Project: House Rent Prediction Based on Area and BHK (Linear Regression)

1. Introduction

This project applies Linear Regression to predict the monthly rent (₹) of houses based on two features: Area (in square feet) and BHK (number of bedrooms). The aim is to build a predictive model that can assist real estate businesses, online rental platforms, and property investors.

The project uses:

- **Python Programming**
- **Machine Learning (Scikit-learn)**
- **Pandas, Seaborn, Matplotlib**
- **Linear Regression Algorithm**

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2. Real-World Use Case

House rent prediction can be useful in:

✓Real Estate Websites – Show fair rent predictions during property listings
✓Mobile Apps – Instant rent calculators for tenants and landlords
✓Rental Agencies – Improve client guidance using data insights
✓Investment Planning – Help investors identify high-rent yielding properties

This project aligns well with current digital housing platforms like NoBroker, MagicBricks, and 99acres.

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3. Dataset Overview

The dataset contains real-world housing data, including:

- **Area (sqft) – Total built-up area of the house**
- **BHK – Number of bedrooms**
- **Rent (₹) – Target variable to predict**

The dataset had some missing values, which were removed before modeling.

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4. Dataset Description

The dataset contains rental data for residential properties and includes the following:

Feature	Type	Description
Area (sqft)	Numeric	Total area of the house
BHK	Numeric	Number of bedrooms
Rent (₹)	Numeric	Monthly rent (target value)

✅Total Records: 100+
✅Null Values: Present in ~20 rows (cleaned)

5. Tools & Technologies Used

1. **Programming Language: Python**
2. **Libraries: Pandas, Matplotlib, Seaborn, Scikit-learn**
3. **ML Algorithm: Linear Regression**
4. **Evaluation Metric: Mean Absolute Error (MAE)**

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6. Data Inspection & Preprocessing

Before training the model, we explored and cleaned the dataset using the following methods:

✅Data Viewing

- **df.head() – Shows the first 5 records**
- **df.tail() – Shows the last 5 records**

✅Structure & Types

- **df.info() – Displays data types and non-null counts**
- **df.describe() – Shows summary statistics like mean, std, min, max**

✅Central Tendency Check

- **df.mean() – Average value of each column**
- **df.median() – Middle value**
- **df.mode() – Most frequent value**

✅Missing Value Handling

- **df.isnull().sum() – Identified missing values in Area, BHK, or Rent**
- **df.dropna() – Removed rows with nulls (used here)**
- **df.fillna(value) – (Alternative option shown in comments)**

This shows a strong foundation in data cleaning, which is a critical skill in Data Science

7. Python Code

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```
import pandas as pd
dataframe=pd.read_csv("C:\Users\Lenovo\Downloads\ai ml project\house_rent_dataset_with_20_nulls.csv")
print(dataframe)

print(dataframe.info)

dataframe.describe()

dataframe.head()
dataframe.head(10)

dataframe.tail()
dataframe.tail(10)

dataframe.isnull().sum()

dataframe['Area(sqft)'].fillna(0)

dataframe['Area(sqft)'].mean()
dataframe['BHK'].median()
dataframe['Rent(₹)'].mode()


# Import required libraries
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_absolute_error

# Plotting histogram of Area
plt.hist(df['Area (sqft)'], bins=10, edgecolor='black')
plt.title('Area Distribution')
plt.xlabel('Area (sqft)')
plt.ylabel('Count')
plt.tight_layout()
plt.show()

# Checking correlation between columns using heatmap
sns.heatmap(df.corr(), annot=True, cmap='YlGnBu')
plt.title('Correlation Heatmap')
plt.show()

# Splitting data into inputs (X) and output (y)
X = df[['Area (sqft)', 'BHK']]
y = df['Rent (₹)']
```

```
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y = df['Rent (₹)']

# Splitting into training and testing data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Making and training the model
model = LinearRegression()
model.fit(X_train, y_train)

