RAJALAKSHMI ENGINEERING COLLEGE

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Department of Computer Science and Engineering

CS23334 Fundamentals of Data Science Lab

III semester II Year (2023R)

Name of the Student : SAISANJAY SS

Register Number : 2116240701458

ex - 1a

October 31, 2025

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

     sns.set(style="whitegrid")

     def load_job_data(csv_path=None):
         if csv_path:
             df = pd.read_csv(csv_path, parse_dates=['date_posted'])
             return df
         rng = pd.date_range(start='2015-01-01', end='2024-12-31', freq='D')
         years = rng.year
         base_by_year = {y: 50 + (y - 2015) * 60 for y in range(2015, 2025)}
         counts = [np.random.poisson(lam=max(1, base_by_year[y]/30)) for y in years]
         df = pd.DataFrame({'date_posted': rng, 'postings': counts})
         return df

     def aggregate_by_year(df):
         df['date_posted'] = pd.to_datetime(df['date_posted'])
         df['year'] = df['date_posted'].dt.year
         if 'postings' in df.columns:
             yearly = df.groupby('year')['postings'].sum().
       ↪reset_index(name='num_postings')
         else:
             yearly = df.groupby('year').size().reset_index(name='num_postings')
         return yearly

     def plot_trend(yearly_df, title="Data Science Job Postings by Year"):
         plt.figure(figsize=(10,5))
         ax = sns.lineplot(data=yearly_df, x='year', y='num_postings', marker='o')
         ax.set_title(title)
         ax.set_xlabel("Year")
         ax.set_ylabel("Number of Job Postings")
         plt.xticks(yearly_df['year'])
         plt.tight_layout()
```

```python
    plt.show()

if _name_ == "_main_":
    df = load_job_data(csv_path=None)
    yearly = aggregate_by_year(df)
    print(yearly)
    plot_trend(yearly)
```

ex - 1b

October 31, 2025

[ ]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import re

sns.set(style="whitegrid")

ROLE_KEYWORDS = {
    'Data Scientist': ['data scientist', r'\bds\b', 'machine learning␣
 ↪scientist', 'ml scientist'],
    'Data Engineer': ['data engineer', 'etl engineer', 'pipeline engineer'],
    'Data Analyst': ['data analyst', 'business analyst', 'analyst', 'bi␣
 ↪analyst'],
    'Machine Learning Engineer': ['ml engineer', 'machine learning engineer',␣
 ↪'mle'],
    'BI Developer': ['bi developer', 'business intelligence', 'power bi',␣
 ↪'tableau developer'],
    'Research Scientist': ['research scientist', 'researcher'],
    'Other': []
}

def map_title_to_role(title):
    t = title.lower()
    for role, keys in ROLE_KEYWORDS.items():
        for key in keys:
            if re.search(r'\b' + re.escape(key) + r'\b', t) or key in t:
                return role
    return 'Other'

def categorize_roles(df, title_col='job_title'):
    df = df.copy()
    df[title_col] = df[title_col].astype(str)
    df['role'] = df[title_col].apply(map_title_to_role)
    return df

def plot_role_distribution(df, title_col='role'):
    counts = df[title_col].value_counts().reset_index()
    counts.columns = ['role', 'count']
    plt.figure(figsize=(10,5))
    sns.barplot(data=counts, x='role', y='count')
    plt.xticks(rotation=45, ha='right')
    plt.title("Distribution of Data Science Roles (bar)")
    plt.tight_layout()
    plt.show()

    plt.figure(figsize=(7,7))
    plt.pie(counts['count'], labels=counts['role'], autopct='%1.1f%%',␣
  ↪startangle=140)
    plt.title("Distribution of Data Science Roles (pie)")
    plt.tight_layout()
    plt.show()

if _name_ == "_main_":
    sample_titles = [
        "Senior Data Scientist", "Junior Data Analyst", "Machine Learning␣
  ↪Engineer",
        "Data Engineer", "BI Developer (Power BI)", "Business Analyst - Data",
        "Research Scientist, ML", "Data Scientist / ML", "Analyst", "ETL␣
  ↪Engineer",
        "Data Scientist", "Data Analyst", "MLOps Engineer", "Data Engineer -␣
  ↪Big Data"
    ]
    df = pd.DataFrame({'job_title': sample_titles})
    df = categorize_roles(df)
    print(df[['job_title','role']])
    plot_role_distribution(df, title_col='role')
```

ex - 1c

October 31, 2025

[ ]:
```python
import pandas as pd
import json
from xml.etree import ElementTree as ET

def structured_example():
    data = {
        'id': [1,2,3],
        'name': ['Alice','Bob','Carol'],
        'age': [29, 34, 23]
    }
    df = pd.DataFrame(data)
    print("Structured data (pandas DataFrame):")
    print(df)
    df.to_csv('structured_example.csv', index=False)
    print("Saved to structured_example.csv")

def unstructured_example():
    docs = [
        "Today I attended a data science meetup and learned about transformers.
 ↪",
        "Error: Connection refused at 2025-10-31 10:12:00 - service X failed.",
        "Image: binary data (not text) - e.g. photos, audio transcripts"
    ]
    print("\nUnstructured data (plain text documents):")
    for i, doc in enumerate(docs,1):
        print(f"Doc {i}: {doc}")
    with open('unstructured_example.txt','w',encoding='utf-8') as f:
        for d in docs:
            f.write(d + "\n")

def semi_structured_example():
    items = [
        {"id":1, "name":"Alice", "skills":["python","sql"]},
        {"id":2, "name":"Bob", "contact":{"email":"bob@example.com","phone":
 ↪"12345"}},
        {"id":3, "name":"Carol", "notes":"Prefers remote"}
    ]
    print("\nSemi-structured data (JSON-like):")
    print(json.dumps(items, indent=2))
    with open('semi_structured_example.json','w',encoding='utf-8') as f:
        json.dump(items, f, indent=2)

def xml_example():
    root = ET.Element('employees')
    e1 = ET.SubElement(root,'employee', attrib={'id':'1'})
    ET.SubElement(e1, 'name').text = 'Alice'
    ET.SubElement(e1, 'role').text = 'Data Scientist'
    tree = ET.ElementTree(root)
    tree.write('semi_structured_example.xml', encoding='utf-8',␣
 ↪xml_declaration=True)
    print("\nWrote semi_structured_example.xml (XML is semi-structured)")

if _name_ == "_main_":
    structured_example()
    unstructured_example()
    semi_structured_example()
    xml_example()

    print("\nCharacteristics summary:")
    print("- Structured: rigid schema, easy to query (e.g., SQL tables, CSV).")
    print("- Unstructured: no predefined schema (text, images), needs parsing/
 ↪NLP/vision.")
    print("- Semi-structured: tags/keys but not rigid (JSON, XML, logs with key:
 ↪value).")
```

ex - 1d

October 31, 2025

[ ]:
```python
from cryptography.fernet import Fernet

def generate_key():
    return Fernet.generate_key()

def encrypt_message(key: bytes, plaintext: str) -> bytes:
    f = Fernet(key)
    token = f.encrypt(plaintext.encode('utf-8'))
    return token

def decrypt_message(key: bytes, token: bytes) -> str:
    f = Fernet(key)
    plaintext = f.decrypt(token)
    return plaintext.decode('utf-8')

if _name_ == "_main_":
    key = generate_key()
    print("Generated key (store securely):", key.decode())

    secret = "MyVerySensitivePassword123!"
    token = encrypt_message(key, secret)
    print("\nEncrypted token (bytes):", token)

    recovered = decrypt_message(key, token)
    print("\nDecrypted plaintext:", recovered)

    with open('secret.key','wb') as f:
        f.write(key)
    print("\nKey saved to secret.key (handle securely)")
```

ex - 2

October 31, 2025

[ ]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
file_path='C:\sales_data.csv'
df = pd.read_csv(file_path)
print(df.head())
print(df.isnull().sum())
df['Sales'].fillna(df['Sales'].mean(), inplace=True)
df.dropna(subset=['Product', 'Quantity', 'Region'], inplace=True)
print(df.describe())
product_summary = df.groupby('Product').agg({
'Sales': 'sum',
'Quantity': 'sum'
}).reset_index()
print(product_summary)
plt.figure(figsize=(10, 6))
plt.bar(product_summary['Product'], product_summary['Sales'])
plt.xlabel('Product')
plt.ylabel('Total Sales')
plt.title('Total Sales by Product')
plt.show()
df['Date'] = pd.to_datetime(df['Date'])
sales_over_time = df.groupby('Date').agg({'Sales': 'sum'}).reset_index()
plt.figure(figsize=(10, 6))
plt.plot(sales_over_time['Date'],sales_over_time['Sales'])
plt.xlabel('Date')
plt.ylabel('Total Sales')
plt.title('SalesOver Time')
plt.show()
pivot_table = df.pivot_table(values='Sales', index='Region', columns='Product',
aggfunc=np.sum, fill_value=0)
print(pivot_table)
correlation_matrix = df.corr()
print(correlation_matrix)
import seaborn as sns
plt.figure(figsize=(8, 6))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm')
```

```
plt.title('Correlation Matrix')
plt.show()
```

exercise3

November 2, 2025

```
[138]: import pandas as pd
       df=pd.read_csv('pre_process_datasample.csv')
```

```
[139]: df
```

```
[139]:    Country   Age   Salary Purchased
       0   France  44.0  72000.0        No
       1    Spain  27.0  48000.0       Yes
       2  Germany  30.0  54000.0        No
       3    Spain  38.0  61000.0        No
       4  Germany  40.0  61000.0       Yes
       5   France  35.0  58000.0       Yes
       6    Spain  44.0  52000.0        No
       7   France  48.0  79000.0       Yes
       8   France  50.0  83000.0        No
       9   France  37.0  67000.0       Yes
```

```
[140]: df['Country'].isnull()
```

```
[140]: 0    False
       1    False
       2    False
       3    False
       4    False
       5    False
       6    False
       7    False
       8    False
       9    False
       Name: Country, dtype: bool
```

```
[141]: df.loc[8]
```

```
[141]: Country       France
       Age             50.0
       Salary       83000.0
       Purchased         No
       Name: 8, dtype: object
```

[142]:
```
n=df['Country'].mode()[0]
print(n)
```

```
France
```

[143]:
```
df['Country']=df['Country'].fillna(n)
```

[144]:
```
df
```

[144]:
```
   Country   Age   Salary Purchased
0   France  44.0  72000.0        No
1    Spain  27.0  48000.0       Yes
2  Germany  30.0  54000.0        No
3    Spain  38.0  61000.0        No
4  Germany  40.0  61000.0       Yes
5   France  35.0  58000.0       Yes
6    Spain  44.0  52000.0        No
7   France  48.0  79000.0       Yes
8   France  50.0  83000.0        No
9   France  37.0  67000.0       Yes
```

[145]:
```
df['Age'].count()
```

[145]:
```
np.int64(10)
```

[146]:
```
df['Age'].isna().sum()
```

[146]:
```
np.int64(0)
```

[147]:
```
df['Age']=df['Age'].fillna(df['Age'].mode())
```

[148]:
```
df
```

[148]:
```
   Country   Age   Salary Purchased
0   France  44.0  72000.0        No
1    Spain  27.0  48000.0       Yes
2  Germany  30.0  54000.0        No
3    Spain  38.0  61000.0        No
4  Germany  40.0  61000.0       Yes
5   France  35.0  58000.0       Yes
6    Spain  44.0  52000.0        No
7   France  48.0  79000.0       Yes
8   France  50.0  83000.0        No
9   France  37.0  67000.0       Yes
```

[149]:
```
df['Salary']=df['Salary'].fillna(df['Salary'].mode())
```

[150]:
```
df
```

[150]:
```
   Country   Age   Salary Purchased
0   France  44.0  72000.0        No
1    Spain  27.0  48000.0       Yes
2  Germany  30.0  54000.0        No
3    Spain  38.0  61000.0        No
4  Germany  40.0  61000.0       Yes
5   France  35.0  58000.0       Yes
6    Spain  44.0  52000.0        No
7   France  48.0  79000.0       Yes
8   France  50.0  83000.0        No
9   France  37.0  67000.0       Yes
```

[153]:
```
df
```

[153]:
```
   Country   Age   Salary Purchased
0   France  44.0  72000.0        No
1    Spain  27.0  48000.0       Yes
2  Germany  30.0  54000.0        No
3    Spain  38.0  61000.0        No
4  Germany  40.0  61000.0       Yes
5   France  35.0  58000.0       Yes
6    Spain  44.0  52000.0        No
7   France  48.0  79000.0       Yes
8   France  50.0  83000.0        No
9   France  37.0  67000.0       Yes
```

[154]:
```
df.to_csv('pre_process_datasample.csv',index=False)
```

[155]:
```
df
```

[155]:
```
   Country   Age   Salary Purchased
0   France  44.0  72000.0        No
1    Spain  27.0  48000.0       Yes
2  Germany  30.0  54000.0        No
3    Spain  38.0  61000.0        No
4  Germany  40.0  61000.0       Yes
5   France  35.0  58000.0       Yes
6    Spain  44.0  52000.0        No
7   France  48.0  79000.0       Yes
8   France  50.0  83000.0        No
9   France  37.0  67000.0       Yes
```

[ ]:
```
#next file pre-processing
```

[217]:
```
df1=pd.read_csv('Hotel_Dataset.csv')
```

[218]:
```
df1
```

```
[218]:     CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
       0            1     20-25            4       Ibis            veg  1300
       1            2     30-35            5  LemonTree        Non-Veg  2000
       2            3     25-30            6     RedFox            Veg  1322
       3            4     20-25           -1  LemonTree            Veg  1234
       4            5       35+            3       Ibis     Vegetarian   989
       5            6       35+            3       Ibys        Non-Veg  1909
       6            7       35+            4     RedFox     Vegetarian  1000
       7            8     20-25            7  LemonTree            Veg  2999
       8            9     25-30            2       Ibis        Non-Veg  3456
       9            9     25-30            2       Ibis        Non-Veg  3456
       10          10     30-35            5     RedFox        non-Veg -6755

           NoOfPax  EstimatedSalary Age_Group.1
       0         2            40000       20-25
       1         3            59000       30-35
       2         2            30000       25-30
       3         2           120000       20-25
       4         2            45000         35+
       5         2           122220         35+
       6        -1            21122         35+
       7       -10           345673       20-25
       8         3           -99999       25-30
       9         3           -99999       25-30
       10        4            87777       30-35
```

```
[219]: df1.drop_duplicates(inplace=True)
```

```
[220]: df1
```

```
[220]:     CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
       0            1     20-25            4       Ibis            veg  1300
       1            2     30-35            5  LemonTree        Non-Veg  2000
       2            3     25-30            6     RedFox            Veg  1322
       3            4     20-25           -1  LemonTree            Veg  1234
       4            5       35+            3       Ibis     Vegetarian   989
       5            6       35+            3       Ibys        Non-Veg  1909
       6            7       35+            4     RedFox     Vegetarian  1000
       7            8     20-25            7  LemonTree            Veg  2999
       8            9     25-30            2       Ibis        Non-Veg  3456
       10          10     30-35            5     RedFox        non-Veg -6755

           NoOfPax  EstimatedSalary Age_Group.1
       0         2            40000       20-25
       1         3            59000       30-35
       2         2            30000       25-30
       3         2           120000       20-25
```

```
4          2           45000         35+
5          2          122220         35+
6         -1           21122         35+
7        -10          345673       20-25
8          3          -99999       25-30
10         4           87777       30-35
```

```
[221]: df1.reset_index(drop=True, inplace=False)
```

```
[221]:    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  NoOfPax  \
       0           1     20-25            4       Ibis            veg  1300        2
       1           2     30-35            5  LemonTree        Non-Veg  2000        3
       2           3     25-30            6     RedFox            Veg  1322        2
       3           4     20-25           -1  LemonTree            Veg  1234        2
       4           5       35+            3       Ibis     Vegetarian   989        2
       5           6       35+            3       Ibys        Non-Veg  1909        2
       6           7       35+            4     RedFox     Vegetarian  1000       -1
       7           8     20-25            7  LemonTree            Veg  2999      -10
       8           9     25-30            2       Ibis        Non-Veg  3456        3
       9          10     30-35            5     RedFox        non-Veg -6755        4

          EstimatedSalary Age_Group.1
       0            40000       20-25
       1            59000       30-35
       2            30000       25-30
       3           120000       20-25
       4            45000         35+
       5           122220         35+
       6            21122         35+
       7           345673       20-25
       8           -99999       25-30
       9            87777       30-35
```

```
[222]: df1['FoodPreference']=df1['FoodPreference'].str.replace('Vegetarian', 'Veg')
```

```
[223]: df1['FoodPreference']=df1['FoodPreference'].str.replace('non-veg','Non-Veg')
```

```
[224]: df1
```

```
[224]:     CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
       0            1     20-25            4       Ibis            veg  1300
       1            2     30-35            5  LemonTree        Non-Veg  2000
       2            3     25-30            6     RedFox            Veg  1322
       3            4     20-25           -1  LemonTree            Veg  1234
       4            5       35+            3       Ibis            Veg   989
       5            6       35+            3       Ibys        Non-Veg  1909
       6            7       35+            4     RedFox            Veg  1000
```

```
7             8     20-25            7  LemonTree             Veg  2999
8             9     25-30            2       Ibis         Non-Veg  3456
10           10     30-35            5     RedFox         non-Veg -6755

    NoOfPax  EstimatedSalary Age_Group.1
0         2            40000       20-25
1         3            59000       30-35
2         2            30000       25-30
3         2           120000       20-25
4         2            45000         35+
5         2           122220         35+
6        -1            21122         35+
7       -10           345673       20-25
8         3           -99999       25-30
10        4            87777       30-35
```

[225]:
```
df1['FoodPreference']=df1['FoodPreference'].str.replace('veg', 'Veg')
```

[226]:
```
df1
```

[226]:
```
    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
0            1     20-25            4       Ibis            Veg  1300
1            2     30-35            5  LemonTree        Non-Veg  2000
2            3     25-30            6     RedFox            Veg  1322
3            4     20-25           -1  LemonTree            Veg  1234
4            5       35+            3       Ibis            Veg   989
5            6       35+            3       Ibys        Non-Veg  1909
6            7       35+            4     RedFox            Veg  1000
7            8     20-25            7  LemonTree            Veg  2999
8            9     25-30            2       Ibis        Non-Veg  3456
10          10     30-35            5     RedFox        non-Veg -6755

    NoOfPax  EstimatedSalary Age_Group.1
0         2            40000       20-25
1         3            59000       30-35
2         2            30000       25-30
3         2           120000       20-25
4         2            45000         35+
5         2           122220         35+
6        -1            21122         35+
7       -10           345673       20-25
8         3           -99999       25-30
10        4            87777       30-35
```

[227]:
```
df1['Hotel']=df1['Hotel'].str.replace('Ibys', 'Ibis')
```

[228]:
```
df1
```

[228]:
```
    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
0            1     20-25            4       Ibis            Veg  1300
1            2     30-35            5  LemonTree        Non-Veg  2000
2            3     25-30            6     RedFox            Veg  1322
3            4     20-25           -1  LemonTree            Veg  1234
4            5       35+            3       Ibis            Veg   989
5            6       35+            3       Ibis        Non-Veg  1909
6            7       35+            4     RedFox            Veg  1000
7            8     20-25            7  LemonTree            Veg  2999
8            9     25-30            2       Ibis        Non-Veg  3456
10          10     30-35            5     RedFox        non-Veg -6755

    NoOfPax  EstimatedSalary Age_Group.1
0         2            40000       20-25
1         3            59000       30-35
2         2            30000       25-30
3         2           120000       20-25
4         2            45000         35+
5         2           122220         35+
6        -1            21122         35+
7       -10           345673       20-25
8         3           -99999       25-30
10        4            87777       30-35
```

[229]:
```
condition = df1['Bill'] < 0
print(condition)
```

```
0     False
1     False
2     False
3     False
4     False
5     False
6     False
7     False
8     False
10     True
Name: Bill, dtype: bool
```

[230]:
```
df1.loc[condition, 'Bill'] = 0
```

[231]:
```
df1
```

[231]:
```
    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
0            1     20-25            4       Ibis            Veg  1300
1            2     30-35            5  LemonTree        Non-Veg  2000
2            3     25-30            6     RedFox            Veg  1322
3            4     20-25           -1  LemonTree            Veg  1234
```

```
4             5        35+            3        Ibis           Veg   989
5             6        35+            3        Ibis       Non-Veg  1909
6             7        35+            4      RedFox           Veg  1000
7             8      20-25            7   LemonTree           Veg  2999
8             9      25-30            2        Ibis       Non-Veg  3456
10           10      30-35            5      RedFox       non-Veg     0

    NoOfPax  EstimatedSalary Age_Group.1
0         2            40000       20-25
1         3            59000       30-35
2         2            30000       25-30
3         2           120000       20-25
4         2            45000         35+
5         2           122220         35+
6        -1            21122         35+
7       -10           345673       20-25
8         3           -99999       25-30
10        4            87777       30-35
```

[232]:
```
condition = df1['EstimatedSalary'] < 0
```

[235]:
```
df1.loc[condition, 'EstimatedSalary'] = 0
```

[236]:
```
df1
```

[236]:
```
    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
0            1     20-25            4        Ibis           Veg  1300
1            2     30-35            5   LemonTree       Non-Veg  2000
2            3     25-30            6      RedFox           Veg  1322
3            4     20-25           -1   LemonTree           Veg  1234
4            5       35+            3        Ibis           Veg   989
5            6       35+            3        Ibis       Non-Veg  1909
6            7       35+            4      RedFox           Veg  1000
7            8     20-25            7   LemonTree           Veg  2999
8            9     25-30            2        Ibis       Non-Veg  3456
10          10     30-35            5      RedFox       non-Veg     0

    NoOfPax  EstimatedSalary Age_Group.1
0         2            40000       20-25
1         3            59000       30-35
2         2            30000       25-30
3         2           120000       20-25
4         2            45000         35+
5         2           122220         35+
6        -1            21122         35+
7       -10           345673       20-25
8         3                0       25-30
```

