DSA0508 – QUERY PROCESSING FOR DATA SCIENCE WITH DATA EXPLORATION

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Q1: PROGRAM

```
import pandas as pd
data = {
   'DEPARTMENT_ID': [10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180,
190, 200, 210, 220, 230, 240, 250, 260, 270],
   'DEPARTMENT_NAME': ['Administration', 'Marketing', 'Purchasing', 'Human Resources', 'Shipping',
'IT', 'Public Relations', 'Sales', 'Executive', 'Finance', 'Accounting', 'Treasury', 'Corporate Tax', 'Control
And Credit', 'Shareholder Services', 'Benefits', 'Manufacturing', 'Construction', 'Contracting',
'Operations', 'IT Support', 'NOC', 'IT Helpdesk', 'Government Sales', 'Retail Sales', 'Recruiting',
'Payroll'],
   'MANAGER_ID': [200, 201, 114, 203, 121, 103, 204, 145, 100, 108, 205, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0],
   'LOCATION_ID': [1700, 1800, 1700, 2400, 1500, 1400, 2700, 2500, 1700, 1700, 1700, 1700, 1700,
1700, 1700, 1700, 1700, 1700, 1700, 1700, 1700, 1700, 1700, 1700, 1700, 1700, 1700]
}
employees_df = pd.DataFrame(data)
distinct_department_ids = employees_df['DEPARTMENT_ID'].unique()
print(distinct_department_ids)
```

OUTPUT:

```
[ 10  20  30  40  50  60  70  80  90 100 110 120 130 140 150 160 170 180
 190 200 210 220 230 240 250 260 270]
```

Q2: PROGRAM

```
import pandas as pd
data = {
   'EMPLOYEE_ID': [102, 101, 101, 201, 114, 122, 200, 176, 176, 200],
   'START_DATE': ['2001-01-13', '1997-09-21', '2001-10-28', '2004-02-17', '2006-03-24', '2007-01-01',
'1995-09-17', '2006-03-24', '2007-01-01', '2002-07-01'],
   'END_DATE': ['2006-07-24', '2001-10-27', '2005-03-15', '2007-12-19', '2007-12-31', '2007-12-31',
'2001-06-17', '2006-12-31', '2007-12-31', '2006-12-31'],
   'JOB_ID': ['IT_PROG', 'AC_ACCOUNT', 'AC_MGR', 'MK_REP', 'ST_CLERK', 'ST_CLERK', 'AD_ASST',
'SA_REP', 'SA_MAN', 'AC_ACCOUNT'],
   'DEPARTMENT_ID': [60, 110, 110, 20, 50, 50, 90, 80, 80, 90]
}
employees_df = pd.DataFrame(data)
employee_jobs_count = employees_df.groupby('EMPLOYEE_ID')['JOB_ID'].nunique()
employees_with_multiple_jobs = employee_jobs_count[employee_jobs_count >= 2]
print(employees_with_multiple_jobs.index.tolist())
```

OUTPUT:

[101, 176, 200]

Q3: PROGRAM

```
import pandas as pd

data = {

   'JOB_ID': ['AD_PRES', 'AD_VP', 'AD_ASST', 'FI_MGR', 'FI_ACCOUNT', 'AC_MGR', 'AC_ACCOUNT',
'SA_MAN', 'SA_REP', 'PU_MAN', 'PU_CLERK', 'ST_MAN', 'ST_CLERK', 'SH_CLERK', 'IT_PROG',
'MK_MAN', 'MK_REP', 'HR_REP', 'PR_REP'],

   'JOB_TITLE': ['President', 'Administration Vice President', 'Administration Assistant', 'Finance
Manager', 'Accountant', 'Accounting Manager', 'Public Accountant', 'Sales Manager', 'Sales
Representative', 'Purchasing Manager', 'Purchasing Clerk', 'Stock Manager', 'Stock Clerk', 'Shipping
Clerk', 'Programmer', 'Marketing Manager', 'Marketing Representative', 'Human Resources
Representative', 'Public Relations Representative'],

   'MIN_SALARY': [20080, 15000, 3000, 8200, 4200, 8200, 4200, 10000, 6000, 8000, 2500, 5500,
2008, 2500, 4000, 9000, 4000, 4000, 4500],

   'MAX_SALARY': [40000, 30000, 6000, 16000, 9000, 16000, 9000, 20080, 12008, 15000, 5500, 8500,
5000, 5500, 10000, 15000, 9000, 9000, 10500]

}

jobs_df = pd.DataFrame(data)

sorted_jobs_df = jobs_df.sort_values(by='JOB_TITLE', ascending=False)

print(sorted_jobs_df)
```