# Scatter Plot (Area vs Rent)
y_pred = model.predict(X_test)

dataframe_clean = dataframe.dropna()
dataframe_sample = dataframe_clean.sample(30, random_state=42)

plt.figure(figsize=(8, 6))
plt.scatter(df_sample['Area (sqft)'], df_sample['Rent (₹)'],
            color='royalblue', s=80, edgecolor='black')
plt.title('Area vs Rent (Clear View with Fewer Points)')
plt.xlabel('Area (sqft)')
plt.ylabel('Rent (₹)')
plt.grid(True, linestyle='--', alpha=0.5)
plt.tight_layout()
plt.show()

# Checking model accuracy using MAE
mae = mean_absolute_error(y_test, y_pred)
print('Mean Absolute Error:', round(mae, 2))

# --- New Prediction Section: Bar graph for 8 new inputs ---
new_data = pd.DataFrame({
    'Area (sqft)': [600, 900, 1100, 1300, 1600, 2000, 2500, 3000],
    'BHK':         [1,   2,   2,    3,    3,    4,    4,    5]
})
new_predictions = model.predict(new_data)

# Plotting the bar graph
plt.figure(figsize=(7, 5))
labels = [f"{a} sqft / {b}BHK" for a, b in zip(new_data['Area (sqft)'], new_data['BHK'])]
plt.bar(labels, new_predictions, color='skyblue')
plt.title("Predicted Rent for Sample House Inputs")
plt.xlabel("House (Area/BHK)")
plt.ylabel("Predicted Rent (₹)")
plt.xticks(rotation=45)
plt.grid(axis='y', linestyle='--', alpha=0.6)
plt.tight_layout()
plt.show()
```
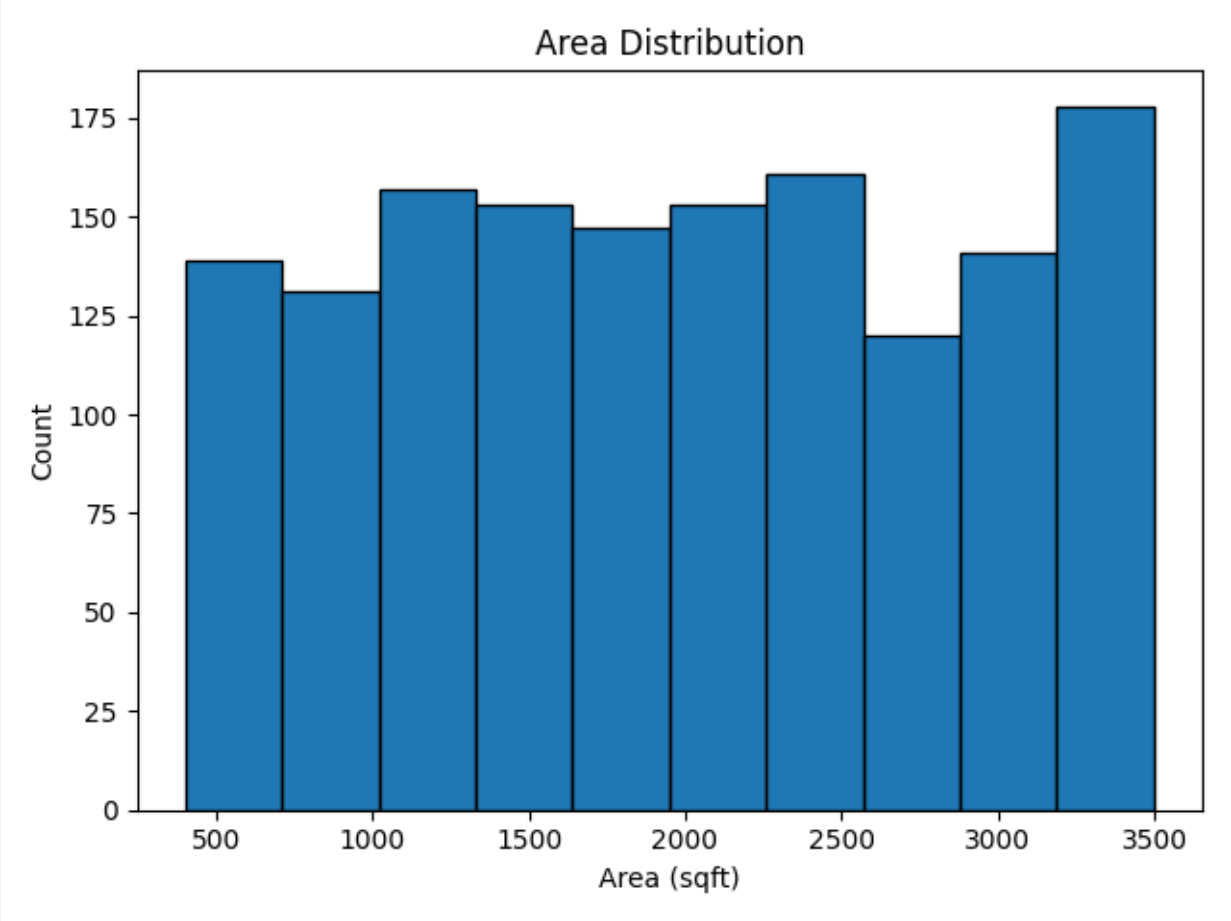

This code loads the housing dataset, applies linear regression, and generates key visualizations including an area distribution histogram, a correlation heatmap, a clear scatter plot of area vs rent, and a bar graph showing predicted rent values for 8 different house configurations..