```
10          4            87777       30-35
```

[237]:
```
condition1=[]
condition1.append(df1['NoOfPax'] < 0)
```

[241]:
```
for i in condition1:
    df1.loc[i, 'NoOfPax'] = 0
```

[242]:
```
df1
```

[242]:
```
    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
0            1     20-25            4       Ibis           Veg  1300
1            2     30-35            5  LemonTree       Non-Veg  2000
2            3     25-30            6     RedFox           Veg  1322
3            4     20-25           -1  LemonTree           Veg  1234
4            5       35+            3       Ibis           Veg   989
5            6       35+            3       Ibis       Non-Veg  1909
6            7       35+            4     RedFox           Veg  1000
7            8     20-25            7  LemonTree           Veg  2999
8            9     25-30            2       Ibis       Non-Veg  3456
10          10     30-35            5     RedFox       non-Veg     0

    NoOfPax  EstimatedSalary Age_Group.1
0         2            40000       20-25
1         3            59000       30-35
2         2            30000       25-30
3         2           120000       20-25
4         2            45000         35+
5         2           122220         35+
6         0            21122         35+
7         0           345673       20-25
8         0                0       25-30
10        4            87777       30-35
```

[243]:
```
condition = df1['Rating(1-5)'] < 0
```

[244]:
```
df1.loc[condition, 'Rating(1-5)'] = 0
```

[245]:
```
df1
```

[245]:
```
    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
0            1     20-25            4       Ibis           Veg  1300
1            2     30-35            5  LemonTree       Non-Veg  2000
2            3     25-30            6     RedFox           Veg  1322
3            4     20-25            0  LemonTree           Veg  1234
4            5       35+            3       Ibis           Veg   989
5            6       35+            3       Ibis       Non-Veg  1909
```

```
6             7      35+             4      RedFox           Veg  1000
7             8    20-25             7  LemonTree           Veg  2999
8             9    25-30             2       Ibis       Non-Veg  3456
10           10    30-35             5     RedFox       non-Veg     0

    NoOfPax  EstimatedSalary Age_Group.1
0         2            40000       20-25
1         3            59000       30-35
2         2            30000       25-30
3         2           120000       20-25
4         2            45000         35+
5         2           122220         35+
6         0            21122         35+
7         0           345673       20-25
8         0                0       25-30
10        4            87777       30-35
```

[246]:
```
df1['FoodPreference']=df1['FoodPreference'].str.replace('non-Veg','Non-Veg')
```

[247]:
```
df1
```

[247]:
```
    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
0            1     20-25            4       Ibis           Veg  1300
1            2     30-35            5  LemonTree       Non-Veg  2000
2            3     25-30            6     RedFox           Veg  1322
3            4     20-25            0  LemonTree           Veg  1234
4            5       35+            3       Ibis           Veg   989
5            6       35+            3       Ibis       Non-Veg  1909
6            7       35+            4     RedFox           Veg  1000
7            8     20-25            7  LemonTree           Veg  2999
8            9     25-30            2       Ibis       Non-Veg  3456
10          10     30-35            5     RedFox       Non-Veg     0

    NoOfPax  EstimatedSalary Age_Group.1
0         2            40000       20-25
1         3            59000       30-35
2         2            30000       25-30
3         2           120000       20-25
4         2            45000         35+
5         2           122220         35+
6         0            21122         35+
7         0           345673       20-25
8         0                0       25-30
10        4            87777       30-35
```

[248]:
```
condition = df1['Rating(1-5)'] == 0
```

[261]:
```
df1.loc[condition, 'Rating(1-5)'] = round(df1['Rating(1-5)'].mean(), 2)
```

[262]:
```
df1
```

[262]:
```
    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference  Bill  \
0            1     20-25         4.00       Ibis            Veg  1300
1            2     30-35         5.00  LemonTree        Non-Veg  2000
2            3     25-30         6.00     RedFox            Veg  1322
3            4     20-25         4.33  LemonTree            Veg  1234
4            5       35+         3.00       Ibis            Veg   989
5            6       35+         3.00       Ibis        Non-Veg  1909
6            7       35+         4.00     RedFox            Veg  1000
7            8     20-25         7.00  LemonTree            Veg  2999
8            9     25-30         2.00       Ibis        Non-Veg  3456
10          10     30-35         5.00     RedFox        Non-Veg     0

    NoOfPax  EstimatedSalary Age_Group.1
0         2            40000       20-25
1         3            59000       30-35
2         2            30000       25-30
3         2           120000       20-25
4         2            45000         35+
5         2           122220         35+
6         0            21122         35+
7         0           345673       20-25
8         0                0       25-30
10        4            87777       30-35
```

[265]:
```
condition = df1['Bill'] == 0
```

[266]:
```
df1.loc[condition, 'Bill'] = round(df1['Bill'].mean(), 2)
```

[267]:
```
df1
```

[267]:
```
    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference    Bill  \
0            1     20-25         4.00       Ibis            Veg  1300.0
1            2     30-35         5.00  LemonTree        Non-Veg  2000.0
2            3     25-30         6.00     RedFox            Veg  1322.0
3            4     20-25         4.33  LemonTree            Veg  1234.0
4            5       35+         3.00       Ibis            Veg   989.0
5            6       35+         3.00       Ibis        Non-Veg  1909.0
6            7       35+         4.00     RedFox            Veg  1000.0
7            8     20-25         7.00  LemonTree            Veg  2999.0
8            9     25-30         2.00       Ibis        Non-Veg  3456.0
10          10     30-35         5.00     RedFox        Non-Veg  1620.9

    NoOfPax  EstimatedSalary Age_Group.1
```

```
0          2            40000       20-25
1          3            59000       30-35
2          2            30000       25-30
3          2           120000       20-25
4          2            45000         35+
5          2           122220         35+
6          0            21122         35+
7          0           345673       20-25
8          0                0       25-30
10         4            87777       30-35
```

```
[270]: condition1=[]
       condition1.append(df1['NoOfPax'] == 0)
```

```
[276]: for i in condition1:
           df1.loc[i, 'NoOfPax'] =df1['NoOfPax'].mean()
```

```
[277]: df1
```

```
[277]:     CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference    Bill  \
       0            1     20-25         4.00       Ibis            Veg  1300.0
       1            2     30-35         5.00  LemonTree        Non-Veg  2000.0
       2            3     25-30         6.00     RedFox            Veg  1322.0
       3            4     20-25         4.33  LemonTree            Veg  1234.0
       4            5       35+         3.00       Ibis            Veg   989.0
       5            6       35+         3.00       Ibis        Non-Veg  1909.0
       6            7       35+         4.00     RedFox            Veg  1000.0
       7            8     20-25         7.00  LemonTree            Veg  2999.0
       8            9     25-30         2.00       Ibis        Non-Veg  3456.0
       10          10     30-35         5.00     RedFox        Non-Veg  1620.9

           NoOfPax  EstimatedSalary Age_Group.1
       0       2.0            40000       20-25
       1       3.0            59000       30-35
       2       2.0            30000       25-30
       3       2.0           120000       20-25
       4       2.0            45000         35+
       5       2.0           122220         35+
       6       2.3            21122         35+
       7       2.3           345673       20-25
       8       2.3                0       25-30
       10      4.0            87777       30-35
```

```
[280]: df1=df1.drop('Age_Group.1',axis=1)
```

```
[282]: condition = df1['EstimatedSalary'] == 0
```

[288]:
```
df1.loc[condition, 'EstimatedSalary'] = int(round(df1['EstimatedSalary'].
 ↪median(),0))
```

[289]:
```
df1
```

[289]:
```
    CustomerID Age_Group  Rating(1-5)      Hotel FoodPreference    Bill  \
0            1     20-25         4.00       Ibis            Veg  1300.0
1            2     30-35         5.00  LemonTree        Non-Veg  2000.0
2            3     25-30         6.00     RedFox            Veg  1322.0
3            4     20-25         4.33  LemonTree            Veg  1234.0
4            5       35+         3.00       Ibis            Veg   989.0
5            6       35+         3.00       Ibis        Non-Veg  1909.0
6            7       35+         4.00     RedFox            Veg  1000.0
7            8     20-25         7.00  LemonTree            Veg  2999.0
8            9     25-30         2.00       Ibis        Non-Veg  3456.0
10          10     30-35         5.00     RedFox        Non-Veg  1620.9

    NoOfPax  EstimatedSalary
0       2.0          40000.0
1       3.0          59000.0
2       2.0          30000.0
3       2.0         120000.0
4       2.0          45000.0
5       2.0         122220.0
6       2.3          21122.0
7       2.3         345673.0
8       2.3          62510.0
10      4.0          87777.0
```

[293]:
```
df1.to_csv('Hotel_Dataset.csv',index=False)
```

[ ]:
```
#create an own csv file in pandas
```

[314]:
```
import pandas as pd
import numpy as np
```

[315]:
```
df2=pd.read_csv('bookstore_inventory.csv')
```

[316]:
```
df2
```

[316]:
```
    Book_ID                     Title              Author  \
0       101          The Great Gatsby  F. Scott Fitzgerald
1       102     To Kill a Mockingbird          Harper Lee
2       103                      1984       George Orwell
3       104       Pride and Prejudice         Jane Austen
4       105    The Catcher in the Rye       J. D. Salinger
5       106                The Hobbit     J. R. R. Tolkien
```

```
6       107  Harry Potter and the Philosopher's Stone          J.K. Rowling
7       108                     The Lord of the Rings       J. R. R. Tolkien
8       109                               Animal Farm         George Orwell
9       110                             The Alchemist          Paulo Coelho
10      111                             The Alchemist          Paulo Coelho
11      112                          The Davinci Code             Dan Brown
12      113                                   Inferno             Dan Brown
13      114                          Angels & Demons             Dan Brown
14      115                           The Kite Runner       Khaled Hosseini
15      116            One Hundred Years of Solitude  Gabriel García Márquez
16      117                       Crime and Punishment      Fyodor Dostoevsky
17      118                                 Moby Dick        Herman Melville
18      119                             War and Peace           Leo Tolstoy
19      120                               The Odyssey                 Homer

              Genre          Price  Stock                   Publisher  \
0           Fiction          10.99   25.0                    Scribner
1           Fiction            8.5    NaN      J. B. Lippincott & Co
2         Dystopian           9.99   40.0            Secker & Warburg
3           Romance            abc   30.0                 T. Egerton
4           Fiction            7.5   20.0  Little, Brown and Company
5           Fantasy          12.75   50.0        George Allen & Unwin
6           Fantasy           11.2  100.0                 Bloomsburry
7           Fantasy             15    NaN        George Allen & Unwin
8            Satire           5.99   70.0            Secker & Warburg
9         Adventure           6.75   60.0                   HarperOne
10        Adventure           6.75   60.0                   HarperOne
11         Thriller            9.5   80.0                   Doubleday
12              NaN          10.25   90.0                   Doubleday
13          Thriler            8.9   85.0                   Doubleday
14            Drama            7.2  100.0             Riverhead Books
15  Magical Realism           13.3   45.0               Harper & Row
16    Philosophical           11.5   55.0      The Russian Messenger
17        Adventure  not available   30.0          Harper & Brothers
18       Historical             14   20.0      The Russian Messenger
19      Epic Poetry             10    NaN  Ancient Greece Publishing

    Year_Published    Language
0             1925     English
1             1960     ENGLISH
2             1949     English
3             1813     english
4             1951          EN
5             1937         Eng
6             1997     English
7             1954     English
8             1945     ENGLISH
```

```
9             1988     English
10            1988  English
11            2003     english
12            2013     English
13            2000     ENglish
14            2003     English
15            1970     Spansih
16            1866     Russian
17            1851     English
18            1869      Englsh
19            -800       Greek
```

[317]:
```
df2.drop_duplicates(inplace=True)
```

[318]:
```
df2
```

[318]:
```
    Book_ID                                     Title                  Author  \
0       101                          The Great Gatsby      F. Scott Fitzgerald
1       102                     To Kill a Mockingbird               Harper Lee
2       103                                      1984            George Orwell
3       104                       Pride and Prejudice              Jane Austen
4       105                    The Catcher in the Rye           J. D. Salinger
5       106                                The Hobbit         J. R. R. Tolkien
6       107  Harry Potter and the Philosopher's Stone             J.K. Rowling
7       108                     The Lord of the Rings         J. R. R. Tolkien
8       109                               Animal Farm            George Orwell
9       110                             The Alchemist             Paulo Coelho
10      111                             The Alchemist             Paulo Coelho
11      112                          The Davinci Code                Dan Brown
12      113                                   Inferno                Dan Brown
13      114                           Angels & Demons                Dan Brown
14      115                           The Kite Runner          Khaled Hosseini
15      116           One Hundred Years of Solitude  Gabriel García Márquez
16      117                       Crime and Punishment       Fyodor Dostoevsky
17      118                                Moby Dick          Herman Melville
18      119                             War and Peace              Leo Tolstoy
19      120                               The Odyssey                    Homer

          Genre        Price  Stock                 Publisher  \
0       Fiction        10.99   25.0                  Scribner
1       Fiction          8.5    NaN     J. B. Lippincott & Co
2     Dystopian         9.99   40.0          Secker & Warburg
3       Romance          abc   30.0                T. Egerton
4       Fiction          7.5   20.0  Little, Brown and Company
5       Fantasy        12.75   50.0       George Allen & Unwin
6       Fantasy         11.2  100.0                Bloomsburry
7       Fantasy           15    NaN       George Allen & Unwin
```

```
8           Satire           5.99   70.0          Secker & Warburg
9        Adventure           6.75   60.0                 HarperOne
10       Adventure           6.75   60.0                 HarperOne
11        Thriller            9.5   80.0                 Doubleday
12             NaN          10.25   90.0                 Doubleday
13         Thriler            8.9   85.0                 Doubleday
14           Drama            7.2  100.0           Riverhead Books
15 Magical Realism           13.3   45.0               Harper & Row
16   Philosophical           11.5   55.0     The Russian Messenger
17       Adventure  not available   30.0         Harper & Brothers
18      Historical             14   20.0     The Russian Messenger
19     Epic Poetry             10    NaN  Ancient Greece Publishing

    Year_Published    Language
0             1925     English
1             1960     ENGLISH
2             1949     English
3             1813     english
4             1951          EN
5             1937         Eng
6             1997     English
7             1954     English
8             1945     ENGLISH
9             1988     English
10            1988  English
11            2003     english
12            2013     English
13            2000     ENglish
14            2003     English
15            1970     Spansih
16            1866     Russian
17            1851     English
18            1869      Englsh
19            -800       Greek
```

[319]:
```
df2.drop_duplicates(subset=[col for col in df.columns if col != 'Book_ID'],␣
 ↪inplace=True)
```

[320]:
```
df2
```

[320]:
```
    Book_ID                       Title              Author  \
0       101            The Great Gatsby  F. Scott Fitzgerald
1       102       To Kill a Mockingbird          Harper Lee
2       103                        1984       George Orwell
3       104         Pride and Prejudice         Jane Austen
4       105      The Catcher in the Rye       J. D. Salinger
5       106                  The Hobbit     J. R. R. Tolkien
```

```
6       107  Harry Potter and the Philosopher's Stone           J.K. Rowling
7       108                     The Lord of the Rings       J. R. R. Tolkien
8       109                               Animal Farm          George Orwell
9       110                             The Alchemist          Paulo Coelho
10      111                             The Alchemist          Paulo Coelho
11      112                          The Davinci Code             Dan Brown
12      113                                   Inferno             Dan Brown
13      114                           Angels & Demons             Dan Brown
14      115                            The Kite Runner       Khaled Hosseini
15      116            One Hundred Years of Solitude  Gabriel García Márquez
16      117                      Crime and Punishment     Fyodor Dostoevsky
17      118                                 Moby Dick       Herman Melville
18      119                             War and Peace           Leo Tolstoy
19      120                               The Odyssey                 Homer

              Genre          Price  Stock                     Publisher  \
0           Fiction          10.99   25.0                      Scribner
1           Fiction            8.5    NaN      J. B. Lippincott & Co
2         Dystopian           9.99   40.0            Secker & Warburg
3           Romance            abc   30.0                  T. Egerton
4           Fiction            7.5   20.0  Little, Brown and Company
5           Fantasy          12.75   50.0          George Allen & Unwin
6           Fantasy           11.2  100.0                  Bloomsburry
7           Fantasy             15    NaN          George Allen & Unwin
8            Satire           5.99   70.0            Secker & Warburg
9         Adventure           6.75   60.0                  HarperOne
10        Adventure           6.75   60.0                  HarperOne
11         Thriller            9.5   80.0                  Doubleday
12              NaN          10.25   90.0                  Doubleday
13          Thriler            8.9   85.0                  Doubleday
14            Drama            7.2  100.0            Riverhead Books
15  Magical Realism           13.3   45.0               Harper & Row
16    Philosophical           11.5   55.0      The Russian Messenger
17        Adventure  not available   30.0          Harper & Brothers
18       Historical             14   20.0      The Russian Messenger
19      Epic Poetry             10    NaN  Ancient Greece Publishing

   Year_Published   Language
0            1925    English
1            1960    ENGLISH
2            1949    English
3            1813    english
4            1951         EN
5            1937        Eng
6            1997    English
7            1954    English
8            1945    ENGLISH
```

```
9             1988     English
10            1988  English
11            2003     english
12            2013     English
13            2000     ENglish
14            2003     English
15            1970     Spansih
16            1866     Russian
17            1851     English
18            1869      Englsh
19            -800       Greek
```

[321]:
```
for col in df2.columns:
    if df2[col].dtype == 'object':
        df2[col] = df2[col].str.strip()
    elif col != 'Book_ID':
        df2[col] = df2[col].astype(str)
```

[322]:
```
df2 = df2.drop_duplicates(subset=[i for i in df2.columns if i != 'Book_ID'])
```

[323]:
```
df2
```

[323]:
```
    Book_ID                                     Title                 Author  \
0       101                          The Great Gatsby     F. Scott Fitzgerald
1       102                     To Kill a Mockingbird             Harper Lee
2       103                                      1984          George Orwell
3       104                       Pride and Prejudice            Jane Austen
4       105                    The Catcher in the Rye          J. D. Salinger
5       106                                The Hobbit       J. R. R. Tolkien
6       107  Harry Potter and the Philosopher's Stone            J.K. Rowling
7       108                     The Lord of the Rings       J. R. R. Tolkien
8       109                               Animal Farm          George Orwell
9       110                             The Alchemist           Paulo Coelho
11      112                          The Davinci Code              Dan Brown
12      113                                   Inferno              Dan Brown
13      114                           Angels & Demons              Dan Brown
14      115                           The Kite Runner         Khaled Hosseini
15      116              One Hundred Years of Solitude  Gabriel García Márquez
16      117                      Crime and Punishment       Fyodor Dostoevsky
17      118                                 Moby Dick         Herman Melville
18      119                             War and Peace             Leo Tolstoy
19      120                               The Odyssey                   Homer

          Genre          Price  Stock                Publisher  \
0       Fiction          10.99   25.0                 Scribner
1       Fiction            8.5    nan      J. B. Lippincott & Co
2     Dystopian           9.99   40.0          Secker & Warburg
```

```
3           Romance            abc   30.0                  T. Egerton
4           Fiction            7.5   20.0  Little, Brown and Company
5           Fantasy          12.75   50.0       George Allen & Unwin
6           Fantasy           11.2  100.0                 Bloomsburry
7           Fantasy             15    nan       George Allen & Unwin
8            Satire           5.99   70.0            Secker & Warburg
9         Adventure           6.75   60.0                  HarperOne
11         Thriller            9.5   80.0                   Doubleday
12              NaN          10.25   90.0                   Doubleday
13          Thriler            8.9   85.0                   Doubleday
14            Drama            7.2  100.0            Riverhead Books
15  Magical Realism           13.3   45.0                Harper & Row
16    Philosophical           11.5   55.0      The Russian Messenger
17        Adventure  not available   30.0          Harper & Brothers
18       Historical             14   20.0      The Russian Messenger
19      Epic Poetry             10    nan  Ancient Greece Publishing

   Year_Published Language
0            1925  English
1            1960  ENGLISH
2            1949  English
3            1813  english
4            1951       EN
5            1937      Eng
6            1997  English
7            1954  English
8            1945  ENGLISH
9            1988  English
11           2003  english
12           2013  English
13           2000  ENglish
14           2003  English
15           1970  Spansih
16           1866  Russian
17           1851  English
18           1869   Englsh
19           -800    Greek
```

[324]:
```
column=[]
```

[325]:
```
for i in range(len(df2['Stock'])):
    if(df2['Stock'].iloc[i]=='nan'):
        column.append(i)
```

[326]:
```
column
```

[326]:
```
[1, 7, 18]
```

[327]:
```
df2['Stock'].info()
```

```
<class 'pandas.core.series.Series'>
Index: 19 entries, 0 to 19
Series name: Stock
Non-Null Count  Dtype
--------------  -----
19 non-null     object
dtypes: object(1)
memory usage: 304.0+ bytes
```

[328]:
```
df2['Stock'].info()
```

```
<class 'pandas.core.series.Series'>
Index: 19 entries, 0 to 19
Series name: Stock
Non-Null Count  Dtype
--------------  -----
19 non-null     object
dtypes: object(1)
memory usage: 304.0+ bytes
```

[329]:
```
for i in column:
    df2.loc[i, 'Stock'] = 0
```

[330]:
```
df2
```

[330]:
```
    Book_ID                                   Title                  Author  \
0       101                        The Great Gatsby      F. Scott Fitzgerald
1       102                   To Kill a Mockingbird               Harper Lee
2       103                                    1984            George Orwell
3       104                     Pride and Prejudice              Jane Austen
4       105                  The Catcher in the Rye           J. D. Salinger
5       106                              The Hobbit         J. R. R. Tolkien
6       107  Harry Potter and the Philosopher's Stone             J.K. Rowling
7       108                   The Lord of the Rings         J. R. R. Tolkien
8       109                             Animal Farm            George Orwell
9       110                           The Alchemist             Paulo Coelho
11      112                        The Davinci Code                Dan Brown
12      113                                 Inferno                Dan Brown
13      114                         Angels & Demons                Dan Brown
14      115                          The Kite Runner          Khaled Hosseini
15      116         One Hundred Years of Solitude  Gabriel García Márquez
16      117                    Crime and Punishment       Fyodor Dostoevsky
17      118                               Moby Dick          Herman Melville
18      119                           War and Peace              Leo Tolstoy
19      120                             The Odyssey                    Homer
```