OUTPUT:

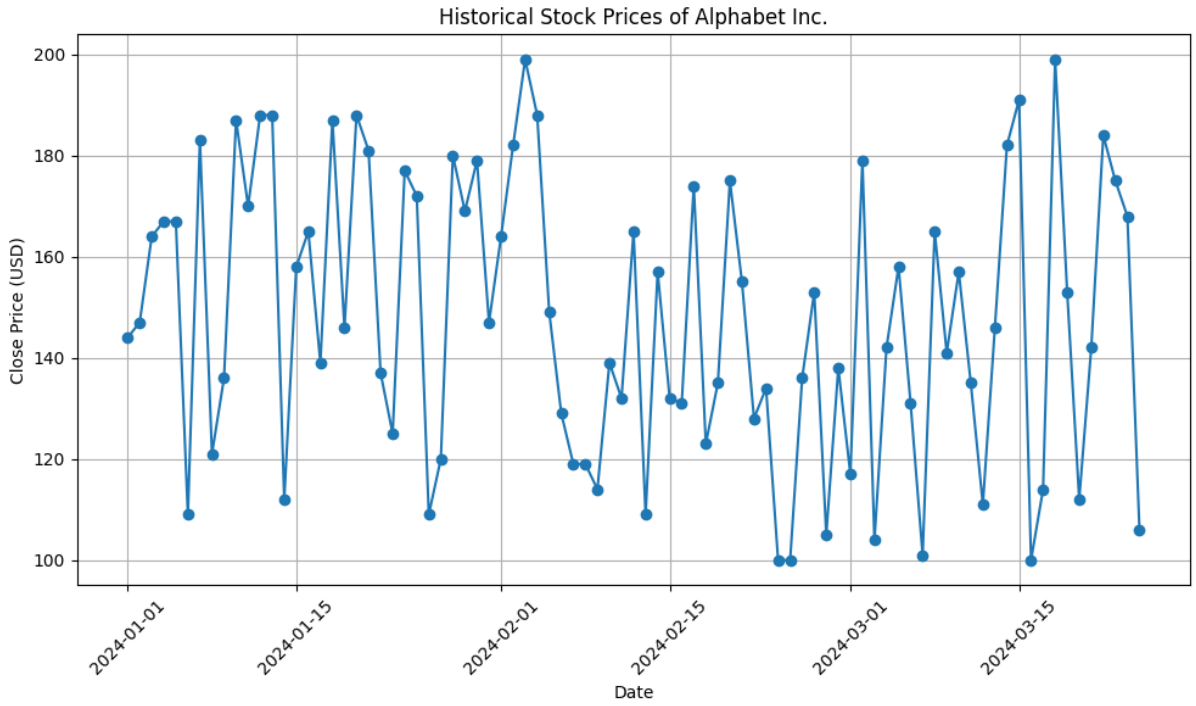
```
JOB_ID                   JOB_TITLE  MIN_SALARY  MAX_SALARY
11     ST_MAN                Stock Manager        5500        8500
12    ST_CLERK                 Stock Clerk        2008        5000
13    SH_CLERK               Shipping Clerk        2500        5500
8      SA_REP           Sales Representative        6000       12008
7      SA_MAN                Sales Manager       10000       20080
9      PU_MAN             Purchasing Manager        8000       15000
10    PU_CLERK              Purchasing Clerk        2500        5500
18     PR_REP  Public Relations Representative        4500       10500
6   AC_ACCOUNT              Public Accountant        4200        9000
14     IT_PROG                   Programmer        4000       10000
0      AD_PRES                    President       20080       40000
16     MK_REP         Marketing Representative        4000        9000
15     MK_MAN               Marketing Manager        9000       15000
17     HR_REP   Human Resources Representative        4000        9000
3      FI_MGR                Finance Manager        8200       16000
1       AD_VP    Administration Vice President       15000       30000
2     AD_ASST         Administration Assistant        3000        6000
5      AC_MGR              Accounting Manager        8200       16000
```