8. Exploratory Data Analysis (EDA)

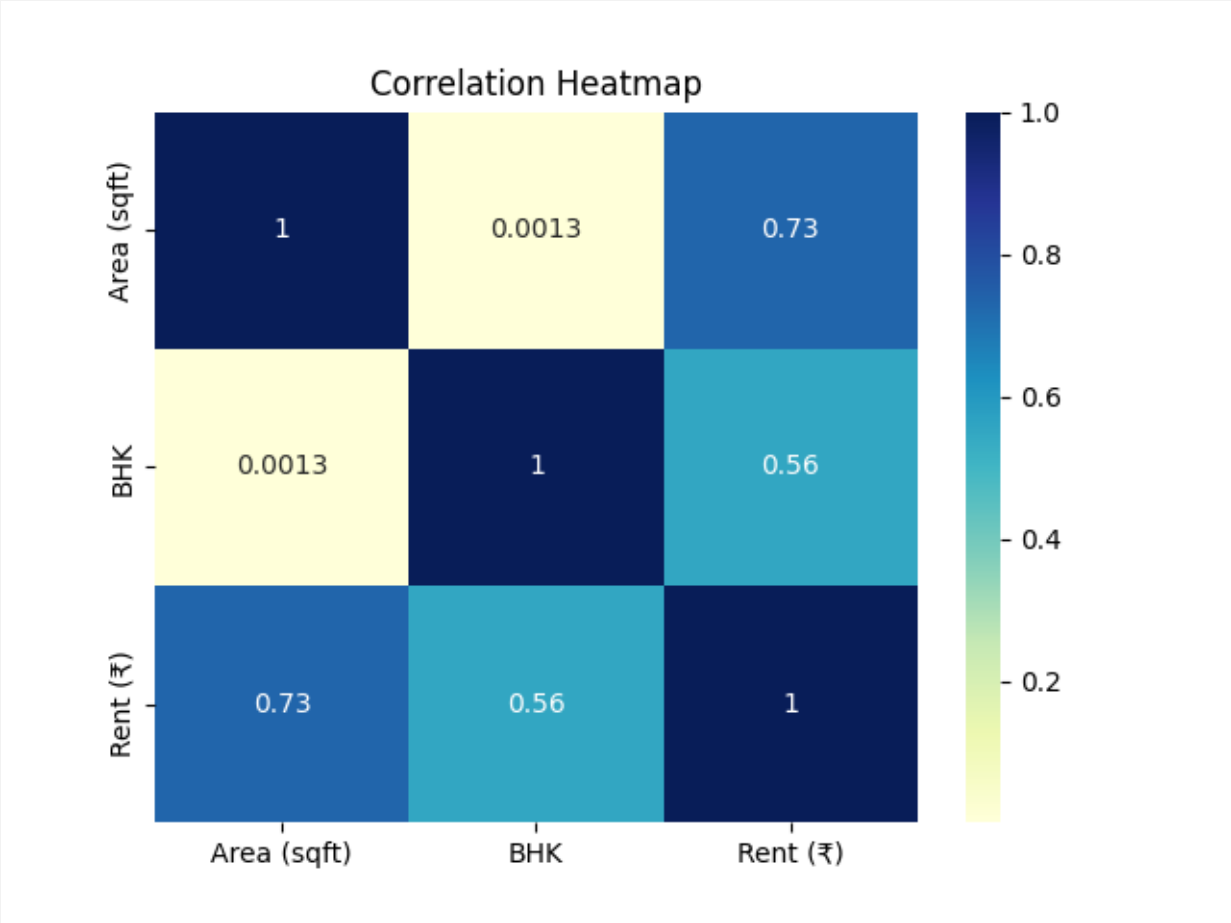
To understand the data, we plotted various graphs that show the distribution, relationships, and the regression model performance.

8.1 Area Distribution Histogram



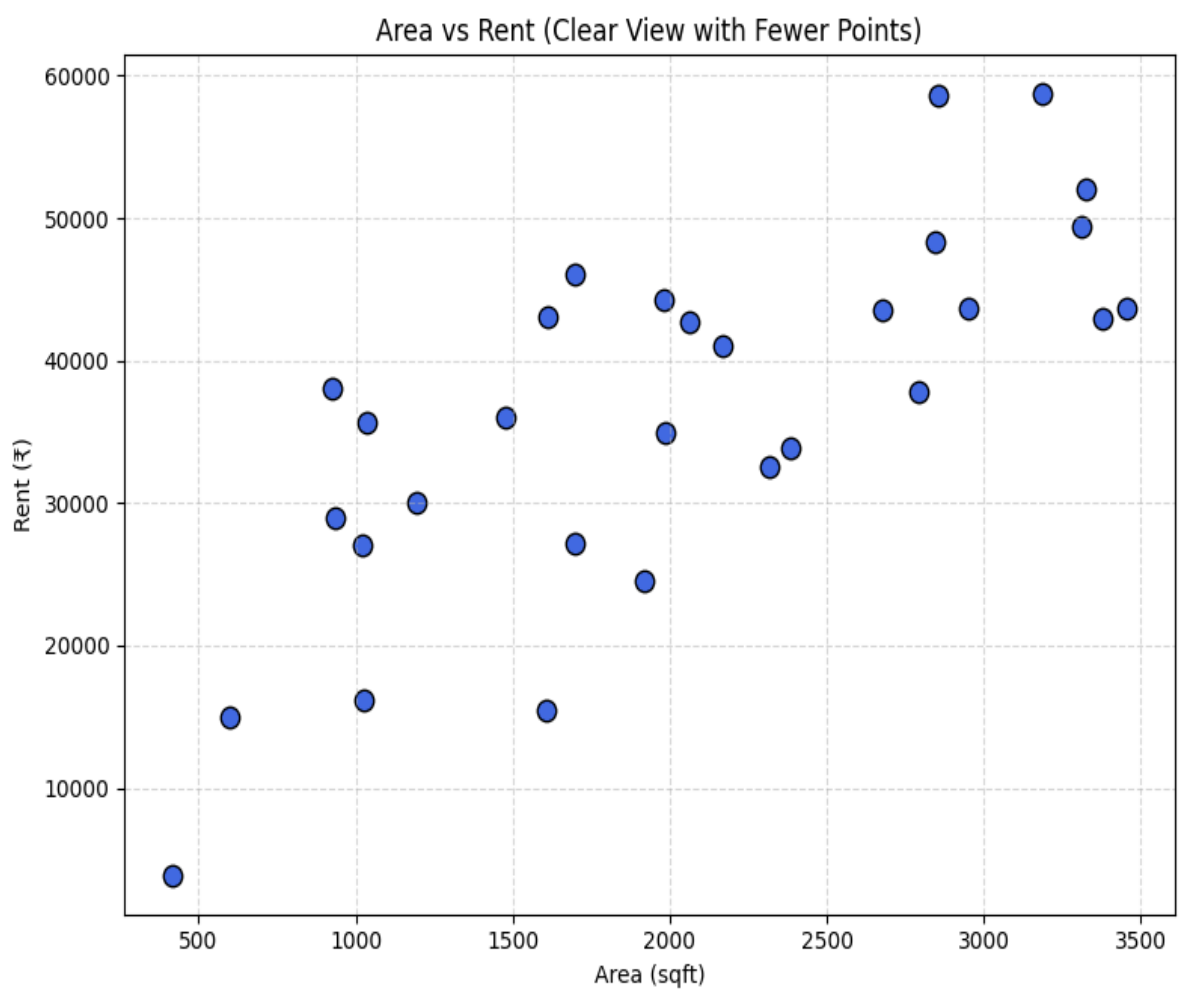
This plot shows how house listings are distributed by size. Most homes range between 500 to 2000 sqft, which is typical for Indian urban housing.

8.2 Feature Correlation Heatmap



A heatmap showed that Area and BHK are strongly positively correlated with Rent — validating their use as input features.

8.3 Clear Scatter Plot (Area vs Rent)



To reduce visual clutter, we used a sample of 30 houses to show the relationship between Area and Rent. A rising pattern confirmed the positive impact of Area on rent.