```
              Genre          Price  Stock                     Publisher  \
0           Fiction          10.99   25.0                      Scribner   
1           Fiction            8.5      0       J. B. Lippincott & Co   
2          Dystopian          9.99   40.0              Secker & Warburg   
3           Romance            abc   30.0                   T. Egerton   
4           Fiction            7.5   20.0  Little, Brown and Company   
5           Fantasy          12.75   50.0         George Allen & Unwin   
6           Fantasy           11.2  100.0                  Bloomsburry   
7           Fantasy             15      0         George Allen & Unwin   
8            Satire           5.99   70.0             Secker & Warburg   
9         Adventure           6.75   60.0                    HarperOne   
11         Thriller            9.5   80.0                    Doubleday   
12              NaN          10.25   90.0                    Doubleday   
13          Thriler            8.9   85.0                    Doubleday   
14            Drama            7.2  100.0              Riverhead Books   
15  Magical Realism           13.3   45.0                 Harper & Row   
16    Philosophical           11.5   55.0      The Russian Messenger   
17        Adventure  not available   30.0           Harper & Brothers   
18       Historical             14      0      The Russian Messenger   
19      Epic Poetry             10    nan  Ancient Greece Publishing   

   Year_Published Language  
0            1925  English  
1            1960  ENGLISH  
2            1949  English  
3            1813  english  
4            1951       EN  
5            1937      Eng  
6            1997  English  
7            1954  English  
8            1945  ENGLISH  
9            1988  English  
11           2003  english  
12           2013  English  
13           2000  ENglish  
14           2003  English  
15           1970  Spansih  
16           1866  Russian  
17           1851  English  
18           1869   Englsh  
19           -800    Greek  
```

[331]:
```
df2.loc[:, 'Stock'] = df2['Stock'].fillna(0)
```

[332]:
```
df2
```

[332]:
```
    Book_ID                                     Title                  Author  \
0       101                          The Great Gatsby     F. Scott Fitzgerald
1       102                     To Kill a Mockingbird              Harper Lee
2       103                                      1984           George Orwell
3       104                       Pride and Prejudice             Jane Austen
4       105                    The Catcher in the Rye          J. D. Salinger
5       106                                The Hobbit        J. R. R. Tolkien
6       107  Harry Potter and the Philosopher's Stone            J.K. Rowling
7       108                     The Lord of the Rings        J. R. R. Tolkien
8       109                               Animal Farm           George Orwell
9       110                             The Alchemist           Paulo Coelho
11      112                          The Davinci Code               Dan Brown
12      113                                   Inferno               Dan Brown
13      114                          Angels & Demons               Dan Brown
14      115                           The Kite Runner         Khaled Hosseini
15      116               One Hundred Years of Solitude  Gabriel García Márquez
16      117                       Crime and Punishment      Fyodor Dostoevsky
17      118                                 Moby Dick         Herman Melville
18      119                             War and Peace             Leo Tolstoy
19      120                               The Odyssey                   Homer

              Genre          Price  Stock                   Publisher  \
0           Fiction          10.99   25.0                    Scribner
1           Fiction            8.5      0     J. B. Lippincott & Co
2         Dystopian           9.99   40.0             Secker & Warburg
3           Romance            abc   30.0                 T. Egerton
4           Fiction            7.5   20.0  Little, Brown and Company
5           Fantasy          12.75   50.0       George Allen & Unwin
6           Fantasy           11.2  100.0                Bloomsburry
7           Fantasy             15      0       George Allen & Unwin
8            Satire           5.99   70.0             Secker & Warburg
9         Adventure           6.75   60.0                  HarperOne
11         Thriller            9.5   80.0                  Doubleday
12              NaN          10.25   90.0                  Doubleday
13          Thriler            8.9   85.0                  Doubleday
14            Drama            7.2  100.0            Riverhead Books
15  Magical Realism           13.3   45.0                Harper & Row
16    Philosophical           11.5   55.0     The Russian Messenger
17        Adventure  not available   30.0          Harper & Brothers
18       Historical             14      0     The Russian Messenger
19      Epic Poetry             10    nan  Ancient Greece Publishing

   Year_Published Language
0            1925  English
1            1960  ENGLISH
2            1949  English
3            1813  english
```

```
4           1951       EN
5           1937      Eng
6           1997  English
7           1954  English
8           1945  ENGLISH
9           1988  English
11          2003  english
12          2013  English
13          2000  ENglish
14          2003  English
15          1970  Spansih
16          1866  Russian
17          1851  English
18          1869   Englsh
19          -800    Greek
```

```
[333]: value = df2['Stock'].median()
```

```
[334]: df2.loc[df2['Stock'] == 0.0, 'Stock'] = value
```

```
[335]: df2
```

```
[335]:     Book_ID                                  Title                 Author  \
0       101                       The Great Gatsby     F. Scott Fitzgerald
1       102                  To Kill a Mockingbird              Harper Lee
2       103                                   1984           George Orwell
3       104                    Pride and Prejudice             Jane Austen
4       105                 The Catcher in the Rye           J. D. Salinger
5       106                             The Hobbit        J. R. R. Tolkien
6       107  Harry Potter and the Philosopher's Stone          J.K. Rowling
7       108                  The Lord of the Rings        J. R. R. Tolkien
8       109                            Animal Farm           George Orwell
9       110                          The Alchemist            Paulo Coelho
11      112                        The Davinci Code               Dan Brown
12      113                                Inferno               Dan Brown
13      114                         Angels & Demons               Dan Brown
14      115                         The Kite Runner         Khaled Hosseini
15      116             One Hundred Years of Solitude  Gabriel García Márquez
16      117                     Crime and Punishment       Fyodor Dostoevsky
17      118                               Moby Dick         Herman Melville
18      119                           War and Peace             Leo Tolstoy
19      120                             The Odyssey                   Homer

              Genre          Price  Stock                  Publisher  \
0           Fiction          10.99   25.0                   Scribner
1           Fiction            8.5   47.5       J. B. Lippincott & Co
2         Dystopian           9.99   40.0            Secker & Warburg
```

```
3           Romance            abc    30.0                  T. Egerton
4           Fiction            7.5    20.0  Little, Brown and Company
5           Fantasy          12.75    50.0       George Allen & Unwin
6           Fantasy           11.2   100.0                 Bloomsburry
7           Fantasy             15    47.5       George Allen & Unwin
8            Satire           5.99    70.0           Secker & Warburg
9         Adventure           6.75    60.0                  HarperOne
11         Thriller            9.5    80.0                  Doubleday
12              NaN          10.25    90.0                  Doubleday
13          Thriler            8.9    85.0                  Doubleday
14            Drama            7.2   100.0             Riverhead Books
15  Magical Realism           13.3    45.0                Harper & Row
16    Philosophical           11.5    55.0      The Russian Messenger
17        Adventure  not available    30.0           Harper & Brothers
18       Historical             14    47.5      The Russian Messenger
19      Epic Poetry             10     nan  Ancient Greece Publishing

   Year_Published Language
0            1925  English
1            1960  ENGLISH
2            1949  English
3            1813  english
4            1951       EN
5            1937      Eng
6            1997  English
7            1954  English
8            1945  ENGLISH
9            1988  English
11           2003  english
12           2013  English
13           2000  ENglish
14           2003  English
15           1970  Spansih
16           1866  Russian
17           1851  English
18           1869   Englsh
19           -800    Greek
```

[336]:
```
df2['Stock'].astype(float)
```

[336]:
```
0      25.0
1      47.5
2      40.0
3      30.0
4      20.0
5      50.0
6     100.0
```

```
7      47.5
8      70.0
9      60.0
11     80.0
12     90.0
13     85.0
14    100.0
15     45.0
16     55.0
17     30.0
18     47.5
19      NaN
Name: Stock, dtype: float64
```

[337]:
```
df2 = df.copy()
df2['Stock'].fillna(value)
```

[337]:
```
0      46.315789
1      46.315789
2      40.000000
3      30.000000
4      20.000000
5      50.000000
6     100.000000
7      46.315789
8      70.000000
9      60.000000
11     80.000000
12     90.000000
13     85.000000
14    100.000000
15     45.000000
16     55.000000
17     30.000000
18      0.000000
19      0.000000
Name: Stock, dtype: float64
```

[338]:
```
df2
```

[338]:
```
   Book_ID                     Title              Author  \
0      101          The Great Gatsby  F. Scott Fitzgerald
1      102     To Kill a Mockingbird           Harper Lee
2      103                      1984        George Orwell
3      104       Pride and Prejudice          Jane Austen
4      105    The Catcher in the Rye        J. D. Salinger
5      106                The Hobbit     J. R. R. Tolkien
```

```
6      107  Harry Potter and the Philosopher's Stone           J.K. Rowling
7      108                     The Lord of the Rings        J. R. R. Tolkien
8      109                               Animal Farm           George Orwell
9      110                             The Alchemist            Paulo Coelho
11     112                           The Davinci Code               Dan Brown
12     113                                   Inferno               Dan Brown
13     114                            Angels & Demons               Dan Brown
14     115                            The Kite Runner         Khaled Hosseini
15     116              One Hundred Years of Solitude  Gabriel García Márquez
16     117                       Crime and Punishment       Fyodor Dostoevsky
17     118                                  Moby Dick         Herman Melville
18     119                              War and Peace             Leo Tolstoy
19     120                                The Odyssey                   Homer

              Genre  Price       Stock                  Publisher  \
0           Fiction     10   46.315789                   Scribner
1           Fiction      8   46.315789      J. B. Lippincott & Co
2         Dystopian      9   40.000000            Secker & Warburg
3           Romance      8   30.000000                 T. Egerton
4           Fiction      7   20.000000  Little, Brown and Company
5           Fantasy     12   50.000000        George Allen & Unwin
6           Fantasy     11  100.000000                 Bloomsburry
7           Fantasy     15   46.315789        George Allen & Unwin
8            Satire      5   70.000000            Secker & Warburg
9         Adventure      6   60.000000                   HarperOne
11         Thriller      9   80.000000                   Doubleday
12              NaN     10   90.000000                   Doubleday
13          Thriler      8   85.000000                   Doubleday
14            Drama      7  100.000000             Riverhead Books
15  Magical Realism     13   45.000000                Harper & Row
16    Philosophical     11   55.000000     The Russian Messenger
17        Adventure      8   30.000000          Harper & Brothers
18       Historical     14    0.000000     The Russian Messenger
19      Epic Poetry     10    0.000000  Ancient Greece Publishing

   Year_Published Language
0            1925  English
1            1960  ENGLISH
2            1949  English
3            1813  english
4            1951       EN
5            1937      Eng
6            1997  English
7            1954  English
8            1945  ENGLISH
9            1988  English
11           2003  english
```

```
12          2013  English
13          2000  ENglish
14          2003  English
15          1970  Spansih
16          1866  Russian
17          1851  English
18          1869   Englsh
19          -800    Greek
```

[339]:
```
df2['Price'].info()
```

```
<class 'pandas.core.series.Series'>
Index: 19 entries, 0 to 19
Series name: Price
Non-Null Count  Dtype
--------------  -----
19 non-null     int64
dtypes: int64(1)
memory usage: 860.0+ bytes
```

[340]:
```
df2['Price'].info()
```

```
<class 'pandas.core.series.Series'>
Index: 19 entries, 0 to 19
Series name: Price
Non-Null Count  Dtype
--------------  -----
19 non-null     int64
dtypes: int64(1)
memory usage: 860.0+ bytes
```

[341]:
```
df2['Price'].fillna(0)
```

[341]:
```
0     10
1      8
2      9
3      8
4      7
5     12
6     11
7     15
8      5
9      6
11     9
12    10
13     8
14     7
15    13
```

```
16    11
17     8
18    14
19    10
Name: Price, dtype: int64
```

[342]:
```
val=df2['Price'].mean()
```

[343]:
```
for i in range(len(df2['Price'])):
    if df2.iloc[i]['Price'] == 0:
        df2.iloc[i]['Price'] =val
```

[344]:
```
df2
```

[344]:
```
   Book_ID                                  Title                 Author  \
0      101                       The Great Gatsby     F. Scott Fitzgerald
1      102                  To Kill a Mockingbird              Harper Lee
2      103                                   1984           George Orwell
3      104                    Pride and Prejudice             Jane Austen
4      105                 The Catcher in the Rye          J. D. Salinger
5      106                             The Hobbit        J. R. R. Tolkien
6      107  Harry Potter and the Philosopher's Stone          J.K. Rowling
7      108                  The Lord of the Rings        J. R. R. Tolkien
8      109                            Animal Farm           George Orwell
9      110                          The Alchemist            Paulo Coelho
11     112                        The Davinci Code              Dan Brown
12     113                                Inferno               Dan Brown
13     114                       Angels & Demons                Dan Brown
14     115                         The Kite Runner        Khaled Hosseini
15     116        One Hundred Years of Solitude   Gabriel García Márquez
16     117                    Crime and Punishment    Fyodor Dostoevsky
17     118                              Moby Dick       Herman Melville
18     119                          War and Peace           Leo Tolstoy
19     120                            The Odyssey                   Homer

        Genre  Price       Stock                  Publisher  \
0     Fiction     10   46.315789                   Scribner
1     Fiction      8   46.315789      J. B. Lippincott & Co
2   Dystopian      9   40.000000          Secker & Warburg
3     Romance      8   30.000000                 T. Egerton
4     Fiction      7   20.000000  Little, Brown and Company
5     Fantasy     12   50.000000     George Allen & Unwin
6     Fantasy     11  100.000000               Bloomsburry
7     Fantasy     15   46.315789     George Allen & Unwin
8      Satire      5   70.000000          Secker & Warburg
9   Adventure      6   60.000000                 HarperOne
11   Thriller      9   80.000000                  Doubleday
```

```
12             NaN      10   90.000000                     Doubleday
13         Thriler       8   85.000000                     Doubleday
14           Drama       7  100.000000               Riverhead Books
15  Magical Realism     13   45.000000                  Harper & Row
16   Philosophical      11   55.000000       The Russian Messenger
17       Adventure       8   30.000000            Harper & Brothers
18      Historical      14    0.000000       The Russian Messenger
19    Epic Poetry       10    0.000000  Ancient Greece Publishing

   Year_Published Language
0            1925  English
1            1960  ENGLISH
2            1949  English
3            1813  english
4            1951       EN
5            1937      Eng
6            1997  English
7            1954  English
8            1945  ENGLISH
9            1988  English
11           2003  english
12           2013  English
13           2000  ENglish
14           2003  English
15           1970  Spansih
16           1866  Russian
17           1851  English
18           1869   Englsh
19           -800    Greek
```

[345]:
```python
df2['Year_Published']=df2['Year_Published'].astype(int)
```

[346]:
```python
df2['Year_Published'].info()
```

```
<class 'pandas.core.series.Series'>
Index: 19 entries, 0 to 19
Series name: Year_Published
Non-Null Count  Dtype
--------------  -----
19 non-null     int64
dtypes: int64(1)
memory usage: 860.0+ bytes
```

[347]:
```python
df2 = df2[df2['Year_Published'] >= 0]
```

[348]:
```python
df2
```

```
[348]:   Book_ID                                      Title                 Author  \
0       101                           The Great Gatsby     F. Scott Fitzgerald
1       102                      To Kill a Mockingbird             Harper Lee
2       103                                       1984          George Orwell
3       104                        Pride and Prejudice            Jane Austen
4       105                     The Catcher in the Rye         J. D. Salinger
5       106                                 The Hobbit       J. R. R. Tolkien
6       107   Harry Potter and the Philosopher's Stone            J.K. Rowling
7       108                      The Lord of the Rings       J. R. R. Tolkien
8       109                                Animal Farm          George Orwell
9       110                              The Alchemist           Paulo Coelho
11      112                           The Davinci Code              Dan Brown
12      113                                    Inferno              Dan Brown
13      114                           Angels & Demons              Dan Brown
14      115                             The Kite Runner        Khaled Hosseini
15      116             One Hundred Years of Solitude  Gabriel García Márquez
16      117                        Crime and Punishment      Fyodor Dostoevsky
17      118                                  Moby Dick        Herman Melville
18      119                              War and Peace            Leo Tolstoy

              Genre  Price       Stock                   Publisher  \
0           Fiction     10   46.315789                    Scribner
1           Fiction      8   46.315789      J. B. Lippincott & Co
2         Dystopian      9   40.000000           Secker & Warburg
3           Romance      8   30.000000                 T. Egerton
4           Fiction      7   20.000000  Little, Brown and Company
5           Fantasy     12   50.000000       George Allen & Unwin
6           Fantasy     11  100.000000                Bloomsburry
7           Fantasy     15   46.315789       George Allen & Unwin
8            Satire      5   70.000000           Secker & Warburg
9         Adventure      6   60.000000                  HarperOne
11         Thriller      9   80.000000                  Doubleday
12              NaN     10   90.000000                  Doubleday
13          Thriler      8   85.000000                  Doubleday
14            Drama      7  100.000000            Riverhead Books
15  Magical Realism     13   45.000000               Harper & Row
16    Philosophical     11   55.000000     The Russian Messenger
17        Adventure      8   30.000000         Harper & Brothers
18       Historical     14    0.000000     The Russian Messenger

    Year_Published Language
0             1925  English
1             1960  ENGLISH
2             1949  English
3             1813  english
4             1951       EN
5             1937      Eng
```

```
6              1997  English
7              1954  English
8              1945  ENGLISH
9              1988  English
11             2003  english
12             2013  English
13             2000  ENglish
14             2003  English
15             1970  Spansih
16             1866  Russian
17             1851  English
18             1869   Englsh
```

[349]:
```
df2.dropna()
```

[349]:
```
   Book_ID                                     Title                 Author  \
0      101                          The Great Gatsby     F. Scott Fitzgerald
1      102                     To Kill a Mockingbird             Harper Lee
2      103                                      1984          George Orwell
3      104                       Pride and Prejudice            Jane Austen
4      105                    The Catcher in the Rye          J. D. Salinger
5      106                                The Hobbit        J. R. R. Tolkien
6      107  Harry Potter and the Philosopher's Stone            J.K. Rowling
7      108                     The Lord of the Rings        J. R. R. Tolkien
8      109                               Animal Farm          George Orwell
9      110                             The Alchemist           Paulo Coelho
11     112                          The Davinci Code              Dan Brown
13     114                          Angels & Demons              Dan Brown
14     115                           The Kite Runner        Khaled Hosseini
15     116           One Hundred Years of Solitude  Gabriel García Márquez
16     117                       Crime and Punishment     Fyodor Dostoevsky
17     118                                 Moby Dick        Herman Melville
18     119                             War and Peace             Leo Tolstoy

         Genre  Price       Stock                  Publisher  \
0      Fiction     10   46.315789                   Scribner
1      Fiction      8   46.315789      J. B. Lippincott & Co
2    Dystopian      9   40.000000          Secker & Warburg
3      Romance      8   30.000000                T. Egerton
4      Fiction      7   20.000000  Little, Brown and Company
5      Fantasy     12   50.000000      George Allen & Unwin
6      Fantasy     11  100.000000               Bloomsburry
7      Fantasy     15   46.315789      George Allen & Unwin
8       Satire      5   70.000000          Secker & Warburg
9    Adventure      6   60.000000                 HarperOne
11    Thriller      9   80.000000                 Doubleday
13     Thriler      8   85.000000                 Doubleday
```

```
14            Drama      7  100.000000          Riverhead Books
15  Magical Realism     13   45.000000             Harper & Row
16    Philosophical     11   55.000000   The Russian Messenger
17        Adventure      8   30.000000       Harper & Brothers
18       Historical     14    0.000000   The Russian Messenger

    Year_Published Language
0             1925  English
1             1960  ENGLISH
2             1949  English
3             1813  english
4             1951       EN
5             1937      Eng
6             1997  English
7             1954  English
8             1945  ENGLISH
9             1988  English
11            2003  english
13            2000  ENglish
14            2003  English
15            1970  Spansih
16            1866  Russian
17            1851  English
18            1869   Englsh
```

[353]:
```
df2 = df2.copy()
df2['Language']=df2['Language'].str.
↪replace(r'\b(ENGLISH|EN|Eng|english|ENglish|Englsh)\b','English',regex=True)
```

[354]:
```
df2
```

[354]:
```
    Book_ID                                    Title                Author  \
0       101                         The Great Gatsby    F. Scott Fitzgerald
1       102                    To Kill a Mockingbird            Harper Lee
2       103                                     1984        George Orwell
3       104                      Pride and Prejudice           Jane Austen
4       105                   The Catcher in the Rye        J. D. Salinger
5       106                               The Hobbit     J. R. R. Tolkien
6       107  Harry Potter and the Philosopher's Stone          J.K. Rowling
7       108                    The Lord of the Rings     J. R. R. Tolkien
8       109                              Animal Farm        George Orwell
9       110                            The Alchemist         Paulo Coelho
11      112                          The Davinci Code            Dan Brown
12      113                                  Inferno            Dan Brown
13      114                         Angels & Demons             Dan Brown
14      115                          The Kite Runner      Khaled Hosseini
15      116              One Hundred Years of Solitude  Gabriel García Márquez
```

```
16     117                      Crime and Punishment       Fyodor Dostoevsky
17     118                                 Moby Dick         Herman Melville
18     119                             War and Peace             Leo Tolstoy

               Genre  Price       Stock                  Publisher  \
0            Fiction     10   46.315789                   Scribner
1            Fiction      8   46.315789     J. B. Lippincott & Co
2          Dystopian      9   40.000000          Secker & Warburg
3            Romance      8   30.000000                T. Egerton
4            Fiction      7   20.000000  Little, Brown and Company
5            Fantasy     12   50.000000       George Allen & Unwin
6            Fantasy     11  100.000000               Bloomsburry
7            Fantasy     15   46.315789       George Allen & Unwin
8             Satire      5   70.000000          Secker & Warburg
9          Adventure      6   60.000000                 HarperOne
11          Thriller      9   80.000000                 Doubleday
12               NaN     10   90.000000                 Doubleday
13           Thriler      8   85.000000                 Doubleday
14             Drama      7  100.000000           Riverhead Books
15   Magical Realism     13   45.000000               Harper & Row
16     Philosophical     11   55.000000     The Russian Messenger
17         Adventure      8   30.000000          Harper & Brothers
18        Historical     14    0.000000     The Russian Messenger