4 FI_ACCOUNT Accountant 4200 9000

Q4: PROGRAM

```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
start_date = '2024-01-01'
end_date = '2024-03-25'
dates = pd.date_range(start=start_date, end=end_date)
num_days = len(dates)
np.random.seed(0)
stock_prices = np.random.randint(100, 200, size=num_days).astype(float)
df = pd.DataFrame({'Date': dates, 'Close': stock_prices})
plt.figure(figsize=(10, 6))
plt.plot(df['Date'], df['Close'], marker='o', linestyle='-')
plt.title('Historical Stock Prices of Alphabet Inc.')
plt.xlabel('Date')
plt.ylabel('Close Price (USD)')
plt.grid(True)
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```

OUTPUT:

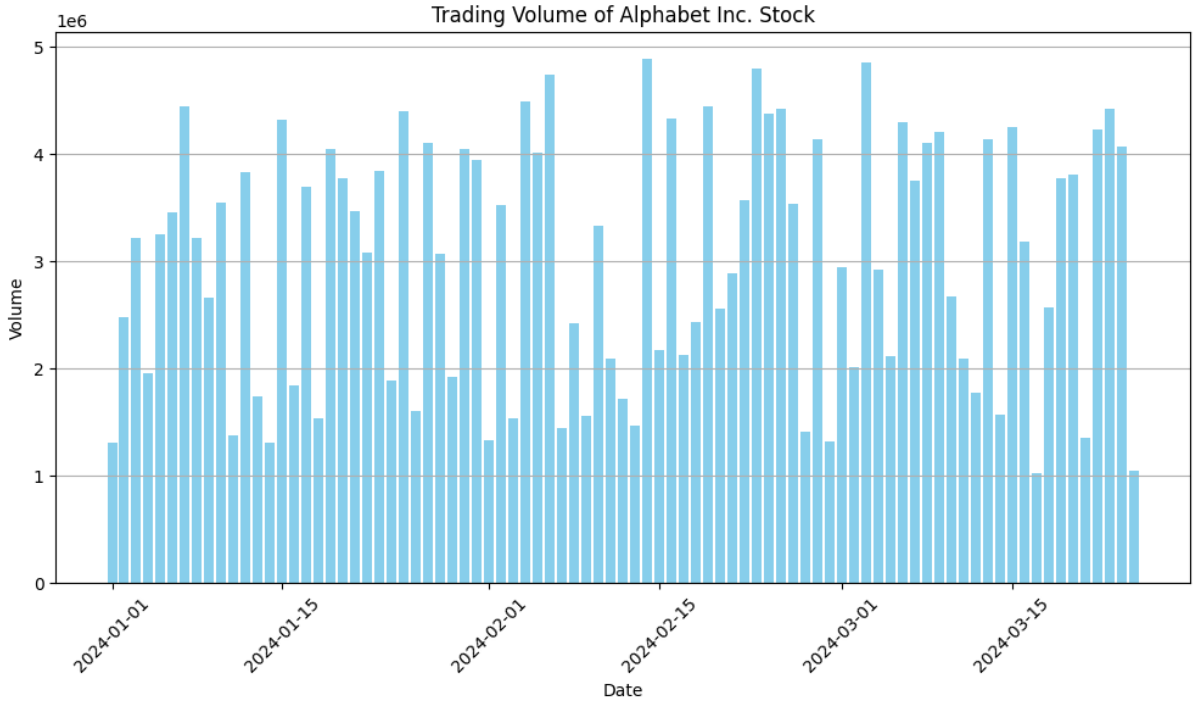


Q5: PROGRAM

```
import pandas as pd
import matplotlib.pyplot as plt
```

```
import numpy as np
start_date = '2024-01-01'
end_date = '2024-03-25'
dates = pd.date_range(start=start_date, end=end_date)
num_days = len(dates)
np.random.seed(0)
trading_volume = np.random.randint(1000000, 5000000, size=num_days)
df = pd.DataFrame({'Date': dates, 'Volume': trading_volume})
plt.figure(figsize=(10, 6))
plt.bar(df['Date'], df['Volume'], color='skyblue')
plt.title('Trading Volume of Alphabet Inc. Stock')
plt.xlabel('Date')
plt.ylabel('Volume')
plt.grid(axis='y')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```

OUTPUT:

