df.shape
```

Out[34]: (0, 5)

In [35]:
```
df.shape
```

Out[35]: (39607, 5)

Forming new dataset excluding the outliers

In [37]:
```
ref_df = df[(z<3).all(axis=1)]
```

In [39]:
```
ref_df.shape
```

Out[39]: (38187, 5)

Splitting the dataset into training and testing sets

In [41]:
```
from sklearn.model_selection import train_test_split
```

In [42]:
```
ref_df.head()
```

Out[42]:

	annual_income	monthly_expenses	home_ownership	house_area	loan_amount
0	36000.0	5000.0	1.0	70.0	5000.0
1	94000.0	3600.0	1.0	80.0	7500.0
2	48000.0	4000.0	1.0	50.0	5000.0

	annual_income	monthly_expenses	home_ownership	house_area	loan_amount
3	7000.0	5000.0	1.0	50.0	7500.0
4	36000.0	3500.0	1.0	112.0	5000.0

In [44]:
```
X = ref_df.drop(['loan_amount'],axis=1).values
```

In [45]:
```
X.shape
```

Out[45]: (38187, 4)

In [46]:
```
y = ref_df['loan_amount'].values
```

In [47]:
```
y.shape
```

Out[47]: (38187,)

Splitting the dataset

In [49]:
```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.3,random_state=100)
```

In [50]:
```
print(X_train.shape,'\t',X_test.shape,'\t',y_train.shape,'\t',y_test.shape,'\t',)
```

(26730, 4) (11457, 4) (26730,) (11457,)

Creating Linear Regression Model

In [51]:
```
from sklearn.linear_model import LinearRegression
```

In [52]:
```
lg_model = LinearRegression()
```

Scaling the data

In [53]:
```
from sklearn.preprocessing import MinMaxScaler
```

In [54]:
```
scaler = MinMaxScaler()
```

In [55]:
```
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

Model training and prediction

In [56]:
```
lg_model.fit(X_train,y_train)
```

Out[56]: LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)

In [58]:
```
pred_lg = lg_model.predict(X_test)
```

Model evaluation metrics

In [60]:
```
from sklearn.metrics import mean_absolute_error,mean_squared_error,r2_score
```

In [70]:
```
print(mean_absolute_error(y_test,pred_lg))
print(mean_squared_error(y_test,pred_lg))
print(np.sqrt(mean_squared_error(y_test,pred_lg)))
print(r2_score(y_test,pred_lg))
```

```
2306.6192815188533
8277725.786806463
2877.103714989514
0.11477411415994243
```

Creating an Artificial Neural Network using keras and tensorflow for model training and prediction

In [64]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
```

Defining model parameters and Compiling the ANN

In [65]:
```
dl_model = Sequential()

dl_model.add(Dense(80,activation='relu'))
dl_model.add(Dense(50,activation='relu'))
dl_model.add(Dense(20,activation='relu'))

dl_model.add(Dense(1))

dl_model.compile(optimizer='rmsprop',loss='mse')
```

ANN Model training and prediction

In [68]:
```
dl_model.fit(X_train,y_train,epochs=500,verbose=0,validation_data=(X_test,y_test))
```

Out[68]:
```
<tensorflow.python.keras.callbacks.History at 0x205403bd448>
```

In [71]:
```
pred_dl = dl_model.predict(X_test)
```

ANN model evaluation metrics

In [72]:
```
print(mean_absolute_error(y_test,pred_dl))
print(mean_squared_error(y_test,pred_dl))
print(np.sqrt(mean_squared_error(y_test,pred_dl)))
print(r2_score(y_test,pred_dl))
```

```
1954.43169950259
6711335.628026043
2590.6245633101767
0.2822849923395032
```

As seen from above, the ANN model performs better compared to LinearRegression. However, there is scope for further improvement by tuning hyperparameters as well as checking for predictions including other features

In [ ]:
```
```