    Year_Published Language
0             1925  English
1             1960  English
2             1949  English
3             1813  English
4             1951  English
5             1937  English
6             1997  English
7             1954  English
8             1945  English
9             1988  English
11            2003  English
12            2013  English
13            2000  English
14            2003  English
15            1970  Spansih
16            1866  Russian
17            1851  English
18            1869  English
```

[352]:
```
df2
```

```
[352]:    Book_ID                                         Title                  Author  \
       0      101                              The Great Gatsby    F. Scott Fitzgerald
       1      102                         To Kill a Mockingbird             Harper Lee
       2      103                                          1984          George Orwell
       3      104                           Pride and Prejudice            Jane Austen
       4      105                        The Catcher in the Rye         J. D. Salinger
       5      106                                    The Hobbit       J. R. R. Tolkien
       6      107  Harry Potter and the Philosopher's Stone            J.K. Rowling
       7      108                         The Lord of the Rings       J. R. R. Tolkien
       8      109                                   Animal Farm          George Orwell
       9      110                                 The Alchemist           Paulo Coelho
       11     112                               The Davinci Code              Dan Brown
       12     113                                       Inferno              Dan Brown
       13     114                               Angels & Demons              Dan Brown
       14     115                                The Kite Runner        Khaled Hosseini
       15     116                    One Hundred Years of Solitude  Gabriel García Márquez
       16     117                           Crime and Punishment     Fyodor Dostoevsky
       17     118                                     Moby Dick        Herman Melville
       18     119                                 War and Peace             Leo Tolstoy

                 Genre  Price       Stock                 Publisher  \
       0        Fiction     10   46.315789                  Scribner
       1        Fiction      8   46.315789      J. B. Lippincott & Co
       2       Dystopian      9   40.000000           Secker & Warburg
       3         Romance      8   30.000000                T. Egerton
       4         Fiction      7   20.000000  Little, Brown and Company
       5         Fantasy     12   50.000000      George Allen & Unwin
       6         Fantasy     11  100.000000                Bloomsburry
       7         Fantasy     15   46.315789      George Allen & Unwin
       8          Satire      5   70.000000           Secker & Warburg
       9       Adventure      6   60.000000                 HarperOne
       11       Thriller      9   80.000000                 Doubleday
       12            NaN     10   90.000000                 Doubleday
       13        Thriler      8   85.000000                 Doubleday
       14          Drama      7  100.000000           Riverhead Books
       15  Magical Realism     13   45.000000              Harper & Row
       16    Philosophical     11   55.000000     The Russian Messenger
       17      Adventure      8   30.000000         Harper & Brothers
       18     Historical     14    0.000000     The Russian Messenger

          Year_Published Language
       0            1925  English
       1            1960  English
       2            1949  English
       3            1813  English
       4            1951  English
       5            1937  English
```

```
6             1997  English
7             1954  English
8             1945  English
9             1988  English
11            2003  English
12            2013  English
13            2000  English
14            2003  English
15            1970  Spansih
16            1866  Russian
17            1851  English
18            1869  English
```

```
[355]: df2.to_csv('bookstore_inventory.csv')
```

exe-4

November 2, 2025

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

```
[2]: arr=np.random.randint(50,100,10)
```

```
[3]: arr
```

```
[3]: array([59, 66, 67, 81, 61, 73, 88, 64, 52, 66], dtype=int32)
```

```
[4]: arr.mean()
```

```
[4]: np.float64(67.7)
```

```
[5]: sorted(arr)
```

```
[5]: [np.int32(52),
      np.int32(59),
      np.int32(61),
      np.int32(64),
      np.int32(66),
      np.int32(66),
      np.int32(67),
      np.int32(73),
      np.int32(81),
      np.int32(88)]
```

```
[6]: def out_detec(arr):
         q1,q3=np.percentile(arr,[25,75])
         qr=q3-q1
         n=q1-(1.5*qr)
         m=q3+(1.5*qr)
         return n,m
```

```
[7]: n,m=out_detec(arr)
```

[8]:
```
print(n)
print(m)
```

```
47.125
86.125
```

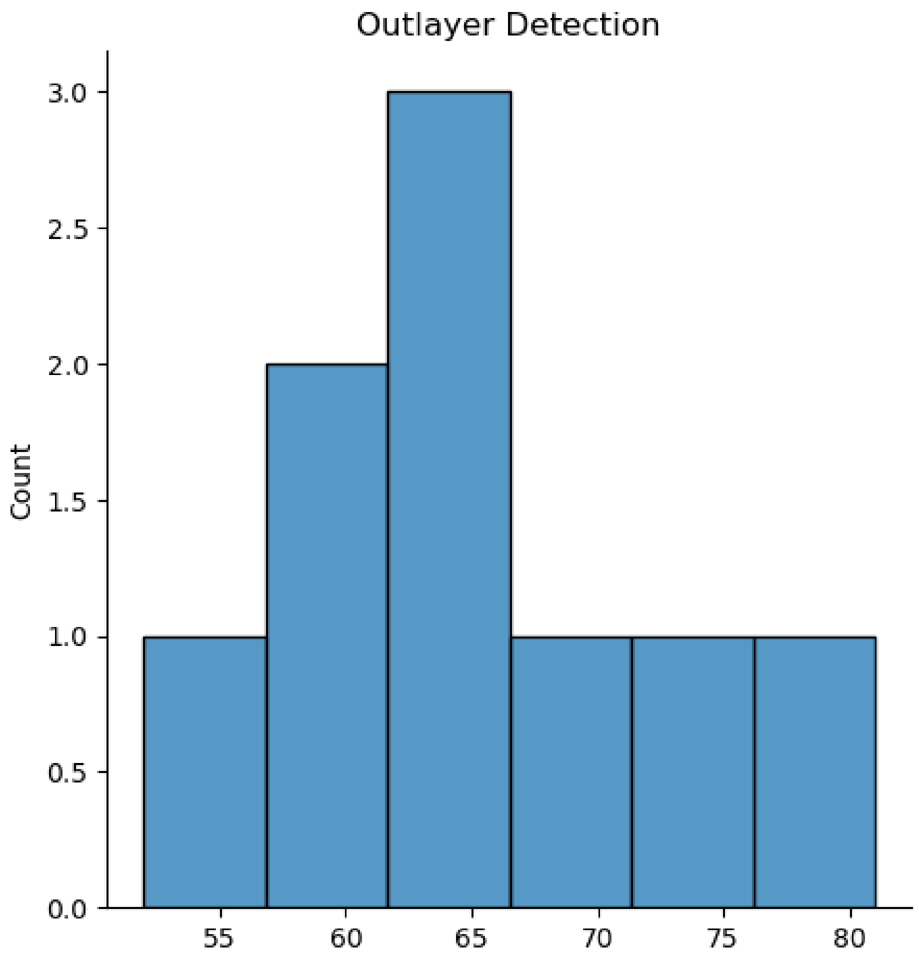
[9]:
```
arr1=arr[(arr>n) & (arr<m)]
```

[10]:
```
arr1
```

[10]:
```
array([59, 66, 67, 81, 61, 73, 64, 52, 66], dtype=int32)
```

[11]:
```
sn.displot(arr1)
plt.title("Outlayer Detection")
```

[11]:
```
Text(0.5, 1.0, 'Outlayer Detection')
```



```
[ ]:
```

Exercise5

November 2, 2025

[9]:
```
import pandas as pd
import numpy as np
df=pd.read_csv('pre_process_datasample_outlayers.csv')
```

[10]:
```
df.head()
```

[10]:
```
   Country   Age   Salary Purchased
0   France  44.0  72000.0        No
1    Spain  27.0  48000.0       Yes
2  Germany  30.0  54000.0        No
3    Spain  38.0  61000.0        No
4  Germany  40.0      NaN       Yes
```

[11]:
```
df['Country'] = df['Country'].fillna(df['Country'].mode()[0])
```

[12]:
```
val=df.iloc[:,:-1].values
val1=df.iloc[:,-1].values
from sklearn.impute import SimpleImputer
n=SimpleImputer(strategy="mean",missing_values=np.nan)
sa=SimpleImputer(strategy="mean",missing_values=np.nan)
n.fit(val[:,[1]])
```

[12]:
```
SimpleImputer()
```

[13]:
```
sa.fit(val[:,[2]])
```

[13]:
```
SimpleImputer()
```

[15]:
```
val[:,[1]]=n.transform(val[:,[1]])
val[:,[2]]=sa.transform(val[:,[2]])
val
```

[15]:
```
array([['France', 44.0, 72000.0],
       ['Spain', 27.0, 48000.0],
       ['Germany', 30.0, 54000.0],
       ['Spain', 38.0, 61000.0],
       ['Germany', 40.0, 63777.77777777778],
       ['France', 35.0, 58000.0],
       ['Spain', 38.77777777777778, 52000.0],
       ['France', 48.0, 79000.0],
       ['Germany', 50.0, 83000.0],
       ['France', 37.0, 67000.0]], dtype=object)
```

```
[16]: from sklearn.preprocessing import OneHotEncoder
      m = OneHotEncoder(sparse_output=False)
      m
```

```
[16]: OneHotEncoder(sparse_output=False)
```

```
[17]: c=m.fit_transform(val[:,[0]])
      c
```

```
[17]: array([[1., 0., 0.],
             [0., 0., 1.],
             [0., 1., 0.],
             [0., 0., 1.],
             [0., 1., 0.],
             [1., 0., 0.],
             [0., 0., 1.],
             [1., 0., 0.],
             [0., 1., 0.],
             [1., 0., 0.]])
```

```
[18]: set_final=np.concatenate((c,val[:,[1,2]]),axis=1)
```

```
[19]: from sklearn.preprocessing import StandardScaler
```

```
[20]: sc=StandardScaler()
      sc.fit(set_final)
      feat_standard_scaler=sc.transform(set_final)
      feat_standard_scaler
```

```
[20]: array([[ 1.22474487e+00, -6.54653671e-01, -6.54653671e-01,
               7.58874362e-01,  7.49473254e-01],
             [-8.16496581e-01, -6.54653671e-01,  1.52752523e+00,
              -1.71150388e+00, -1.43817841e+00],
             [-8.16496581e-01,  1.52752523e+00, -6.54653671e-01,
              -1.27555478e+00, -8.91265492e-01],
             [-8.16496581e-01, -6.54653671e-01,  1.52752523e+00,
              -1.13023841e-01, -2.53200424e-01],
             [-8.16496581e-01,  1.52752523e+00, -6.54653671e-01,
               1.77608893e-01,  6.63219199e-16],
             [ 1.22474487e+00, -6.54653671e-01, -6.54653671e-01,
              -5.48972942e-01, -5.26656882e-01],
             [-8.16496581e-01, -6.54653671e-01,  1.52752523e+00,
               0.00000000e+00, -1.07356980e+00],
             [ 1.22474487e+00, -6.54653671e-01, -6.54653671e-01,
               1.34013983e+00,  1.38753832e+00],
             [-8.16496581e-01,  1.52752523e+00, -6.54653671e-01,
               1.63077256e+00,  1.75214693e+00],
             [ 1.22474487e+00, -6.54653671e-01, -6.54653671e-01,
              -2.58340208e-01,  2.93712492e-01]])
```

[21]:
```
from sklearn.preprocessing import MinMaxScaler
mn1=MinMaxScaler(feature_range=(0,1))
mn1.fit(set_final)
f_min=mn1.transform(set_final)
f_min
```

[21]:
```
array([[1.        , 0.        , 0.        , 0.73913043, 0.68571429],
       [0.        , 0.        , 1.        , 0.        , 0.        ],
       [0.        , 1.        , 0.        , 0.13043478, 0.17142857],
       [0.        , 0.        , 1.        , 0.47826087, 0.37142857],
       [0.        , 1.        , 0.        , 0.56521739, 0.45079365],
       [1.        , 0.        , 0.        , 0.34782609, 0.28571429],
       [0.        , 0.        , 1.        , 0.51207729, 0.11428571],
       [1.        , 0.        , 0.        , 0.91304348, 0.88571429],
       [0.        , 1.        , 0.        , 1.        , 1.        ],
       [1.        , 0.        , 0.        , 0.43478261, 0.54285714]])
```

[ ]:

exercise6

November 2, 2025

[13]:
```
import pandas as pd
import numpy as np
import seaborn as sn
import pandas as pd
import matplotlib.pyplot as plt
```

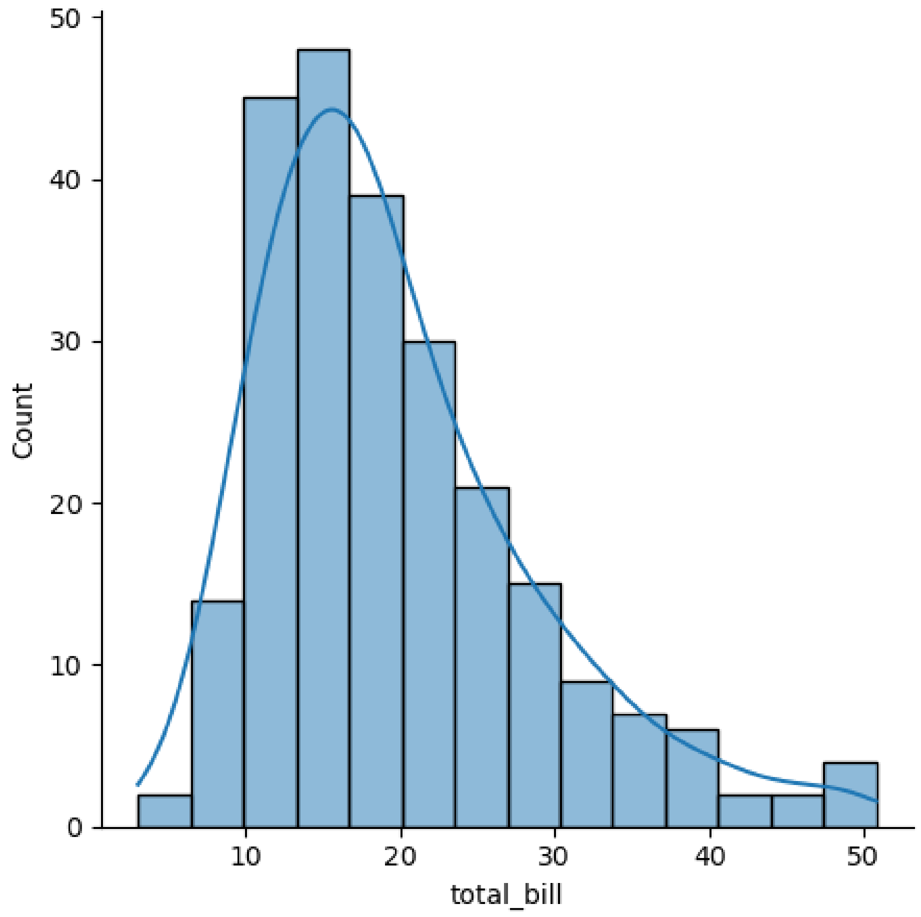
[14]:
```
df=pd.read_csv('tips.csv')
```

[15]:
```
df.head(10)
```

[15]:
```
   total_bill   tip     sex smoker  day    time  size
0       16.99  1.01  Female     No  Sun  Dinner     2
1       10.34  1.66    Male     No  Sun  Dinner     3
2       21.01  3.50    Male     No  Sun  Dinner     3
3       23.68  3.31    Male     No  Sun  Dinner     2
4       24.59  3.61  Female     No  Sun  Dinner     4
5       25.29  4.71    Male     No  Sun  Dinner     4
6        8.77  2.00    Male     No  Sun  Dinner     2
7       26.88  3.12    Male     No  Sun  Dinner     4
8       15.04  1.96    Male     No  Sun  Dinner     2
9       14.78  3.23    Male     No  Sun  Dinner     2
```

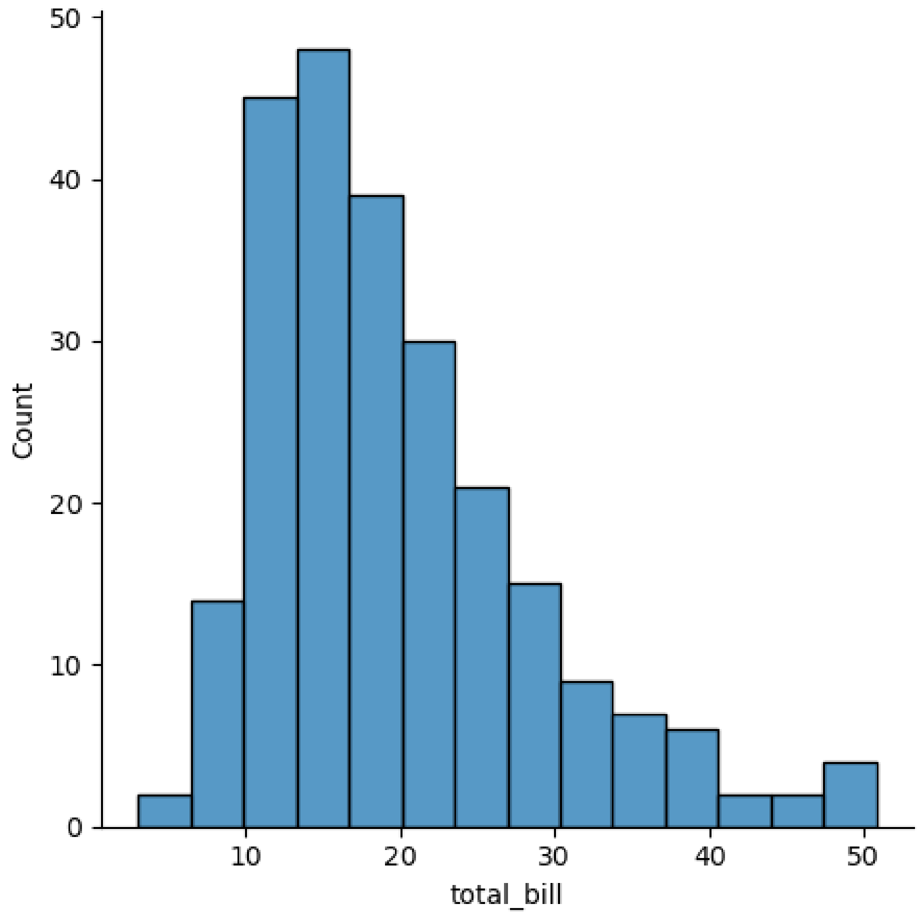
[16]:
```
sn.displot(df.total_bill,kde=True)
```

[16]:
```
<seaborn.axisgrid.FacetGrid at 0x19285a8a490>
```



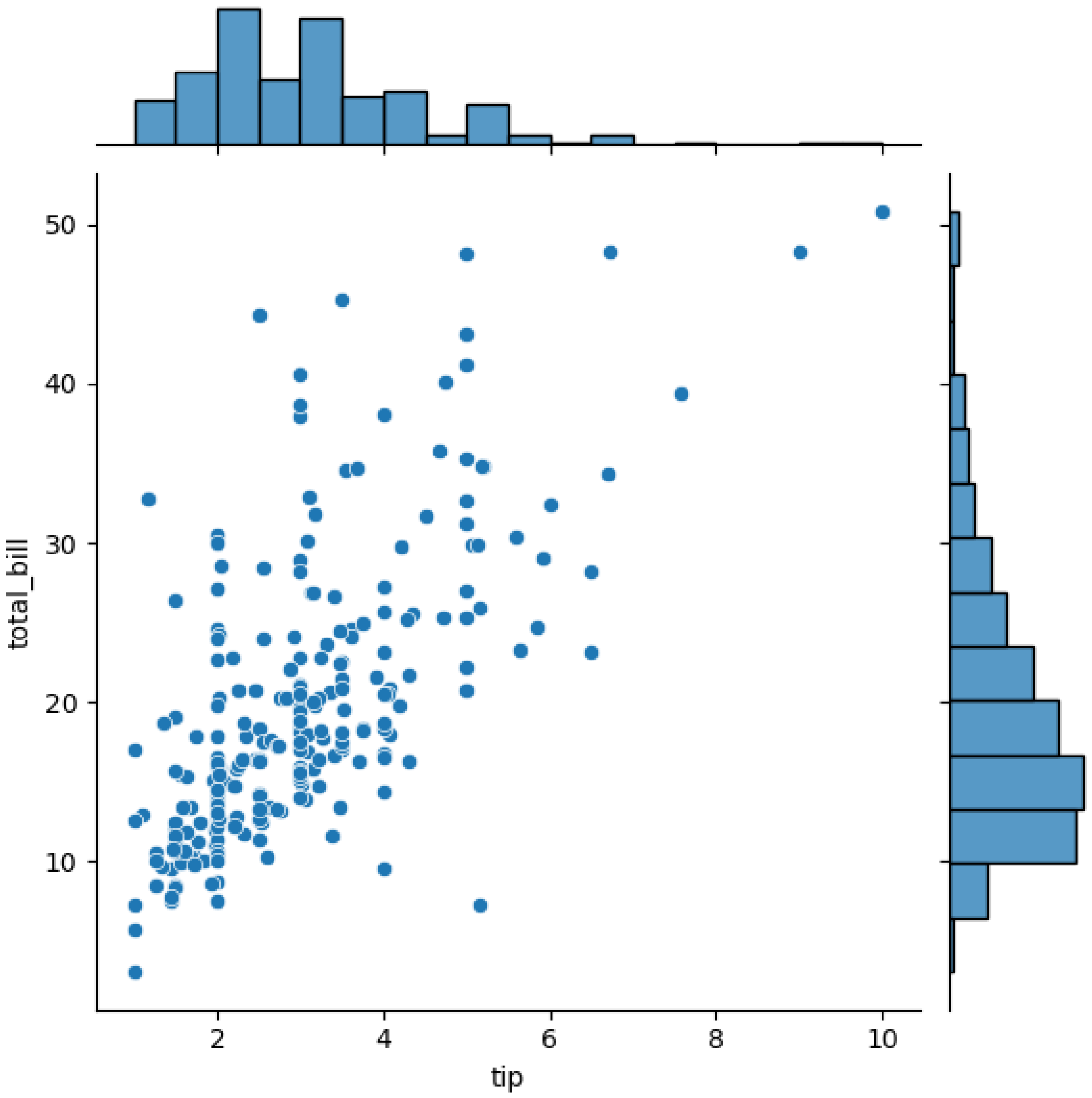
```
[17]: sn.displot(df.total_bill,kde=False)
```