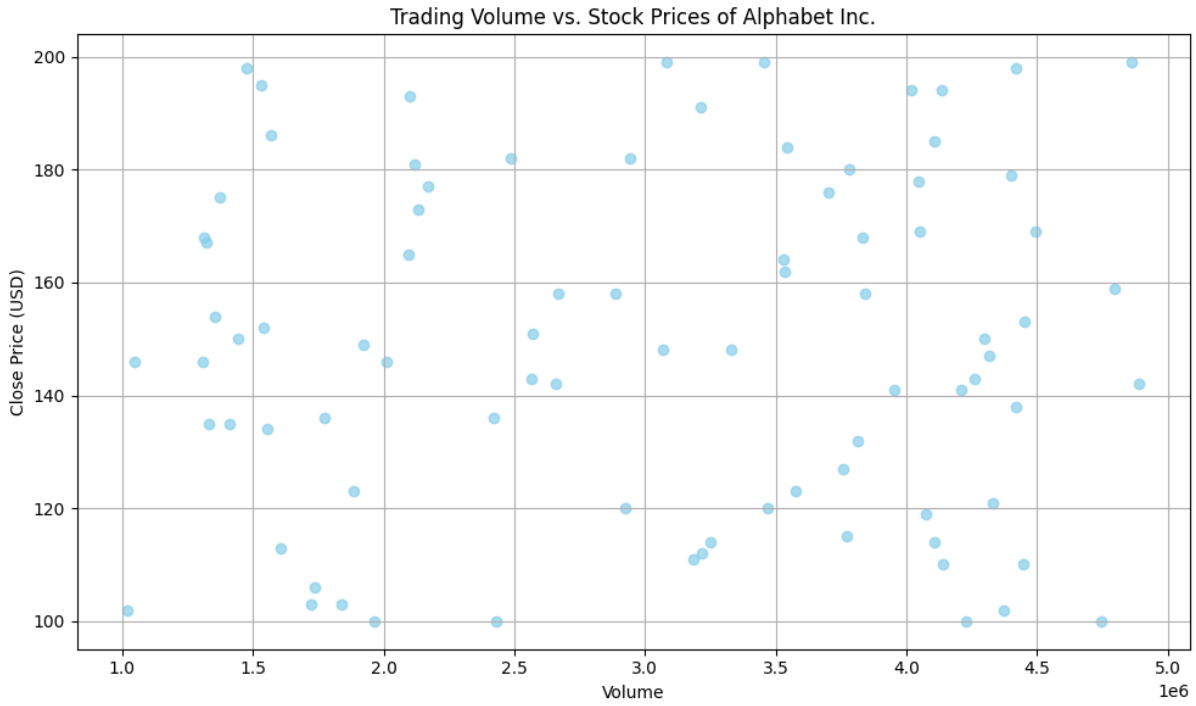


Q6: PROGRAM

```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
start_date = '2024-01-01'
end_date = '2024-03-25'
dates = pd.date_range(start=start_date, end=end_date)
```

```
num_days = len(dates)
np.random.seed(0)
trading_volume = np.random.randint(1000000, 5000000, size=num_days)
stock_prices = np.random.randint(100, 200, size=num_days)
df = pd.DataFrame({'Date': dates, 'Volume': trading_volume, 'Close': stock_prices})
plt.figure(figsize=(10, 6))
plt.scatter(df['Volume'], df['Close'], color='skyblue', alpha=0.7)
plt.title('Trading Volume vs. Stock Prices of Alphabet Inc.')
plt.xlabel('Volume')
plt.ylabel('Close Price (USD)')
plt.grid(True)
plt.tight_layout()
plt.show()
```

OUTPUT:



Q7: PROGRAM

```
import pandas as pd
sales_data = {
    'Item': ['A', 'B', 'C', 'A', 'B', 'C', 'A', 'B', 'C'],
    'Date': ['2024-01-01', '2024-01-01', '2024-01-01', '2024-01-02', '2024-01-02', '2024-01-02', '2024-01-03', '2024-01-03', '2024-01-03'],
    'Sale': [100, 150, 200, 120, 170, 220, 130, 180, 230]
}
df = pd.DataFrame(sales_data)
pivot_table = pd.pivot_table(df, values='Sale', index='Item', aggfunc=['max', 'min'])
print("Pivot Table:")
print(pivot_table)
```

```
max_sale_value = pivot_table['max'].max().iloc[0]
min_sale_value = pivot_table['min'].min().iloc[0]
print("\nMaximum Sale Value:", max_sale_value)
print("Minimum Sale Value:", min_sale_value)
```