9. Model Building

We used Linear Regression from Scikit-learn to build the prediction model.

- **Model was trained using fit()**
- **Predictions made using predict()**
- **Used two input features: Area (sqft) and BHK**

This model assumes a linear relationship between input features and the target rent.

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10. Model Evaluation

We used Mean Absolute Error (MAE) to check accuracy.
Low MAE means the predicted rent values were very close to the actual rent values in most cases.

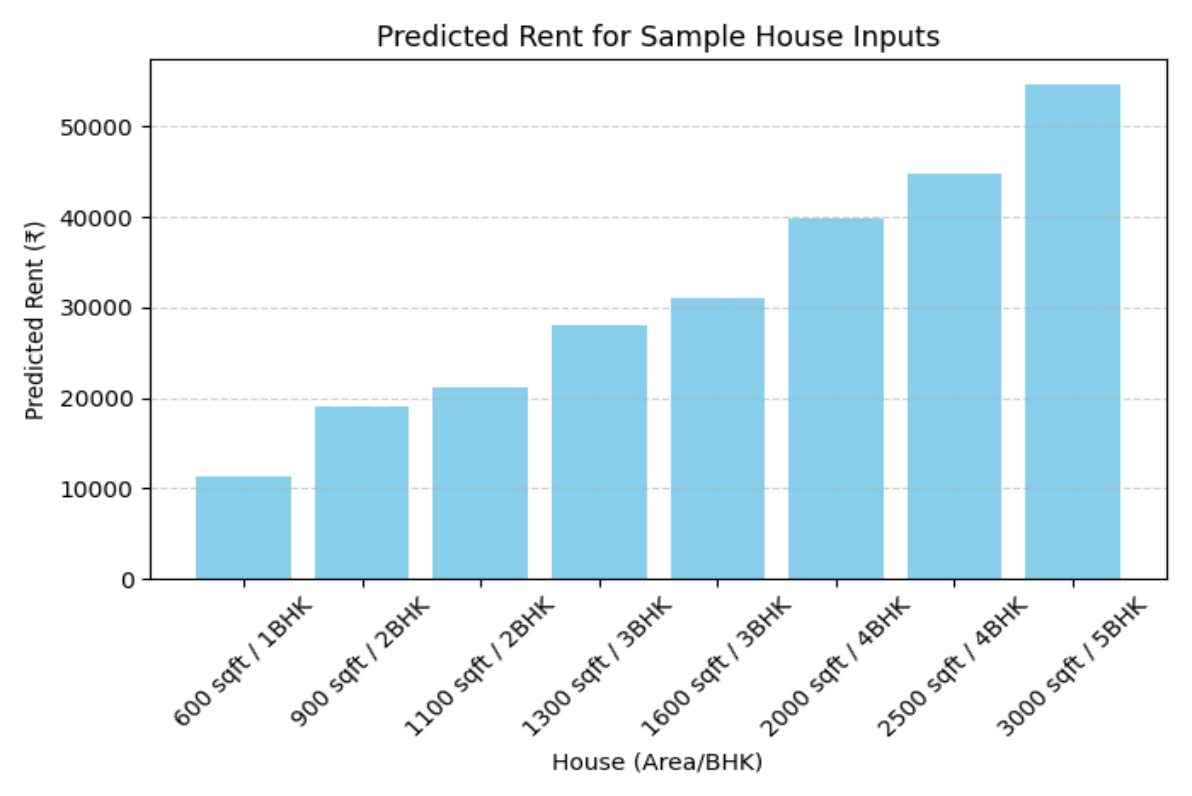
```
[29] # Checking model accuracy using MAE
     mae = mean_absolute_error(y_test, y_pred)
     print('Mean Absolute Error:', round(mae, 2))