```
[17]: <seaborn.axisgrid.FacetGrid at 0x19285e2c7d0>
```



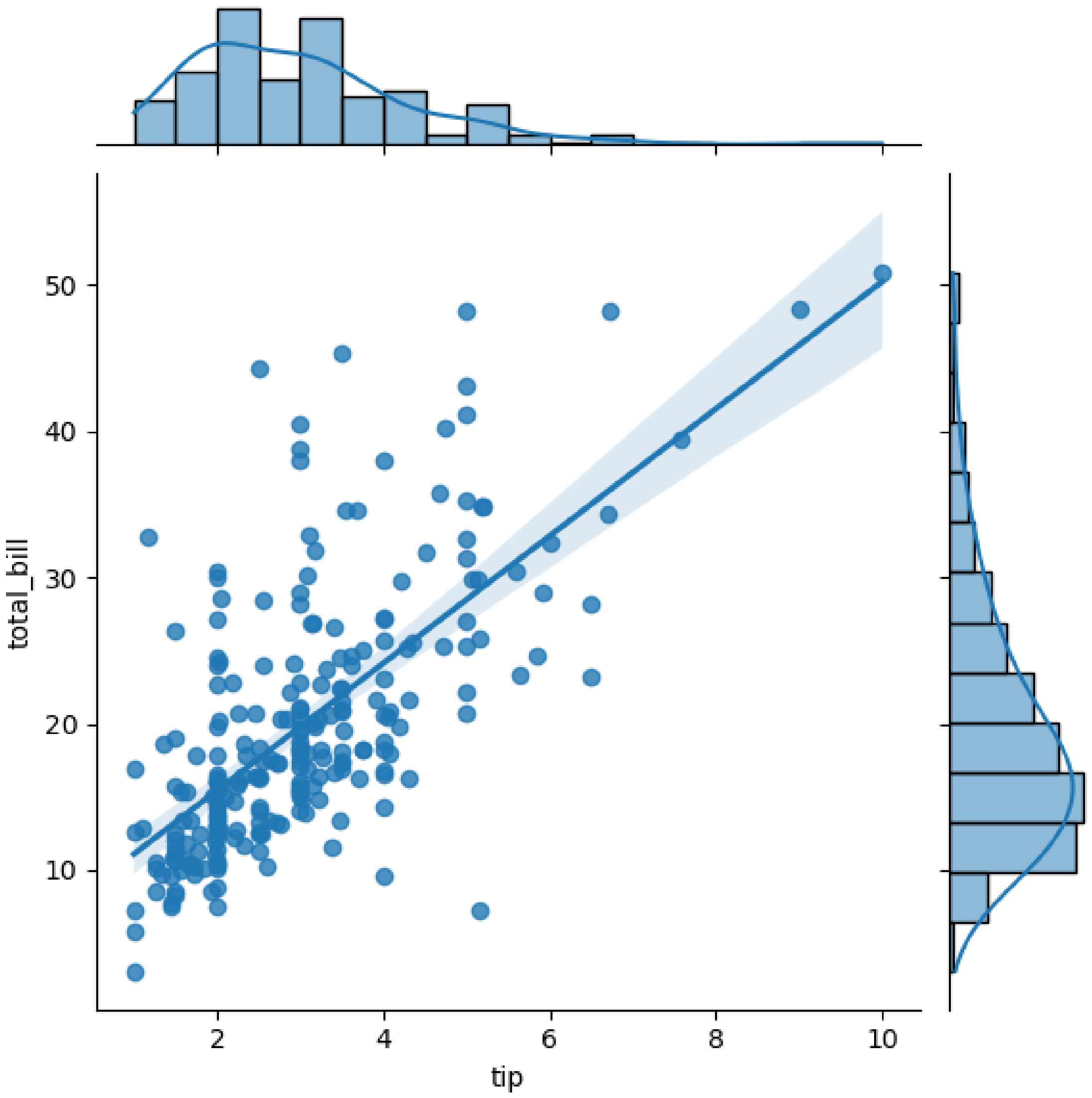
[21]:
```
#plt.scatter(x=df.tip,y=df.total_bill)
sn.jointplot(x=df.tip,y=df.total_bill)
```

[21]:
```
<seaborn.axisgrid.JointGrid at 0x19285f33b10>
```



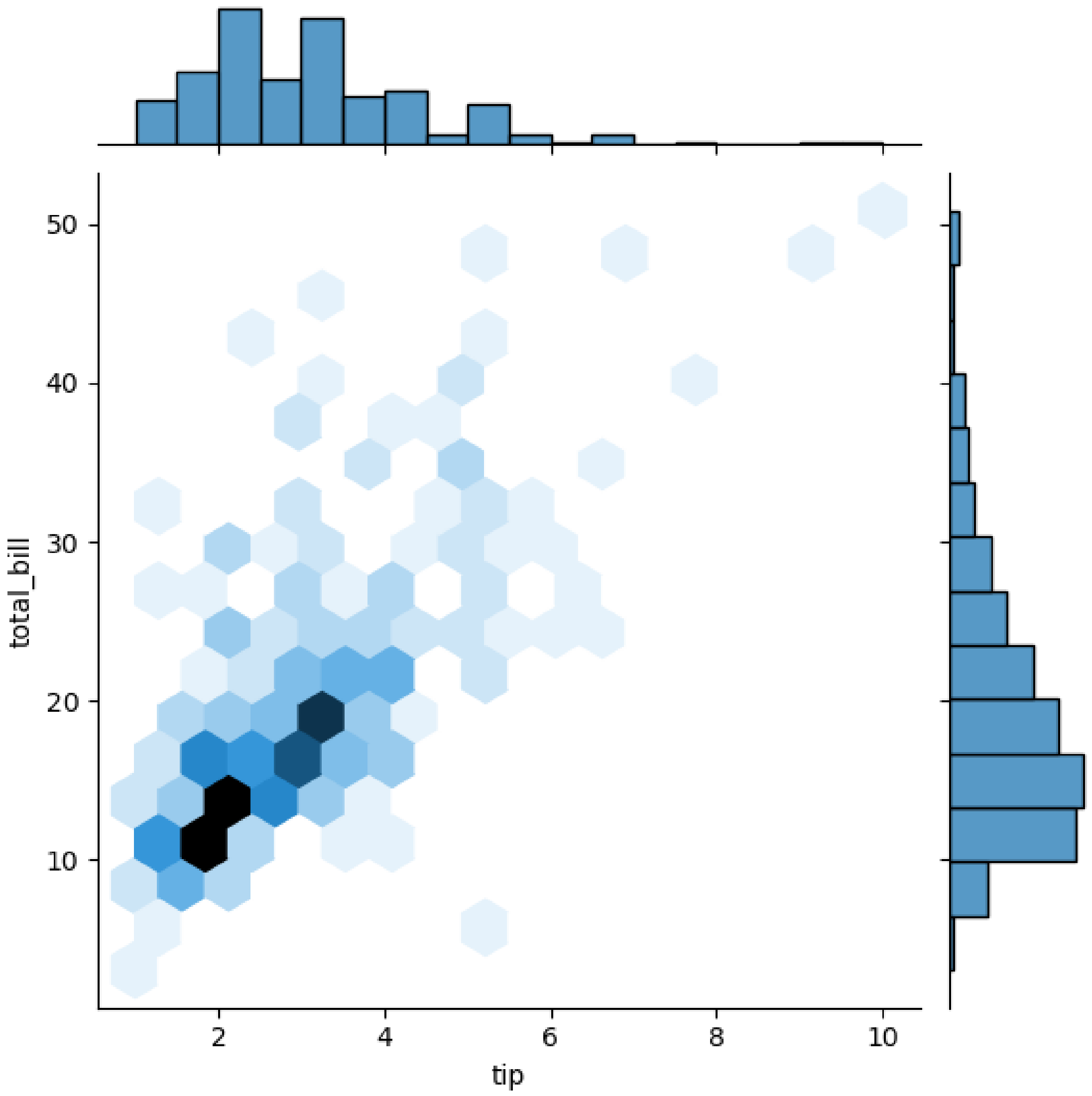
```
[22]: sn.jointplot(x=df.tip,y=df.total_bill,kind="reg")
```

```
[22]: <seaborn.axisgrid.JointGrid at 0x1928606d1d0>
```



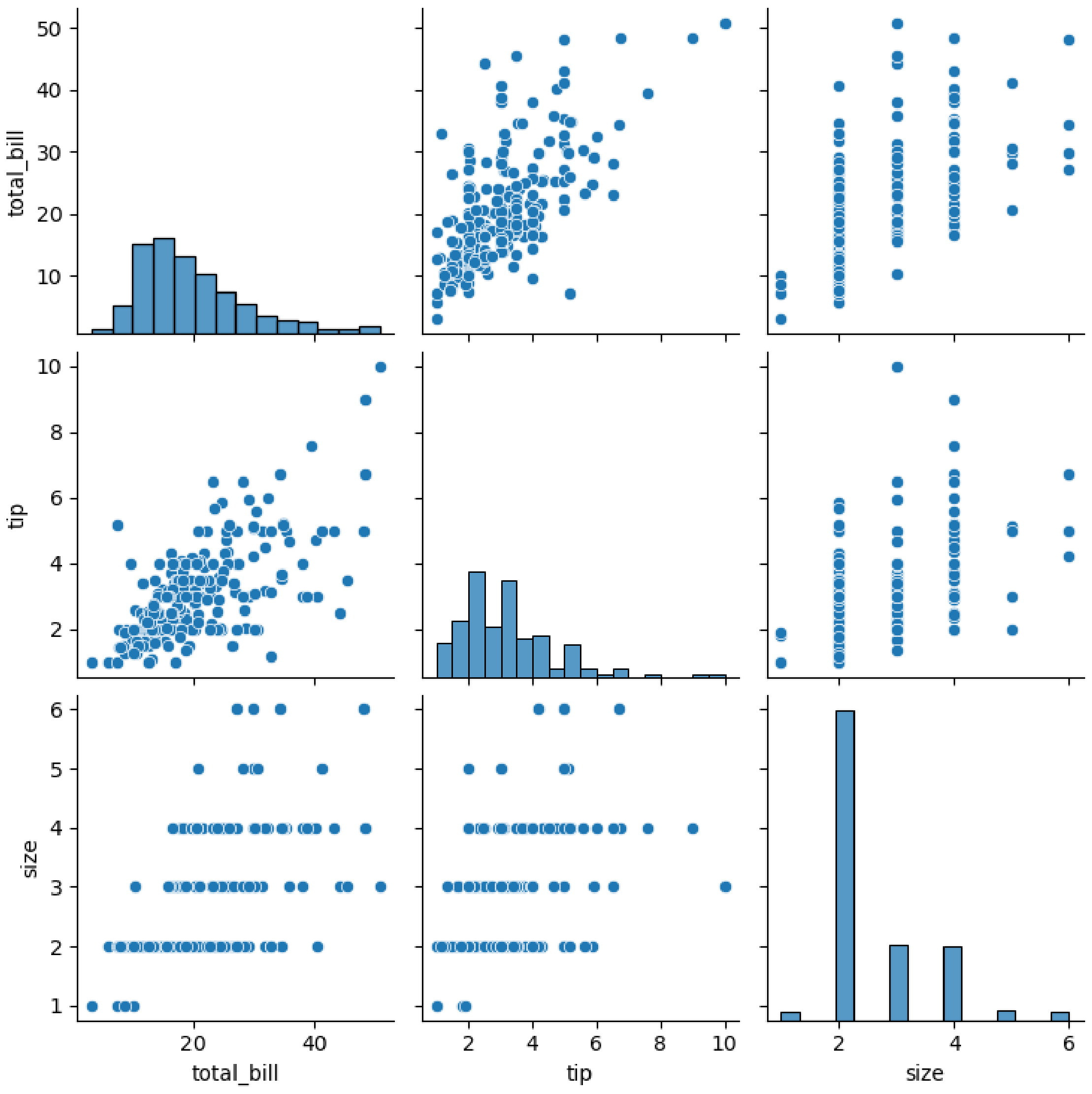
```
[25]: sn.jointplot(x=df.tip,y=df.total_bill,kind="hex")
```

```
[25]: <seaborn.axisgrid.JointGrid at 0x19286a5c050>
```



```
[26]: sn.pairplot(df)
```

```
[26]: <seaborn.axisgrid.PairGrid at 0x192fe45b4d0>
```

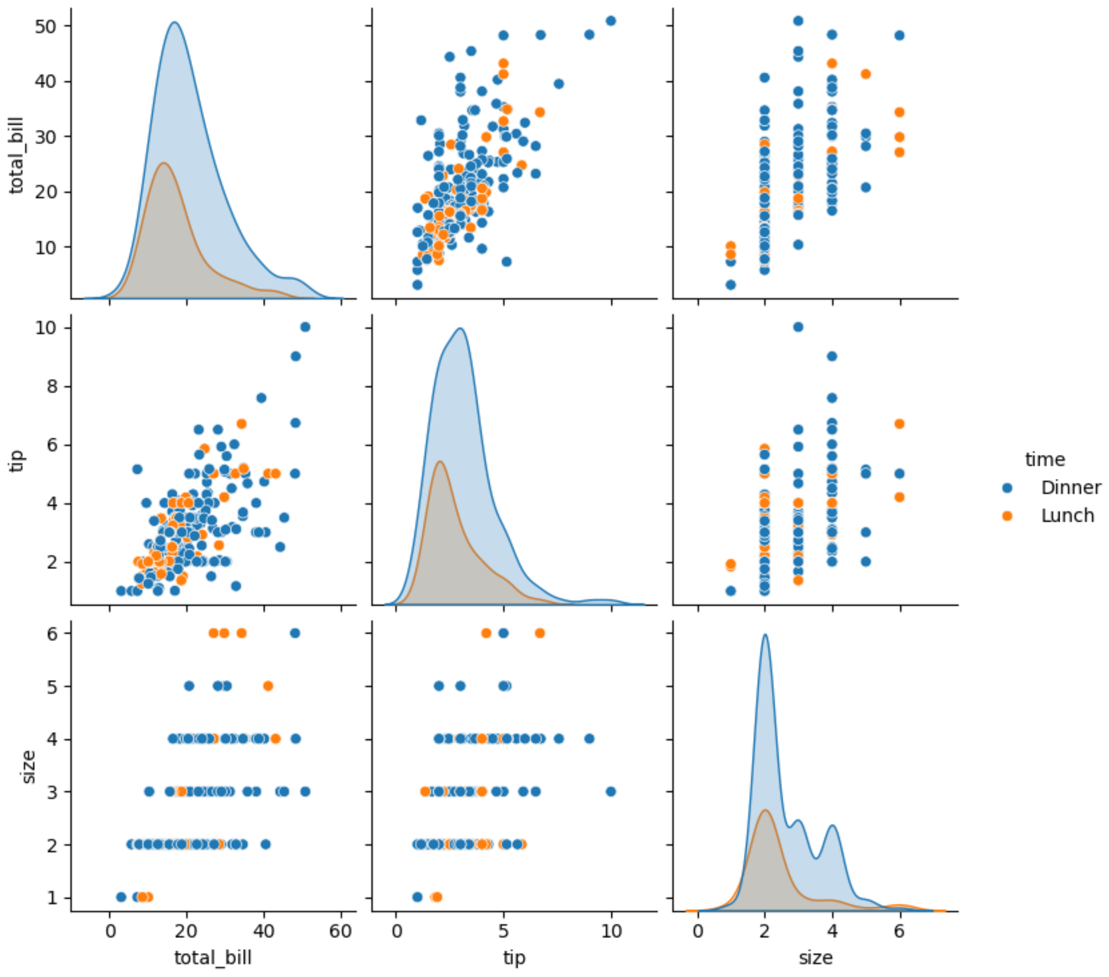


```
[29]: #df.info()
      df.time.value_counts()
```

```
[29]: time
      Dinner    176
      Lunch      68
      Name: count, dtype: int64
```

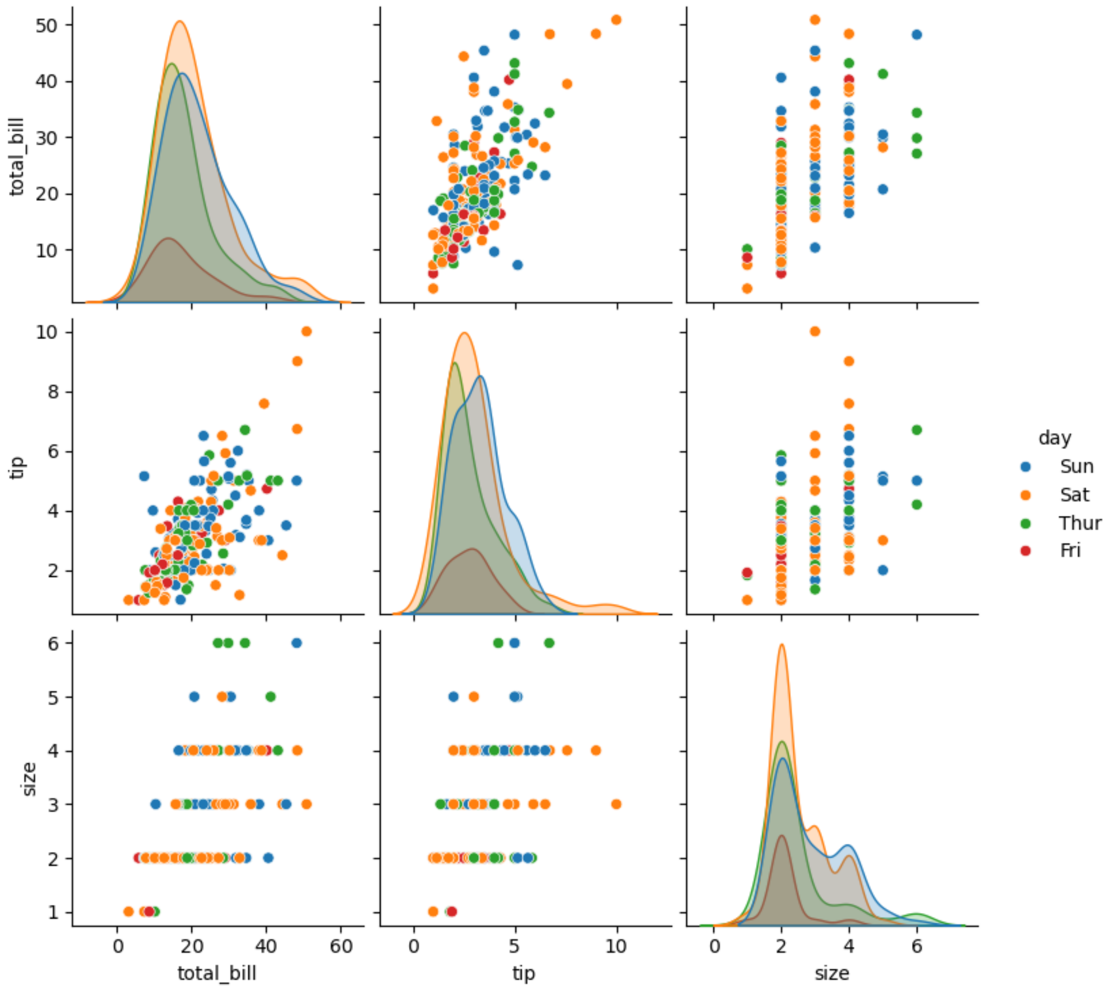
```
[30]: sn.pairplot(df,hue='time')
```

```
[30]: <seaborn.axisgrid.PairGrid at 0x192885e7390>
```



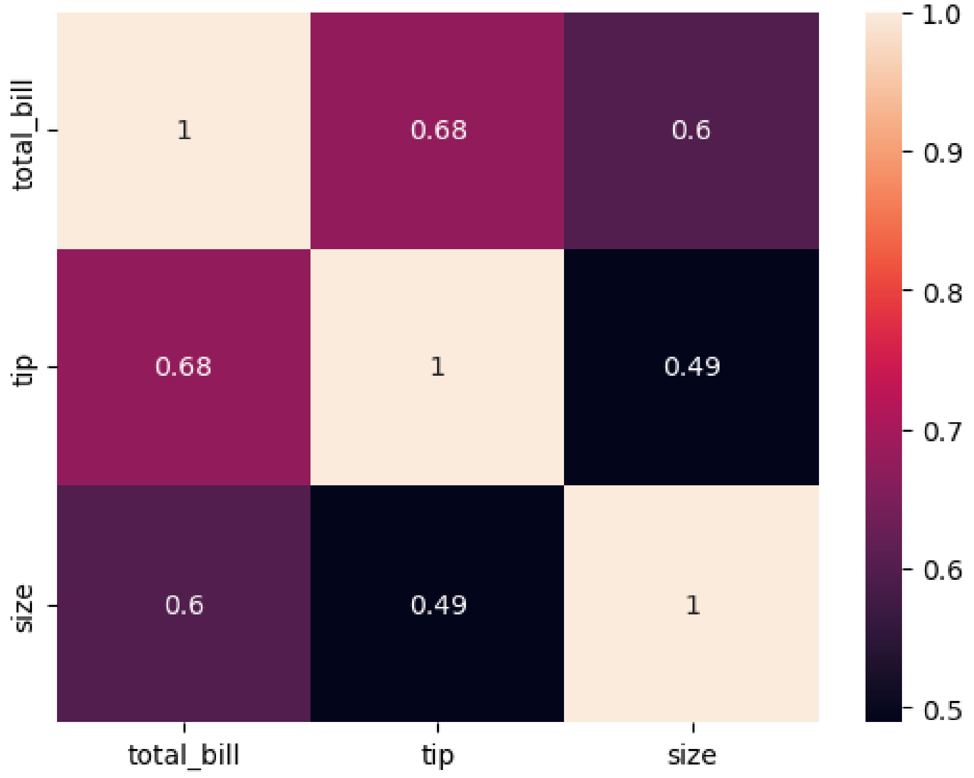
```
[31]: sn.pairplot(df,hue='day')
```