OUTPUT:

```
Pivot Table:
     max  min
    Sale Sale
Item
A     130  100
B     180  150
C     230  200

Maximum Sale Value: 230
Minimum Sale Value: 100
```

Q8: PROGRAM

```
import pandas as pd
sales_data = {
   'Item': ['A', 'B', 'C', 'A', 'B', 'C', 'A', 'B', 'C'],
   'Date': ['2024-01-01', '2024-01-01', '2024-01-01', '2024-01-02', '2024-01-02', '2024-01-02', '2024-
01-03', '2024-01-03', '2024-01-03'],
   'Unit_Sold': [10, 15, 20, 12, 17, 22, 13, 18, 23]
}
df = pd.DataFrame(sales_data)
pivot_table = pd.pivot_table(df, values='Unit_Sold', index='Item', aggfunc='sum')
print("Pivot Table - Item wise unit sold:")
print(pivot_table)
```

OUTPUT:

```
Pivot Table - Item wise unit sold:
     Unit_Sold
Item
A          35
B          50
C          65
```

Q9: PROGRAM

```
import pandas as pd
sales_data = {
   'Region': ['East', 'East', 'West', 'West', 'North', 'North', 'South', 'South', 'East', 'West'],
```

```
    'Manager': ['John', 'John', 'Smith', 'Smith', 'Emma', 'Emma', 'Adam', 'Adam', 'John', 'Smith'],
    'Salesman': ['Alex', 'Bob', 'Charlie', 'David', 'Ethan', 'Frank', 'George', 'Harry', 'Ian', 'Jack'],
    'Sale_Amount': [1000, 1500, 1200, 1700, 1300, 1800, 1400, 1900, 1600, 1100]
}
df = pd.DataFrame(sales_data)
pivot_table = pd.pivot_table(df, values='Sale_Amount', index=['Region', 'Manager', 'Salesman'],
aggfunc='sum')
print("Pivot Table - Total Sale Amount (Region-wise, Manager-wise, Salesman-wise):")
print(pivot_table)
```

OUTPUT:

```
Pivot Table - Total Sale Amount (Region-wise, Manager-wise, Salesman-wise):
                    Sale_Amount
Region Manager Salesman
East   John    Alex          1000
           Bob           1500
           Ian           1600
North  Emma    Ethan         1300
           Frank         1800
South  Adam    George        1400
           Harry         1900
West   Smith   Charlie       1200
           David         1700
           Jack          1100
```

Q10: PROGRAM

```
import pandas as pd
import numpy as np
np.random.seed(0)
data = np.random.randn(10, 4)
df = pd.DataFrame(data, columns=['A', 'B', 'C', 'D'])
def color_negative_red(val):
    color = 'red' if val < 0 else 'black'
    return f'color: {color}'
styled_df = df.style.applymap(color_negative_red)
styled_df
```

OUTPUT:

	A	B	C	D
0	1.764052	0.400157	0.978738	2.240893
1	1.867558	-0.977278	0.950088	-0.151357
2	-0.103219	0.410599	0.144044	1.454274
3	0.761038	0.121675	0.443863	0.333674
4	1.494079	-0.205158	0.313068	-0.854096
5	-2.552990	0.653619	0.864436	-0.742165
6	2.269755	-1.454366	0.045759	-0.187184
7	1.532779	1.469359	0.154947	0.378163
8	-0.887786	-1.980796	-0.347912	0.156349
9	1.230291	1.202380	-0.387327	-0.302303

Q11: PROGRAM

```
import pandas as pd
import numpy as np
np.random.seed(0)
data = np.random.randn(10, 5)
df = pd.DataFrame(data, columns=['A', 'B', 'C', 'D', 'E'])
df.loc[4:4, 'B'] = np.nan
df.loc[3:3, 'D'] = np.nan
df.loc[0:0, 'C'] = np.nan
df.loc[9:9, 'E'] = np.nan
def highlight_nan(val):
    if pd.isna(val):
        return 'background-color: yellow'
    else:
        return ''
styled_df = df.style.applymap(highlight_nan)
styled_df
```

OUTPUT:

	A	B	C	D	E
0	1.764052	0.400157	nan	2.240893	1.867558
1	-0.977278	0.950088	-0.151357	-0.103219	0.410599
2	0.144044	1.454274	0.761038	0.121675	0.443863
3	0.333674	1.494079	-0.205158	nan	-0.854096
4	-2.552990	nan	0.864436	-0.742165	2.269755
5	-1.454366	0.045759	-0.187184	1.532779	1.469359
6	0.154947	0.378163	-0.887786	-1.980796	-0.347912
7	0.156349	1.230291	1.202380	-0.387327	-0.302303
8	-1.048553	-1.420018	-1.706270	1.950775	-0.509652
9	-0.438074	-1.252795	0.777490	-1.613898	nan

Q12: PROGRAM

```
import pandas as pd
import numpy as np
np.random.seed(0)
data = np.random.randn(10, 4)
df = pd.DataFrame(data, columns=['A', 'B', 'C', 'D'])
def set_colors(val):
    return 'background-color: black; color: yellow'
styled_df = df.style.applymap(lambda x: set_colors(x))
styled_df
```

OUTPUT:

	A	B	C	D
0	1.764052	0.400157	0.978738	2.240893
1	1.867558	-0.977278	0.950088	-0.151357
2	-0.103219	0.410599	0.144044	1.454274
3	0.761038	0.121675	0.443863	0.333674
4	1.494079	-0.205158	0.313068	-0.854096
5	-2.552990	0.653619	0.864436	-0.742165
6	2.269755	-1.454366	0.045759	-0.187184
7	1.532779	1.469359	0.154947	0.378163
8	-0.887786	-1.980796	-0.347912	0.156349
9	1.230291	1.202380	-0.387327	-0.302303

Q13: PROGRAM

```
import pandas as pd
import numpy as np
data = {
   'ord_no': [70001.0, np.nan, 70002.0, 70004.0, np.nan, 70005.0, np.nan, 70010.0, 70003.0,
70012.0, np.nan],
   'purch_amt': [None, 150.50, None, None, 65.26, 110.50, 270.65, 1983.43, 2480.40, 250.45, 75.29],
   'ord_date': ['2012-10-05', '2012-09-10', None, '2012-09-10', '2012-08-17', '2012-09-10', '2012-07-
27', '2012-09-10', '2012-10-10', '2012-06-27', '2012-08-17'],
   'customer_id': [3002, 3001, 3001, 3003, 3002, 3001, 3001, 3004, 3003, 3002, 3001],
   'salesman_id': [5002.0, 5002.0, 5003.0, np.nan, 5002.0, 5003.0, 5001.0, np.nan, 5003.0, 5002.0,
5003.0]
}

df = pd.DataFrame(data)
missing_values = df.isna()
print(missing_values)
```

OUTPUT:

```
   ord_no  purch_amt  ord_date  customer_id  salesman_id
0   False       True     False        False        False
1    True      False     False        False        False
2   False       True      True        False        False
3   False       True     False        False         True
4    True      False     False        False        False
5   False      False     False        False        False
6    True      False     False        False        False
7   False      False     False        False         True
```

```
8   False     False    False      False      False
9   False     False    False      False      False
10   True     False    False      False      False
```

Q14: PROGRAM

```
import pandas as pd
import numpy as np
data = {
   'ord_no': [70001, 70002, 70004, np.nan, 70005, 5760, 70010, 70003, 70012, np.nan, 70013],
   'purch_amt': [1, 65.26, 110.5, 948.5, 2400.6, 5760, '?', 12.43, 2480.4, 250.45, 3045.6],
   'ord_date': ['2012-09-10', np.nan, '2012-08-17', '2012-09-10', '2012-07-27', '2012-09-10', '2012-10-
10', '2012-10-10', '2012-06-27', '2012-08-17', '2012-04-25'],
   'customer_id': [3002, 3001, 3003, 3002, 3001, 3001, 3004, 3003, 3002, 3001, np.nan],
   'salesman_id': [5002, np.nan, 5001, np.nan, 5002, 5001, np.nan, 5003, 5002, 5003, np.nan]
}

df = pd.DataFrame(data)
df.replace('?', np.nan, inplace=True)
df.fillna(0, inplace=True)
print(df)
```