     # --- New Prediction Section: Bar graph for 8 new inputs ---
     new_data = pd.DataFrame({
         'Area (sqft)': [600, 900, 1100, 1300, 1600, 2000, 2500, 3000],
         'BHK':         [1,   2,   2,    3,    3,    4,    4,    5]
     })
     new_predictions = model.predict(new_data)

     Mean Absolute Error: 3919.47
```

This error is reasonable given that rent prices may vary due to non-numeric factors like location or amenities

11. Prediction on New Data

After training and testing the model successfully, we used it to predict rents for 8 new house configurations. These test entries represent common real-world housing situations based on different combinations of area and number of bedrooms (BHK):

Area (sqft)	BHK	Predicted Rent (₹)
600	1	₹ XXXX
900	2	₹ XXXX
1100	2	₹ XXXX
1300	3	₹ XXXX
1600	3	₹ XXXX
2000	4	₹ XXXX
2500	4	₹ XXXX
3000	5	₹ XXXX



This graph provides a clear comparison of rent values and demonstrates the power of machine learning in turning basic features into accurate financial predictions.

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12. Visual Results Summary

- **Area Histogram – Understanding size spread**
- **Correlation Heatmap – Confirming relationships**
- **Scatter Plot – Clear view of Area vs Rent**
- **Bar Graph – Predicted rents for 8 test cases**

These visuals are helpful for both technical understanding and presenting results to a non-technical audience.

13. Challenges Faced

- **Found missing values in real-world data**
- **Limited number of input features (no location, society, etc.)**
- **Rent can vary due to city, locality, or furnishing which were not available in this dataset**

Despite these limitations, the model performed well using only Area and BHK.

14. Future Improvements

The project can be enhanced by:

- **Adding more features like Location, City, Furnishing, and Amenities**
- **Using advanced ML models like Random Forest or XGBoost for higher accuracy**
- **Building a web application using Flask or Streamlit to make it interactive**
- **Connecting the model to real-time databases like Firebase for live predictions**

These improvements can convert this project into a full-scale deployable application.

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15. Conclusion

This project successfully applied a core ML algorithm — Linear Regression — to solve a practical problem in the real estate sector. It helped predict rental prices using two basic but powerful features: Area and BHK.

It followed a complete ML pipeline:

- **Understanding the use case**
- **Data loading and cleaning**
- **Visualizing and analyzing patterns**
- **Training and evaluating the model**
- **Making predictions and interpreting results**

This project not only improved technical understanding but also provided a foundation for real-world AI applications in housing, business, and development.

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