```
[31]: <seaborn.axisgrid.PairGrid at 0x1928939cf50>
```



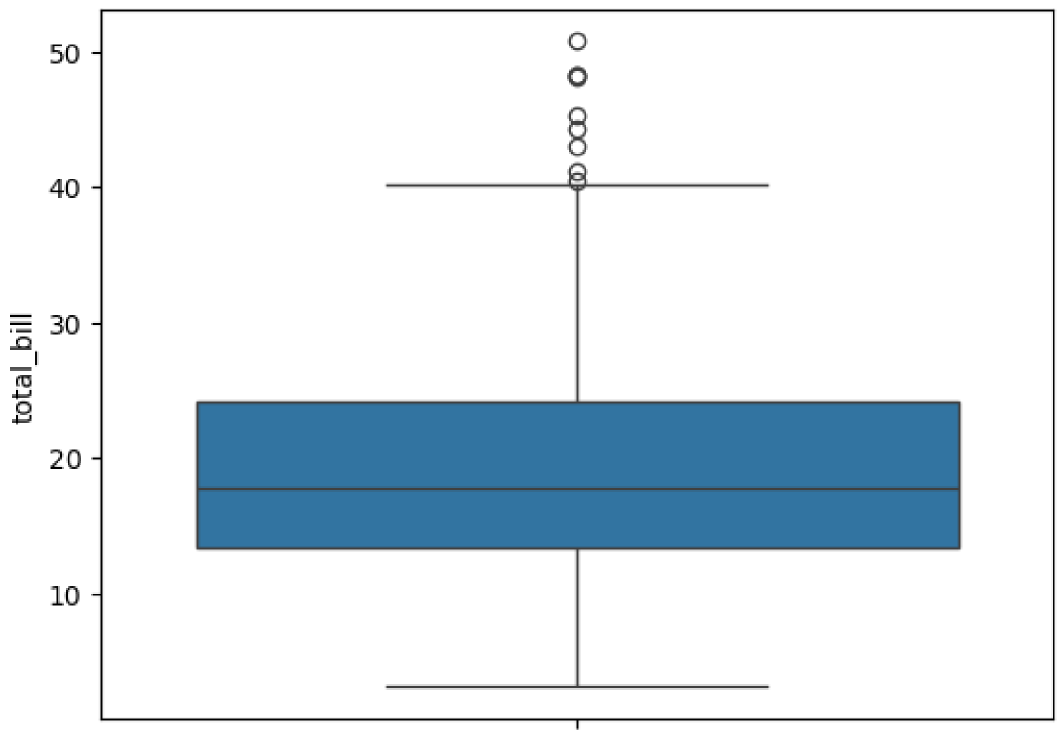
```
[32]: sn.heatmap(df.corr(numeric_only=True),annot=True)
```

```
[32]: <Axes: >
```



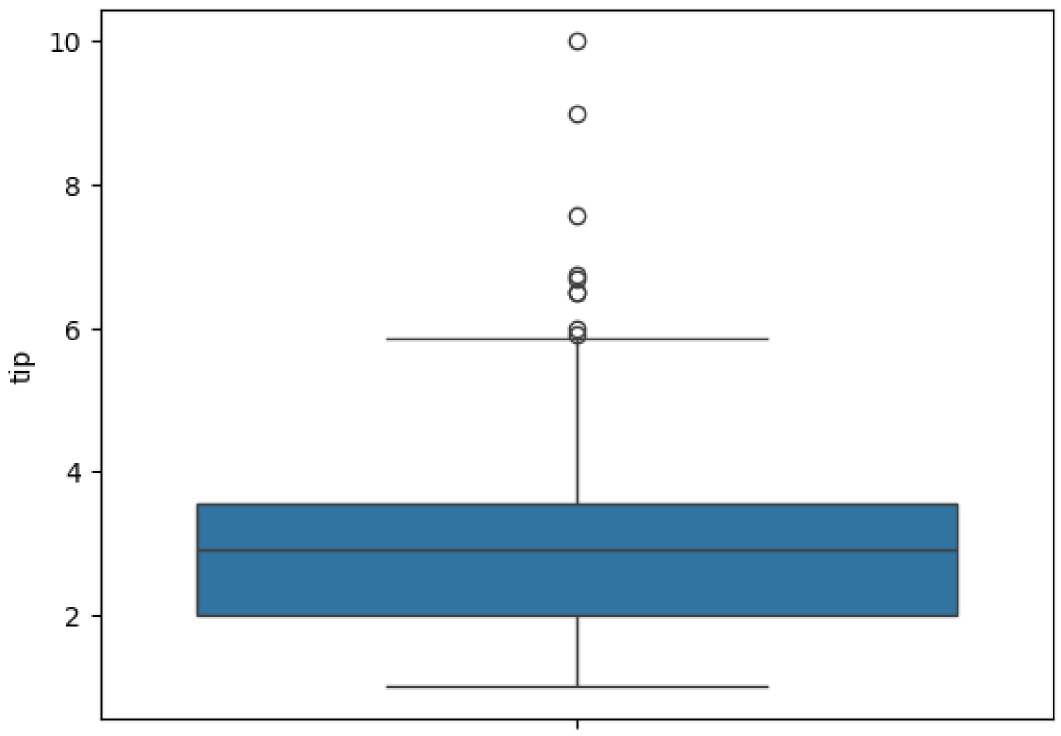
[34]:
```
sn.boxplot(df.total_bill)
```

[34]:
```
<Axes: ylabel='total_bill'>
```



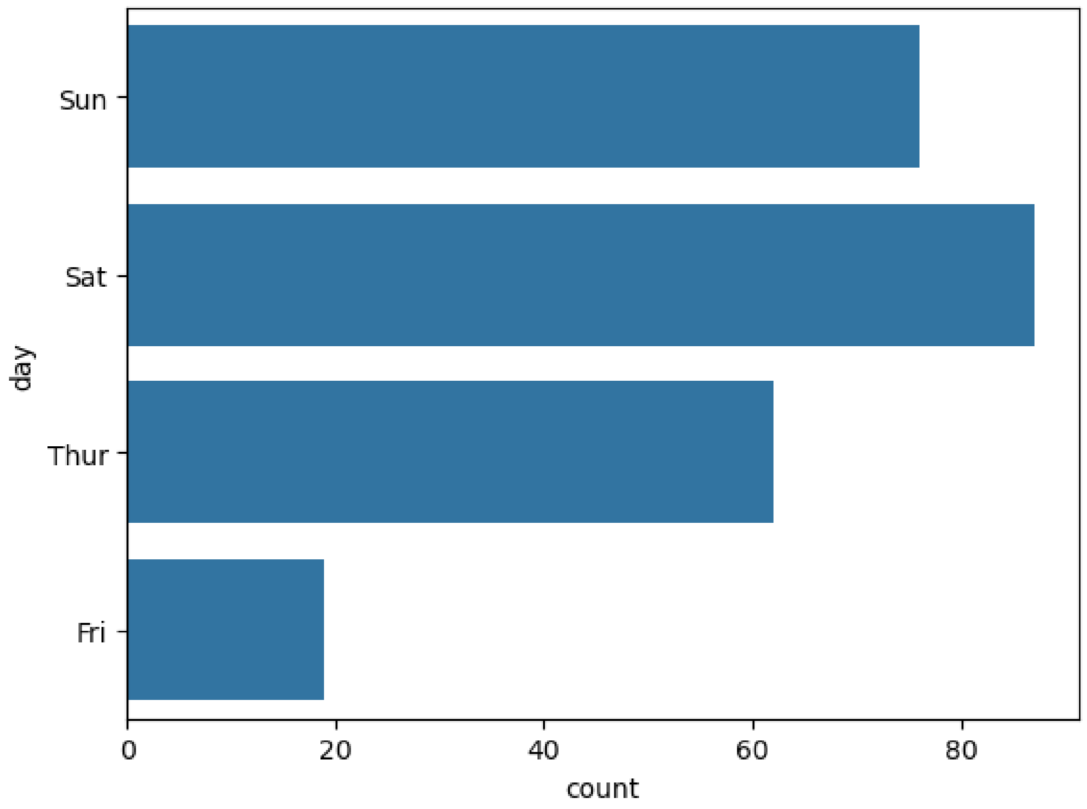
```
[36]: sn.boxplot(df.tip)
```

```
[36]: <Axes: ylabel='tip'>
```



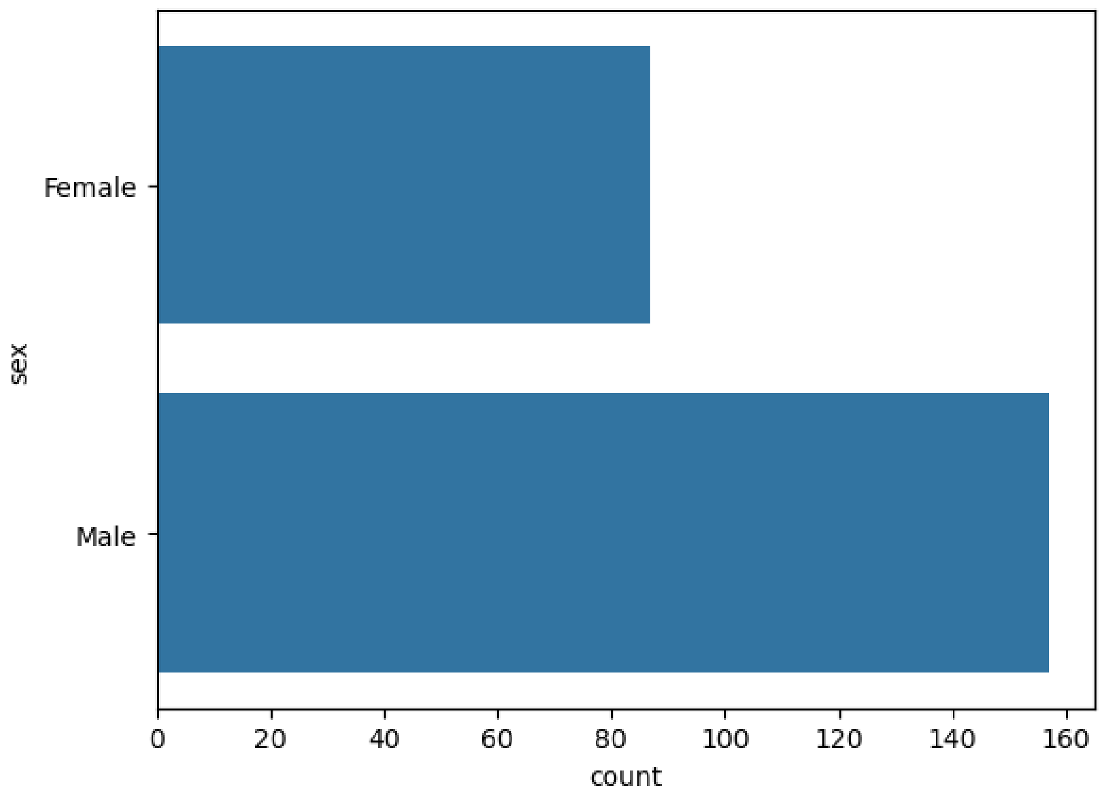
[37]:
```
sn.countplot(df.day)
```

[37]:
```
<Axes: xlabel='count', ylabel='day'>
```



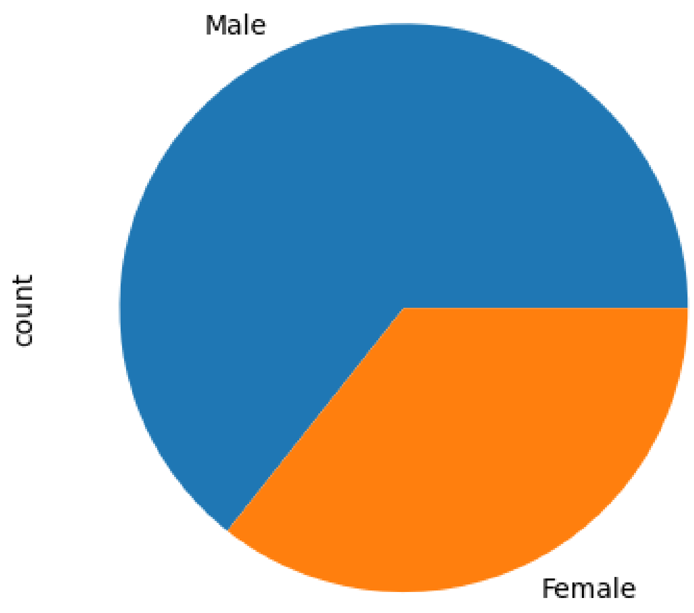
```
[38]: sn.countplot(df.sex)
```

```
[38]: <Axes: xlabel='count', ylabel='sex'>
```



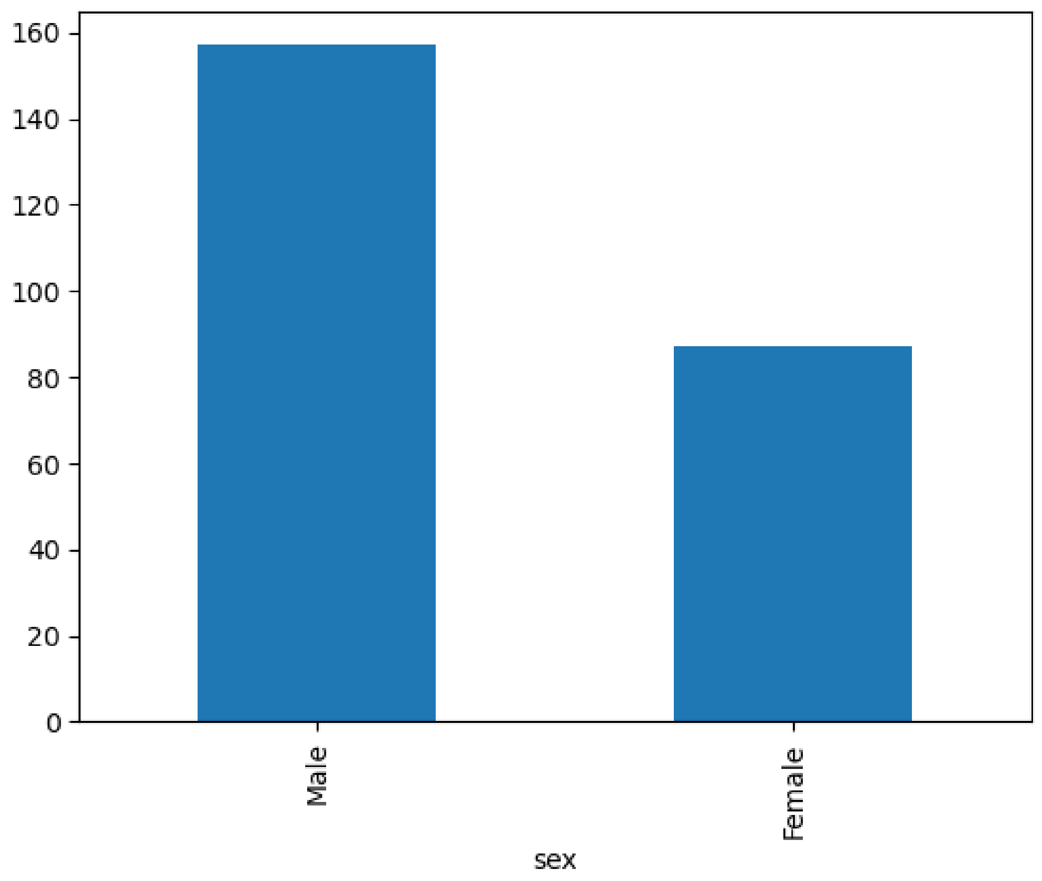
```
[39]: df.sex.value_counts().plot(kind='pie')
```

```
[39]: <Axes: ylabel='count'>
```



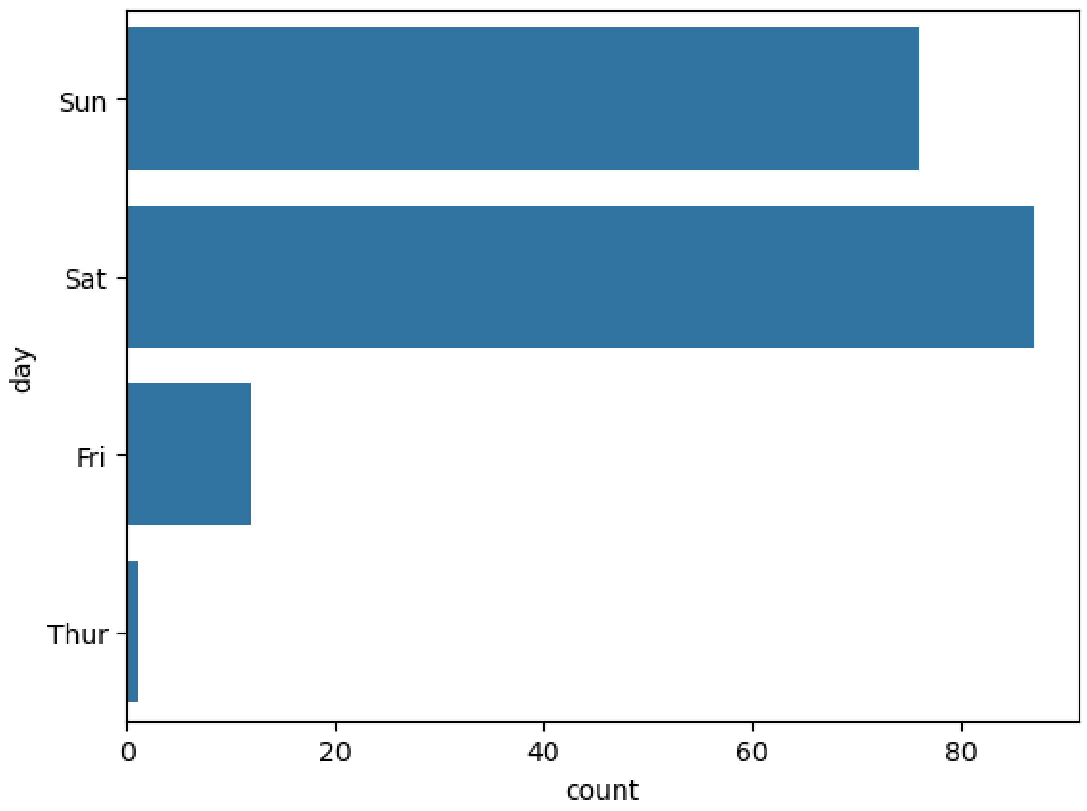
```
[40]: df.sex.value_counts().plot(kind='bar')
```

```
[40]: <Axes: xlabel='sex'>
```



```
[41]: sn.countplot(df[df.time=='Dinner']['day'])
```

```
[41]: <Axes: xlabel='count', ylabel='day'>
```


Sun
Sat
Fri
Thur
day
0
20
40
60
80
count

```
[ ]:
```

regression_and_exercise_7

November 2, 2025

[1]:
```
import pandas as pd
df=pd.read_csv('Salary_data.csv')
```

[2]:
```
df.head(5)
```

[2]:
```
   YearsExperience  Salary
0              1.1   39343
1              1.3   46205
2              1.5   37731
3              2.0   43525
4              2.2   39891
```

[3]:
```
df.dropna()
```

[3]:
```
    YearsExperience  Salary
0               1.1   39343
1               1.3   46205
2               1.5   37731
3               2.0   43525
4               2.2   39891
5               2.9   56642
6               3.0   60150
7               3.2   54445
8               3.2   64445
9               3.7   57189
10              3.9   63218
11              4.0   55794
12              4.0   56957
13              4.1   57081
14              4.5   61111
15              4.9   67938
16              5.1   66029
17              5.3   83088
18              5.9   81363
19              6.0   93940
20              6.8   91738
21              7.1   98273
22              7.9  101302
```

```
23               8.2  113812
24               8.7  109431
25               9.0  105582
26               9.5  116969
27               9.6  112635
28              10.3  122391
29              10.5  121872
```

[4]:
```
x=df.iloc[:,[0]].values
y=df.iloc[:,[1]].values
```

[5]:
```
from sklearn.model_selection import train_test_split
```

[6]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=0)
```

[7]:
```
from sklearn.linear_model import LinearRegression
```

[8]:
```
model=LinearRegression()#this is the stage where i create a model which has no␣
  ↪data an empty model with no knowledge
```

[9]:
```
model
```

[9]:
```
LinearRegression()
```

[10]:
```
model.fit(x_train,y_train)#model is trained with the data of x and y
```