OUTPUT:

```
    ord_no  purch_amt    ord_date  customer_id  salesman_id
0   70001.0       1.00  2012-09-10       3002.0       5002.0
1   70002.0      65.26           0       3001.0          0.0
2   70004.0     110.50  2012-08-17       3003.0       5001.0
3       0.0     948.50  2012-09-10       3002.0          0.0
4   70005.0    2400.60  2012-07-27       3001.0       5002.0
5    5760.0    5760.00  2012-09-10       3001.0       5001.0
6   70010.0       0.00  2012-10-10       3004.0          0.0
7   70003.0      12.43  2012-10-10       3003.0       5003.0
8   70012.0    2480.40  2012-06-27       3002.0       5002.0
9       0.0     250.45  2012-08-17       3001.0       5003.0
10  70013.0    3045.60  2012-04-25          0.0          0.0
```

Q15: PROGRAM

```
import pandas as pd
import numpy as np
data = {
   'ord_no': [np.nan, np.nan, np.nan, np.nan, np.nan, np.nan, np.nan, np.nan, np.nan, np.nan,
np.nan],
   'purch_amt': [1, 2, np.nan, 4, 5, 6, np.nan, np.nan, 9, 10, 11],
   'ord_date': [np.nan, np.nan, 3, np.nan, np.nan, np.nan, 7, 8, 9, np.nan, 11],
   'customer_id': [np.nan, np.nan, np.nan, np.nan, np.nan, np.nan, np.nan, np.nan, np.nan, np.nan,
np.nan]
```

```
}

df = pd.DataFrame(data)
print(df)
```

OUTPUT:

```
   ord_no  purch_amt  ord_date  customer_id
0     NaN        1.0       NaN          NaN
1     NaN        2.0       NaN          NaN
2     NaN        NaN       3.0          NaN
3     NaN        4.0       NaN          NaN
4     NaN        5.0       NaN          NaN
5     NaN        6.0       NaN          NaN
6     NaN        NaN       7.0          NaN
7     NaN        NaN       8.0          NaN
8     NaN        9.0       9.0          NaN
9     NaN       10.0       NaN          NaN
10    NaN       11.0      11.0          NaN
```

Q16: PROGRAM

```
import pandas as pd
data = {
   'school': ['s001', 's002', 's003', 's001', 's002', 's004'],
   'class': ['V', 'V', 'VI', 'VI', 'V', 'VI'],
   'name': ['Alberto Franco', 'Gino Mcneill', 'Ryan Parkes', 'Eesha Hinton', 'Gino Mcneill', 'David
Parkes'],
   'date_of_birth': ['15/05/2002', '17/05/2002', '16/02/1999', '25/09/1998', '11/05/2002',
'15/09/1997'],
   'age': [12, 12, 13, 13, 14, 12],
   'height': [173, 192, 186, 167, 151, 159],
   'weight': [35,32,33,30,31,32],
   'address': ['street1', 'street2', 'street3', 'street1', 'street2', 'street4']
}
df = pd.DataFrame(data)
grouped = df.groupby('school')
print(type(grouped))
for name, group in grouped:
   print("\nSchool Code:", name)
   print(group)
```

OUTPUT:

```
<class 'pandas.core.groupby.generic.DataFrameGroupBy'>

School Code: s001
  school class           name date_of_birth  age  height  weight  address
0   s001     V  Alberto Franco    15/05/2002   12     173      35  street1
3   s001    VI    Eesha Hinton    25/09/1998   13     167      30  street1
```

School Code: s002

	school	class	name	date_of_birth	age	height	weight	address
1	s002	V	Gino Mcneill	17/05/2002	12	192	32	street2
4	s002	V	Gino Mcneill	11/05/2002	14	151	31	street2

School Code: s003

	school	class	name	date_of_birth	age	height	weight	address
2	s003	VI	Ryan Parkes	16/02/1999	13	186	33	street3

School Code: s004

	school	class	name	date_of_birth	age	height	weight	address
5	s004	VI	David Parkes	15/09/1997	12	159	32	street4

Q17: PROGRAM

```
import pandas as pd
data = {
   'school': ['s001', 's002', 's003', 's001', 's002', 's004'],
   'class': ['V', 'V', 'VI', 'VI', 'V', 'VI'],
   'name': ['Alberto Franco', 'Gino Mcneill', 'Ryan Parkes', 'Eesha Hinton', 'Gino Mcneill', 'David
Parkes'],
   'date_of_birth': ['15/05/2002', '17/05/2002', '16/02/1999', '25/09/1998', '11/05/2002',
'15/09/1997'],
   'age': [12, 12, 13, 13, 14, 12],
   'height': [173, 192, 186, 167, 151, 159],
   'weight': [35, 32, 33, 30, 31, 32],
   'address': ['street1', 'street2', 'street3', 'street1', 'street2', 'street4']
}

df = pd.DataFrame(data)
result = df.groupby('school')['age'].agg(['mean', 'min', 'max'])
print("Mean, Min, and Max Age for Each School:")
print(result)
```