[10]:
```
LinearRegression()
```

[11]:
```
model.predict([[5]])
```

[11]:
```
array([[73342.97478427]])
```

[12]:
```
y_pred=model.predict(x_test)
```

[13]:
```
y_pred
```

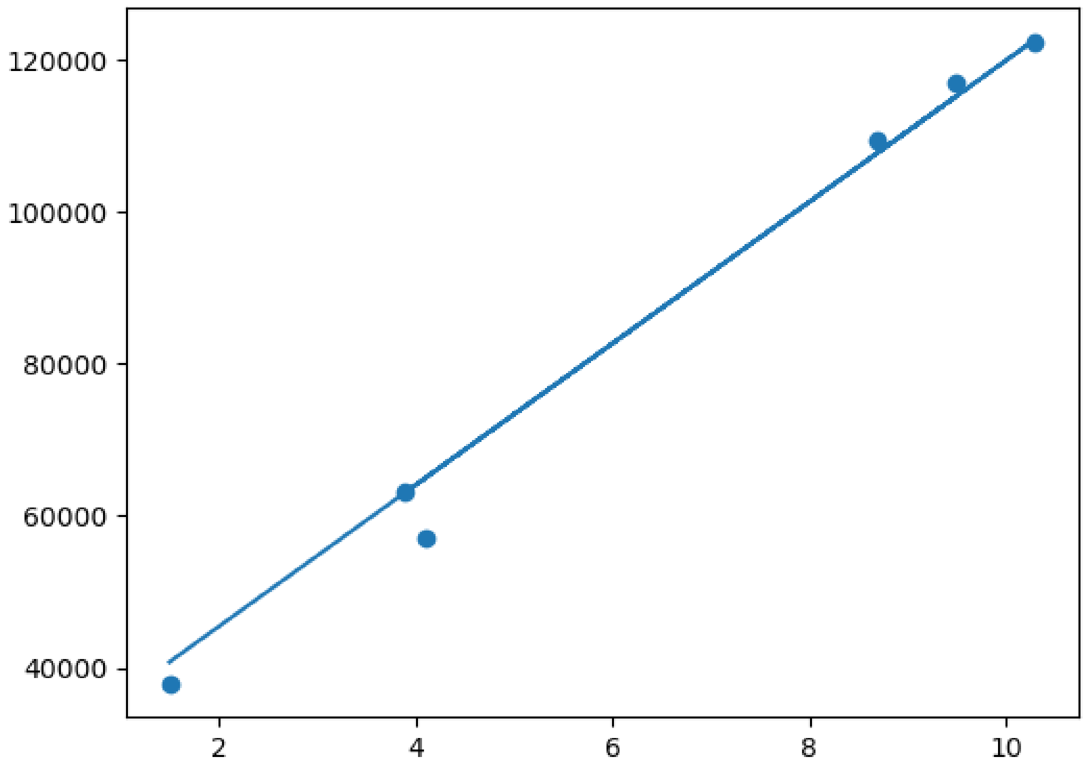
[13]:
```
array([[ 40748.96184072],
       [122699.62295594],
       [ 64961.65717022],
       [ 63099.14214487],
       [115249.56285456],
       [107799.50275317]])
```

[14]:
```
errors=y_pred-y_test
errors
```

[14]:
```
array([[ 3017.96184072],
       [  308.62295594],
       [ 7880.65717022],
       [ -118.85785513],
       [-1719.43714544],
       [-1631.49724683]])
```

[15]:
```
import matplotlib.pyplot as plt
plt.scatter(x_test,y_test)
plt.plot(x_test,y_pred)
```

[15]:
```
[<matplotlib.lines.Line2D at 0x26ea0de2fd0>]
```



[16]:
```
from sklearn.metrics import r2_score
accuracy=r2_score(y_test,y_pred)
```

[17]:
```
accuracy
```

[17]:
```
0.988169515729126
```

[18]:
```
model.predict([[44]])
```

[18]:
```
array([[436533.40472671]])
```

```
[19]: model.score(x_train,y_train)#This tells how the model regression fits this model

[19]: 0.9411949620562126

[20]: model.score(x_test,y_test)

[20]: 0.988169515729126

[21]: model.coef_#the coefficient is the slope of the best-fit line.

[21]: array([[9312.57512673]])

[22]: model.intercept_

[22]: array([26780.09915063])

[23]: model.predict([[55]])

[23]: array([[538971.73112073]])

[ ]:
```

Exercise8

November 2, 2025

[1]:
```
import pandas as pd
df=pd.read_csv('Iris (1).csv')
```

[8]:
```
df.head(5)
```

[8]:
```
   sepal.length  sepal.width  petal.length  petal.width variety
0           5.1          3.5           1.4          0.2  Setosa
1           4.9          3.0           1.4          0.2  Setosa
2           4.7          3.2           1.3          0.2  Setosa
3           4.6          3.1           1.5          0.2  Setosa
4           5.0          3.6           1.4          0.2  Setosa
```

[9]:
```
df.variety.value_counts()
```

[9]:
```
variety
Setosa        50
Versicolor    50
Virginica     50
Name: count, dtype: int64
```

[10]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 5 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   sepal.length  150 non-null    float64
 1   sepal.width   150 non-null    float64
 2   petal.length  150 non-null    float64
 3   petal.width   150 non-null    float64
 4   variety       150 non-null    object
dtypes: float64(4), object(1)
memory usage: 6.0+ KB
```

[16]:
```
df["output"] = 0
```

[42]:
```
df.loc[:49, "output"] = 1
```

[43]:
```
df.loc[50:99,"output"]=2
```

[44]:
```
df.loc[100:149,"output"]=3
```

[45]:
```
df.head(5)
```

[45]:
```
   sepal.length  sepal.width  petal.length  petal.width variety  output
0           5.1          3.5           1.4          0.2  Setosa       1
1           4.9          3.0           1.4          0.2  Setosa       1
2           4.7          3.2           1.3          0.2  Setosa       1
3           4.6          3.1           1.5          0.2  Setosa       1
4           5.0          3.6           1.4          0.2  Setosa       1
```

[46]:
```
df.tail(5)
```

[46]:
```
     sepal.length  sepal.width  petal.length  petal.width    variety  output
145           6.7          3.0           5.2          2.3  Virginica       3
146           6.3          2.5           5.0          1.9  Virginica       3
147           6.5          3.0           5.2          2.0  Virginica       3
148           6.2          3.4           5.4          2.3  Virginica       3
149           5.9          3.0           5.1          1.8  Virginica       3
```

[47]:
```
from sklearn.model_selection import train_test_split
```

[48]:
```
feature=df
label=df
```

[56]:
```
feature=df.drop("output",axis=1)
for col in feature.columns:
    if feature[col].dtype == 'object':
        le = LabelEncoder()
        feature[col] = le.fit_transform(feature[col])
label=df["output"]
```

[57]:
```
feature
```

[57]:
```
     sepal.length  sepal.width  petal.length  petal.width  variety
0             5.1          3.5           1.4          0.2        0
1             4.9          3.0           1.4          0.2        0
2             4.7          3.2           1.3          0.2        0
3             4.6          3.1           1.5          0.2        0
4             5.0          3.6           1.4          0.2        0
..            …            …            …            …        …
145           6.7          3.0           5.2          2.3        2
146           6.3          2.5           5.0          1.9        2
147           6.5          3.0           5.2          2.0        2
148           6.2          3.4           5.4          2.3        2
149           5.9          3.0           5.1          1.8        2
```

```
[150 rows x 5 columns]
```

[58]:
```
label
```

[58]:
```
0      1
1      1
2      1
3      1
4      1
      ..
145    3
146    3
147    3
148    3
149    3
Name: output, Length: 150, dtype: int64
```

[59]:
```
X_train,X_test,Y_train,y_test=train_test_split(feature,label,test_size=0.
 ↪2,random_state=1)
```

[60]:
```
from sklearn.neighbors import KNeighborsClassifier
```

[61]:
```
op=KNeighborsClassifier(n_neighbors=5)
```

[62]:
```
op.fit(X_train,Y_train)
```

[62]:
```
KNeighborsClassifier()
```

[64]:
```
print(op.score(X_test,y_test))
```

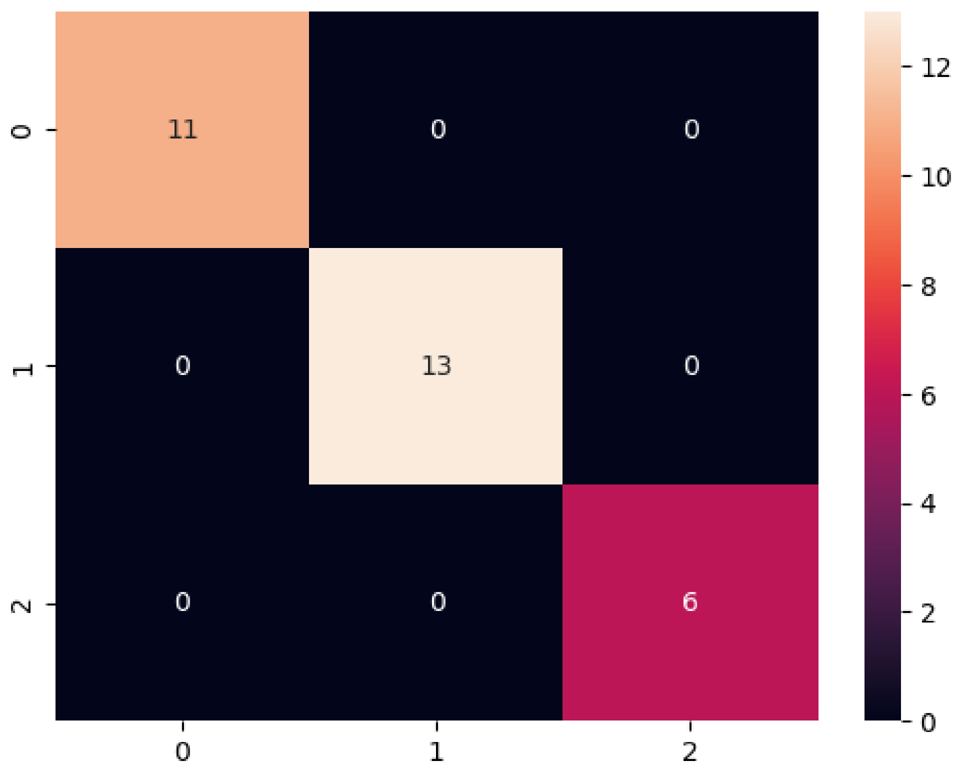
```
1.0
```

[65]:
```
from sklearn.metrics import confusion_matrix
y_pred=op.predict(X_test)
```

[69]:
```
c_n_m=confusion_matrix(y_test,y_pred)
```

[70]:
```
import seaborn as sn
sn.heatmap(c_n_m,annot=True)
```

[70]:
```
<Axes: >
```



```
[72]: from sklearn.metrics import classification_report
      print(classification_report(label,op.predict(feature)))
```

```
              precision    recall  f1-score   support

           1       1.00      1.00      1.00        50
           2       1.00      1.00      1.00        50
           3       1.00      1.00      1.00        50

    accuracy                           1.00       150
   macro avg       1.00      1.00      1.00       150
weighted avg       1.00      1.00      1.00       150
```

```
[ ]:
```

Exercise-9

November 2, 2025

```
[1]: import pandas as pd
     df=pd.read_csv('Social_Network_Ads.csv')
```

```
[3]: import numpy as np
     import pandas as pd
```

```
[4]: features=df.iloc[:,[2,3]].values
     label=df.iloc[:,4].values
     features
```

```
[4]: array([[    19,  19000],
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            [    35,  65000],
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            [    26,  52000],
            [    20,  86000],
            [    32,  18000],
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            [    45,  26000],
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            [    48,  29000],
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            [    50,  20000],
            [    36,  33000],
            [    49,  36000]])
```

[5]:
```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
```

```
[6]: for i in range(1, 401):
         x_train, x_test, y_train, y_test = train_test_split(features, label,␣
      ↪test_size=0.2, random_state=i)

         model = LogisticRegression()
         model.fit(x_train, y_train)

         train_score = model.score(x_train, y_train)
         test_score = model.score(x_test, y_test)

         if test_score > train_score:
             print("Test {:.3f} Train {:.3f} Random State {}".format(test_score,␣
      ↪train_score, i))
```

```
Test 0.900 Train 0.841 Random State 4
Test 0.863 Train 0.850 Random State 5
Test 0.863 Train 0.859 Random State 6
Test 0.887 Train 0.838 Random State 7
Test 0.863 Train 0.838 Random State 9
Test 0.900 Train 0.841 Random State 10
Test 0.863 Train 0.856 Random State 14
Test 0.850 Train 0.844 Random State 15
Test 0.863 Train 0.856 Random State 16
Test 0.875 Train 0.834 Random State 18
Test 0.850 Train 0.844 Random State 19
Test 0.875 Train 0.844 Random State 20
Test 0.863 Train 0.834 Random State 21
Test 0.875 Train 0.841 Random State 22
Test 0.875 Train 0.841 Random State 24
Test 0.850 Train 0.834 Random State 26
Test 0.850 Train 0.841 Random State 27
Test 0.863 Train 0.834 Random State 30
Test 0.863 Train 0.856 Random State 31
Test 0.875 Train 0.853 Random State 32
Test 0.863 Train 0.844 Random State 33
Test 0.875 Train 0.831 Random State 35
Test 0.863 Train 0.853 Random State 36
Test 0.887 Train 0.841 Random State 38
Test 0.875 Train 0.838 Random State 39
Test 0.887 Train 0.838 Random State 42
Test 0.875 Train 0.847 Random State 46
Test 0.912 Train 0.831 Random State 47
Test 0.875 Train 0.831 Random State 51
Test 0.900 Train 0.844 Random State 54
Test 0.850 Train 0.844 Random State 57
Test 0.875 Train 0.844 Random State 58
Test 0.925 Train 0.838 Random State 61
Test 0.887 Train 0.834 Random State 65
Test 0.887 Train 0.841 Random State 68
Test 0.900 Train 0.831 Random State 72
Test 0.887 Train 0.838 Random State 75
Test 0.925 Train 0.825 Random State 76
Test 0.863 Train 0.841 Random State 77
Test 0.863 Train 0.859 Random State 81
Test 0.875 Train 0.838 Random State 82
Test 0.887 Train 0.838 Random State 83
Test 0.863 Train 0.853 Random State 84
Test 0.863 Train 0.841 Random State 85
Test 0.863 Train 0.841 Random State 87
Test 0.875 Train 0.847 Random State 88
Test 0.912 Train 0.838 Random State 90
Test 0.863 Train 0.850 Random State 95
Test 0.875 Train 0.850 Random State 99
Test 0.850 Train 0.841 Random State 101
Test 0.850 Train 0.841 Random State 102
Test 0.900 Train 0.825 Random State 106
Test 0.863 Train 0.841 Random State 107
Test 0.850 Train 0.834 Random State 109
Test 0.850 Train 0.841 Random State 111
Test 0.912 Train 0.841 Random State 112
Test 0.863 Train 0.850 Random State 115
Test 0.863 Train 0.841 Random State 116
Test 0.875 Train 0.834 Random State 119
Test 0.912 Train 0.828 Random State 120
Test 0.863 Train 0.859 Random State 125
Test 0.850 Train 0.847 Random State 128
Test 0.875 Train 0.850 Random State 130
Test 0.900 Train 0.844 Random State 133
Test 0.925 Train 0.834 Random State 134
Test 0.863 Train 0.850 Random State 135
Test 0.875 Train 0.831 Random State 138
Test 0.863 Train 0.850 Random State 141
Test 0.850 Train 0.847 Random State 143
Test 0.850 Train 0.847 Random State 146
Test 0.850 Train 0.844 Random State 147
Test 0.863 Train 0.850 Random State 148
Test 0.875 Train 0.838 Random State 150
Test 0.887 Train 0.831 Random State 151
Test 0.925 Train 0.844 Random State 152
Test 0.850 Train 0.841 Random State 153
Test 0.900 Train 0.844 Random State 154
Test 0.900 Train 0.841 Random State 155
Test 0.887 Train 0.847 Random State 156
Test 0.887 Train 0.834 Random State 158
Test 0.875 Train 0.828 Random State 159
Test 0.900 Train 0.831 Random State 161
Test 0.850 Train 0.838 Random State 163
Test 0.875 Train 0.831 Random State 164
Test 0.863 Train 0.850 Random State 169
Test 0.875 Train 0.841 Random State 171
Test 0.850 Train 0.841 Random State 172
Test 0.900 Train 0.825 Random State 180
Test 0.850 Train 0.834 Random State 184
Test 0.925 Train 0.822 Random State 186
Test 0.900 Train 0.831 Random State 193
Test 0.863 Train 0.850 Random State 195
Test 0.863 Train 0.841 Random State 196
Test 0.863 Train 0.838 Random State 197
Test 0.875 Train 0.841 Random State 198
Test 0.887 Train 0.838 Random State 199
Test 0.887 Train 0.844 Random State 200
Test 0.863 Train 0.838 Random State 202
Test 0.863 Train 0.841 Random State 203
Test 0.887 Train 0.831 Random State 206
Test 0.863 Train 0.834 Random State 211
Test 0.850 Train 0.844 Random State 212
Test 0.863 Train 0.834 Random State 214
Test 0.875 Train 0.831 Random State 217
Test 0.963 Train 0.819 Random State 220
Test 0.875 Train 0.844 Random State 221
Test 0.850 Train 0.841 Random State 222
Test 0.900 Train 0.844 Random State 223
Test 0.863 Train 0.853 Random State 227
Test 0.863 Train 0.834 Random State 228
Test 0.900 Train 0.841 Random State 229
Test 0.850 Train 0.844 Random State 232
Test 0.875 Train 0.847 Random State 233
Test 0.912 Train 0.841 Random State 234
Test 0.863 Train 0.841 Random State 235
Test 0.850 Train 0.847 Random State 236
Test 0.875 Train 0.847 Random State 239
Test 0.850 Train 0.844 Random State 241
Test 0.887 Train 0.850 Random State 242
Test 0.887 Train 0.825 Random State 243
Test 0.875 Train 0.847 Random State 244
Test 0.875 Train 0.841 Random State 245
Test 0.875 Train 0.847 Random State 246
Test 0.863 Train 0.859 Random State 247
Test 0.887 Train 0.844 Random State 248
Test 0.863 Train 0.850 Random State 250
Test 0.875 Train 0.831 Random State 251
Test 0.887 Train 0.844 Random State 252
Test 0.863 Train 0.847 Random State 255
Test 0.900 Train 0.841 Random State 257
Test 0.863 Train 0.856 Random State 260
Test 0.863 Train 0.841 Random State 266
Test 0.863 Train 0.838 Random State 268
Test 0.875 Train 0.841 Random State 275
Test 0.863 Train 0.850 Random State 276
Test 0.925 Train 0.838 Random State 277
Test 0.875 Train 0.847 Random State 282
Test 0.850 Train 0.847 Random State 283
Test 0.850 Train 0.844 Random State 285
Test 0.912 Train 0.834 Random State 286
Test 0.850 Train 0.841 Random State 290
Test 0.850 Train 0.841 Random State 291
Test 0.850 Train 0.847 Random State 292
Test 0.863 Train 0.838 Random State 294
Test 0.887 Train 0.828 Random State 297
Test 0.863 Train 0.834 Random State 300
Test 0.863 Train 0.850 Random State 301
Test 0.887 Train 0.850 Random State 302
Test 0.875 Train 0.847 Random State 303
Test 0.863 Train 0.834 Random State 305
Test 0.912 Train 0.838 Random State 306
Test 0.875 Train 0.847 Random State 308
Test 0.900 Train 0.844 Random State 311
Test 0.863 Train 0.834 Random State 313
Test 0.912 Train 0.834 Random State 314
Test 0.875 Train 0.838 Random State 315
Test 0.900 Train 0.847 Random State 317
Test 0.912 Train 0.822 Random State 319
Test 0.863 Train 0.850 Random State 321
Test 0.912 Train 0.828 Random State 322
Test 0.850 Train 0.847 Random State 328
Test 0.850 Train 0.838 Random State 332
Test 0.887 Train 0.853 Random State 336
Test 0.850 Train 0.838 Random State 337
Test 0.875 Train 0.841 Random State 343
Test 0.863 Train 0.844 Random State 346
Test 0.887 Train 0.831 Random State 351
Test 0.863 Train 0.850 Random State 352
Test 0.950 Train 0.819 Random State 354
Test 0.863 Train 0.850 Random State 356
Test 0.912 Train 0.841 Random State 357
Test 0.863 Train 0.838 Random State 358
Test 0.850 Train 0.841 Random State 362
Test 0.900 Train 0.844 Random State 363
Test 0.863 Train 0.853 Random State 364
Test 0.938 Train 0.822 Random State 366
Test 0.912 Train 0.841 Random State 369
Test 0.863 Train 0.853 Random State 371
Test 0.925 Train 0.834 Random State 376
Test 0.912 Train 0.828 Random State 377
Test 0.887 Train 0.850 Random State 378
Test 0.887 Train 0.850 Random State 379
Test 0.863 Train 0.841 Random State 382
Test 0.863 Train 0.859 Random State 386
Test 0.850 Train 0.838 Random State 387
Test 0.875 Train 0.828 Random State 388
Test 0.850 Train 0.844 Random State 394
Test 0.863 Train 0.838 Random State 395
Test 0.900 Train 0.844 Random State 397
Test 0.863 Train 0.844 Random State 400
```

[7]:
```
x_train, x_test, y_train, y_test = train_test_split(features, label,␣
↪test_size=0.2, random_state=42)
finalModel = LogisticRegression()
finalModel.fit(x_train, y_train)
```

[7]:
```
LogisticRegression()
```

[8]:
```
print(finalModel.score(x_train,y_train))
print(finalModel.score(x_test,y_test))
```

```
0.8375
0.8875
```

[9]:
```
from sklearn.metrics import classification_report
print(classification_report(label,finalModel.predict(features)))
```

```
              precision    recall  f1-score   support

           0       0.85      0.93      0.89       257
           1       0.85      0.70      0.77       143

    accuracy                           0.85       400
   macro avg       0.85      0.81      0.83       400
weighted avg       0.85      0.85      0.84       400
```

[ ]:
```

```

Experiment-10

November 2, 2025

[34]:
```
import pandas as pd
df=pd.read_csv('Mall_Customers.csv')
```

[35]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

[36]:
```
feature=df.iloc[:,[3,4]].values
```

[37]:
```
feature
```

[37]:
```
array([[ 15,  39],
       [ 15,  81],
       [ 16,   6],
       [ 16,  77],
       [ 17,  40],
       [ 17,  76],
       [ 18,   6],
       [ 18,  94],
       [ 19,   3],
       [ 19,  72],
       [ 19,  14],
       [ 19,  99],
       [ 20,  15],
       [ 20,  77],
       [ 20,  13],
       [ 20,  79],
       [ 21,  35],
       [ 21,  66],
       [ 23,  29],
       [ 23,  98],
       [ 24,  35],
       [ 24,  73],
       [ 25,   5],
       [ 25,  73],
       [ 28,  14],
       [ 28,  82],
       [ 28,  32],
       [ 28,  61],
       [ 29,  31],
       [ 29,  87],
       [ 30,   4],
       [ 30,  73],
       [ 33,   4],
       [ 33,  92],
       [ 33,  14],
       [ 33,  81],
       [ 34,  17],
       [ 34,  73],
       [ 37,  26],
       [ 37,  75],
       [ 38,  35],
       [ 38,  92],
       [ 39,  36],
       [ 39,  61],
       [ 39,  28],
       [ 39,  65],
       [ 40,  55],
       [ 40,  47],
       [ 40,  42],
       [ 40,  42],
       [ 42,  52],
       [ 42,  60],
       [ 43,  54],
       [ 43,  60],
       [ 43,  45],
       [ 43,  41],
       [ 44,  50],
       [ 44,  46],
       [ 46,  51],
       [ 46,  46],
       [ 46,  56],
       [ 46,  55],
       [ 47,  52],
       [ 47,  59],
       [ 48,  51],
       [ 48,  59],
       [ 48,  50],
       [ 48,  48],
       [ 48,  59],
       [ 48,  47],
       [ 49,  55],
       [ 49,  42],
       [ 50,  49],
       [ 50,  56],
       [ 54,  47],
       [ 54,  54],
       [ 54,  53],
       [ 54,  48],
       [ 54,  52],
       [ 54,  42],
       [ 54,  51],
       [ 54,  55],
       [ 54,  41],
       [ 54,  44],
       [ 54,  57],
       [ 54,  46],
       [ 57,  58],
       [ 57,  55],
       [ 58,  60],
       [ 58,  46],
       [ 59,  55],
       [ 59,  41],
       [ 60,  49],
       [ 60,  40],
       [ 60,  42],
       [ 60,  52],
       [ 60,  47],
       [ 60,  50],
       [ 61,  42],
       [ 61,  49],
       [ 62,  41],
       [ 62,  48],
       [ 62,  59],
       [ 62,  55],
       [ 62,  56],
       [ 62,  42],
       [ 63,  50],
       [ 63,  46],
       [ 63,  43],
       [ 63,  48],
       [ 63,  52],
       [ 63,  54],
       [ 64,  42],
       [ 64,  46],
       [ 65,  48],
       [ 65,  50],
       [ 65,  43],
       [ 65,  59],
       [ 67,  43],
       [ 67,  57],
       [ 67,  56],
       [ 67,  40],
       [ 69,  58],
       [ 69,  91],
       [ 70,  29],
       [ 70,  77],
       [ 71,  35],
       [ 71,  95],
       [ 71,  11],
       [ 71,  75],
       [ 71,   9],
       [ 71,  75],
       [ 72,  34],
       [ 72,  71],
       [ 73,   5],
       [ 73,  88],
       [ 73,   7],
       [ 73,  73],
       [ 74,  10],
       [ 74,  72],
       [ 75,   5],
       [ 75,  93],
       [ 76,  40],
       [ 76,  87],
       [ 77,  12],
       [ 77,  97],
       [ 77,  36],
       [ 77,  74],
       [ 78,  22],
       [ 78,  90],
       [ 78,  17],
       [ 78,  88],
       [ 78,  20],
       [ 78,  76],
       [ 78,  16],
       [ 78,  89],
       [ 78,   1],
       [ 78,  78],
       [ 78,   1],
       [ 78,  73],
       [ 79,  35],
       [ 79,  83],
       [ 81,   5],
       [ 81,  93],
       [ 85,  26],
       [ 85,  75],
       [ 86,  20],
       [ 86,  95],
       [ 87,  27],
       [ 87,  63],
       [ 87,  13],
       [ 87,  75],
       [ 87,  10],
       [ 87,  92],
       [ 88,  13],
       [ 88,  86],
       [ 88,  15],
       [ 88,  69],
       [ 93,  14],
       [ 93,  90],
       [ 97,  32],
       [ 97,  86],
       [ 98,  15],
       [ 98,  88],
       [ 99,  39],
       [ 99,  97],
       [101,  24],
       [101,  68],
       [103,  17],
       [103,  85],
       [103,  23],
       [103,  69],
       [113,   8],
       [113,  91],
       [120,  16],
       [120,  79],
       [126,  28],
       [126,  74],
       [137,  18],
       [137,  83]])
```

[38]:
```
import os
os.environ["OMP_NUM_THREADS"] = "1"
```

[39]:
```
from sklearn.cluster import KMeans
model=KMeans(n_clusters=5)
model.fit(feature)
KMeans(n_clusters=5)
```

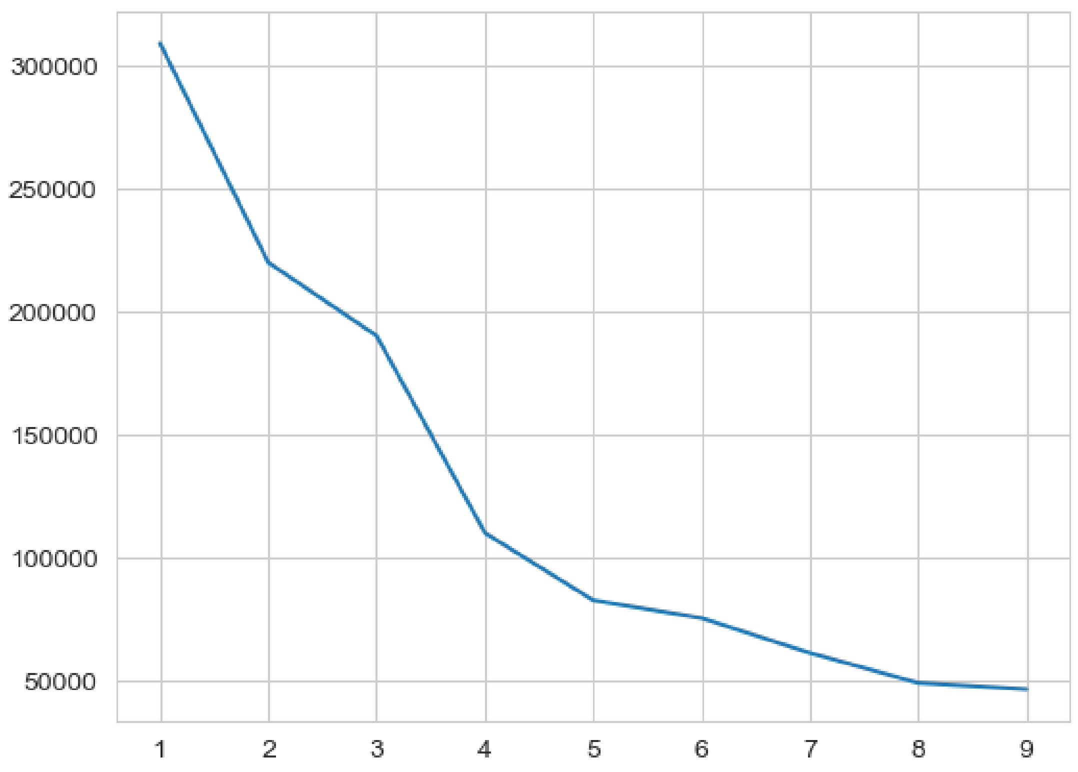
```
D:\Ashvanthan\anaconda3\python\Lib\site-
packages\sklearn\cluster\_kmeans.py:1419: UserWarning: KMeans is known to have a
memory leak on Windows with MKL, when there are less chunks than available
threads. You can avoid it by setting the environment variable OMP_NUM_THREADS=1.
  warnings.warn(
[39]: KMeans(n_clusters=5)
```

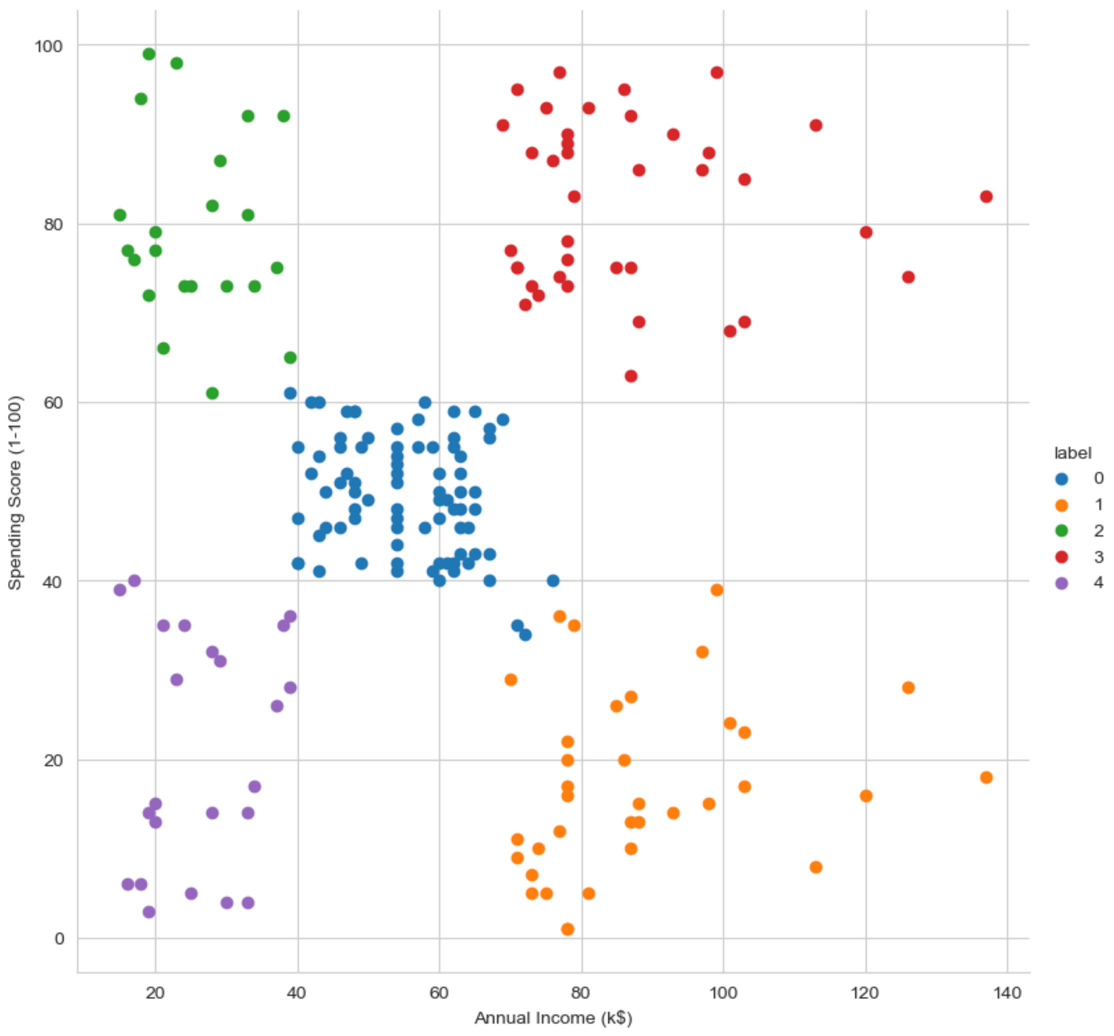
```
[40]: Final=df.iloc[:,[3,4]]
      Final['label']=model.predict(feature)
      Final
```

```
C:\Users\Lenovo\AppData\Local\Temp\ipykernel_9408\551092936.py:2:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  Final['label']=model.predict(feature)
```

```
[40]:      Annual Income (k$)  Spending Score (1-100)  label
      0                    15                      39      4
      1                    15                      81      2
      2                    16                       6      4
      3                    16                      77      2
      4                    17                      40      4
      ..                  …                     …    …
      195                 120                      79      3
      196                 126                      28      1
      197                 126                      74      3
      198                 137                      18      1
      199                 137                      83      3

      [200 rows x 3 columns]
```

```
[41]: sns.set_style("whitegrid")
      sns.FacetGrid(Final,hue="label",height=8).map(plt.scatter,"Annual Income (k$)",␣
        ↪"Spending Score (1-100)").add_legend();
      plt.show()
```


300000
250000
200000
150000
100000
50000
1
2
3
4
5
6
7
8
9


Spending Score (1-100)
Annual Income (k$)
label
0
1
2
3
4
100
80
60
40
20
0
20
40
60
80
100
120
140

Exercie-11

November 2, 2025

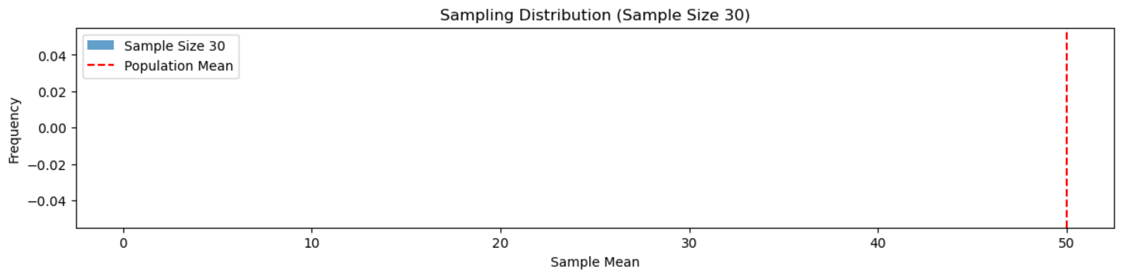
[8]:
```
import numpy as np
import matplotlib.pyplot as plt
```

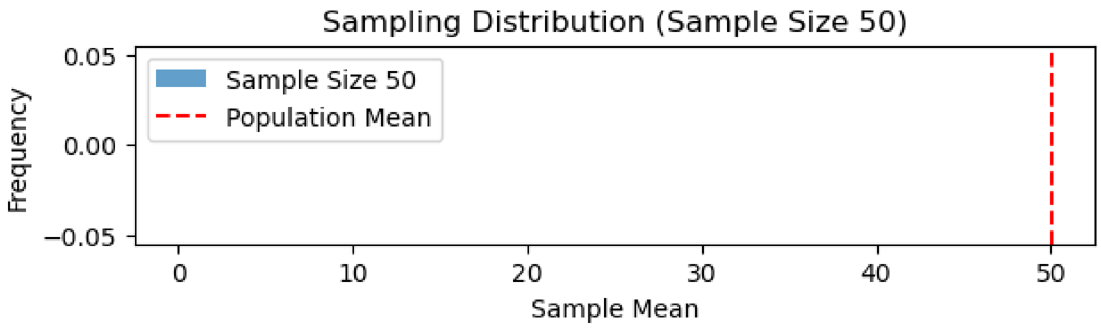
[9]:
```
population_mean = 50
population_std = 10
population_size = 100000
population = np.random.normal(population_mean, population_std, population_size)
```

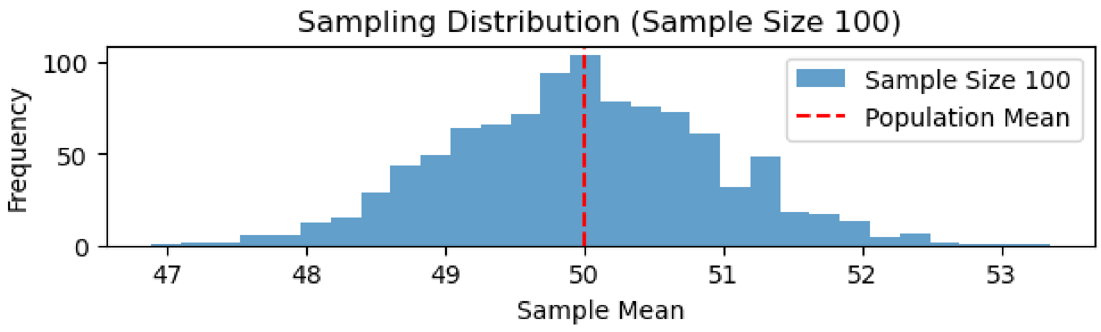
[10]:
```
sample_sizes = [30, 50, 100]
num_samples = 1000
```

[11]:
```
sample_means = {}
for size in sample_sizes:
    sample_means[size] = []
for _ in range(num_samples):
    sample = np.random.choice(population, size=size, replace=False)
    sample_means[size].append(np.mean(sample))
```

[12]:
```
plt.figure(figsize=(12, 8))
for i, size in enumerate(sample_sizes):
    plt.subplot(len(sample_sizes), 1, i+1)
    plt.hist(sample_means[size], bins=30, alpha=0.7, label=f'Sample Size␣
 ↪{size}')
    plt.axvline(np.mean(population), color='red', linestyle='dashed',␣
 ↪linewidth=1.5,label='Population Mean')
    plt.title(f'Sampling Distribution (Sample Size {size})')
    plt.xlabel('Sample Mean')
    plt.ylabel('Frequency')
    plt.legend()
    plt.tight_layout()
    plt.show()
```


Sampling Distribution (Sample Size 30)
Sample Size 30
Population Mean
Frequency
Sample Mean


Sampling Distribution (Sample Size 50)
Sample Size 50
Population Mean
Frequency
Sample Mean


Sampling Distribution (Sample Size 100)
Sample Size 100
Population Mean
Frequency
Sample Mean

```
[ ]:
```

Experiment-12

November 2, 2025

```
[1]: import numpy as np
     import scipy.stats as stats
```

```
[2]: sample_data = np.array([152, 148, 151, 149, 147, 153, 150, 148, 152,
     149,151, 150, 149, 152, 151, 148, 150, 152, 149, 150,148, 153, 151,
     150, 149, 152, 148, 151, 150, 153])
```

```
[3]: population_mean = 150
```

```
[4]: sample_mean = np.mean(sample_data)
     sample_std = np.std(sample_data, ddof=1)
```

```
[5]: n = len(sample_data)
```

```
[6]: z_statistic = (sample_mean - population_mean) / (sample_std /np.sqrt(n))
```

```
[7]: p_value = 2 * (1 - stats.norm.cdf(np.abs(z_statistic)))
```

```
[8]: print(f"Sample Mean: {sample_mean:.2f}")
     print(f"Z-Statistic: {z_statistic:.4f}")
     print(f"P-Value: {p_value:.4f}")
```

```
Sample Mean: 150.20
Z-Statistic: 0.6406
P-Value: 0.5218
```

```
[9]: alpha = 0.05
     if p_value<alpha:
         print("Reject the null hypothesis: The average weight is significantly␣
      ↪different from 150 grams")
     else:
         print("Fail to reject the null hypothesis: There is nosignificant␣
      ↪difference in average weight from 150 grams")
```

```
Fail to reject the null hypothesis: There is nosignificant difference in average
weight from 150 grams
```

```
[ ]:
```

Exercise-13

November 2, 2025

[1]:
```python
import numpy as np
import scipy.stats as stats
```

[2]:
```python
np.random.seed(42)
```

[3]:
```python
sample_size = 25
sample_data = np.random.normal(loc=102, scale=15, size=sample_size)
```

[4]:
```python
population_mean = 100
sample_mean = np.mean(sample_data)
sample_std = np.std(sample_data, ddof=1)
```

[5]:
```python
n = len(sample_data)
```

[6]:
```python
t_statistic, p_value = stats.ttest_1samp(sample_data,population_mean)
print(f"Sample Mean: {sample_mean:.2f}")
print(f"T-Statistic: {t_statistic:.4f}")
print(f"P-Value: {p_value:.4f}")
```

```
Sample Mean: 99.55
T-Statistic: -0.1577
P-Value: 0.8760
```

[8]:
```python
alpha = 0.05
if p_value<alpha:
    print("Reject the null hypothesis: The average IQ score is significantly␣
 ↪different from 100")
else:
    print("Fail to reject the null hypothesis: There is no significant␣
 ↪difference in average IQ score from 100")
```

```
Fail to reject the null hypothesis: There is no significant difference in
average IQ score from 100
```

[ ]:
```python

```

Exercise-14

November 2, 2025

```
[1]: import numpy as np
     import scipy.stats as stats
```

```
[2]: np.random.seed(42)
     n_plants = 25
     growth_A = np.random.normal(loc=10, scale=2, size=n_plants)
     growth_B = np.random.normal(loc=12, scale=3, size=n_plants)
     growth_C = np.random.normal(loc=15, scale=2.5, size=n_plants)
```

```
[3]: all_data = np.concatenate([growth_A, growth_B, growth_C])
     treatment_labels = ['A'] * n_plants + ['B'] * n_plants + ['C'] *n_plants
```

```
[4]: f_statistic, p_value = stats.f_oneway(growth_A, growth_B, growth_C)
```

```
[5]: print("Treatment A Mean Growth:", np.mean(growth_A))
     print("Treatment B Mean Growth:", np.mean(growth_B))
     print("Treatment C Mean Growth:", np.mean(growth_C))
     print()
     print(f"F-Statistic: {f_statistic:.4f}")
     print(f"P-Value: {p_value:.4f}")
```

```
Treatment A Mean Growth: 9.672983882683818
Treatment B Mean Growth: 11.137680744437432
Treatment C Mean Growth: 15.265234904828972

F-Statistic: 36.1214
P-Value: 0.0000
```

```
[8]: alpha = 0.05
     if p_value<alpha:
         print("Reject the null hypothesis: There is a significant difference in␣
      ↪mean growth rates among the three treatments")
     else:
         print("Fail to reject the null hypothesis: There is no significant␣
      ↪difference in mean growth rates among the three treatments")
     if p_value<alpha:
         from statsmodels.stats.multicomp import pairwise_tukeyhsd
         tukey_results = pairwise_tukeyhsd(all_data, treatment_labels,alpha=0.05)
```

```
    print("\nTukey's HSD Post-hoc Test:")
    print(tukey_results)
```

```
Reject the null hypothesis: There is a significant difference in mean growth
rates among the three treatments

Tukey's HSD Post-hoc Test:
Multiple Comparison of Means - Tukey HSD, FWER=0.05
===================================================
group1 group2 meandiff p-adj   lower  upper  reject
---------------------------------------------------
     A      B   1.4647 0.0877 -0.1683 3.0977  False
     A      C   5.5923    0.0  3.9593 7.2252   True
     B      C   4.1276    0.0  2.4946 5.7605   True
---------------------------------------------------
```

```
[ ]:
```