OUTPUT:

Mean, Min, and Max Age for Each School:

school	mean	min	max
s001	12.5	12	13
s002	13.0	12	14
s003	13.0	13	13
s004	12.0	12	12

Q18: PROGRAM

```
import pandas as pd
data = {
   'school': ['s001', 's002', 's003', 's001', 's002', 's004'],
```

```
    'class': ['V', 'V', 'VI', 'VI', 'V', 'VI'],
    'name': ['Alberto Franco', 'Gino Mcneill', 'Ryan Parkes', 'Eesha Hinton', 'Gino Mcneill', 'David
Parkes'],
    'date_of_birth': ['15/05/2002', '17/05/2002', '16/02/1999', '25/09/1998', '11/05/2002',
'15/09/1997'],
    'age': [12, 12, 13, 13, 14, 12],
    'height': [173, 192, 186, 167, 151, 159],
    'weight': [35, 32, 33, 30, 31, 32],
    'address': ['street1', 'street2', 'street3', 'street1', 'street2', 'street4']
}

df = pd.DataFrame(data)
grouped = df.groupby(['school', 'class'])
for name, group in grouped:
    print("\nGroup:", name)
    print(group)
```

OUTPUT:

```
Group: ('s001', 'V')
  school class          name date_of_birth  age  height  weight  address
0   s001     V  Alberto Franco    15/05/2002   12     173      35  street1

Group: ('s001', 'VI')
  school class         name date_of_birth  age  height  weight  address
3   s001    VI  Eesha Hinton    25/09/1998   13     167      30  street1

Group: ('s002', 'V')
  school class         name date_of_birth  age  height  weight  address
1   s002     V  Gino Mcneill    17/05/2002   12     192      32  street2
4   s002     V  Gino Mcneill    11/05/2002   14     151      31  street2

Group: ('s003', 'VI')
  school class        name date_of_birth  age  height  weight  address
2   s003    VI  Ryan Parkes    16/02/1999   13     186      33  street3

Group: ('s004', 'VI')
  school class         name date_of_birth  age  height  weight  address
5   s004    VI  David Parkes    15/09/1997   12     159      32  street4
```

Q19: PROGRAM

```
import pandas as pd
data = {
    'Year': [1986, 1986, 1985, 1986, 1987],
    'WHO region': ['Western Pacific', 'Americas', 'Africa', 'Americas', 'Americas'],
    'Country': ['Viet Nam', 'Uruguay', "Cte d'Ivoire", 'Colombia', 'Saint Kitts and Nevis'],
    'Beverage Types': ['Wine', 'Other', 'Wine', 'Beer', 'Beer'],
    'Display Value': [0.00, 0.50, 1.62, 4.27, 1.98]
}
```

```
df = pd.DataFrame(data)
print("Dimensions or Shape of the DataFrame:", df.shape)
column_names = df.columns.tolist()
print("Column Names:")
for name in column_names:
    print(name)
```

OUTPUT:

Dimensions or Shape of the DataFrame: (5, 5)
Column Names:
Year
WHO region
Country
Beverage Types
Display Value

Q20: PROGRAM

```
import pandas as pd
data = {'Text': ['apple', 'banana', 'orange', 'grape']}
df = pd.DataFrame(data)
def find_substring_index(dataframe, column_name, substring):
    indices = []
    for index, row in dataframe.iterrows():
        index_of_substring = row[column_name].find(substring)
        indices.append(index_of_substring)
    return indices
substring = 'ra'
df['Substring_Index'] = find_substring_index(df, 'Text', substring)
print(df)
```

OUTPUT:

	Text	Substring_Index
0	apple	-1
1	banana	-1
2	orange	1
3	grape	1

Q21: PROGRAM

```
import pandas as pd
data = {'Name': ['John', 'Alice', 'Bob', 'Diana'],
        'Age': [25, 30, 35, 40]}
df = pd.DataFrame(data)
```

```
df['Name'] = df['Name'].str.swapcase()
print(df)
```

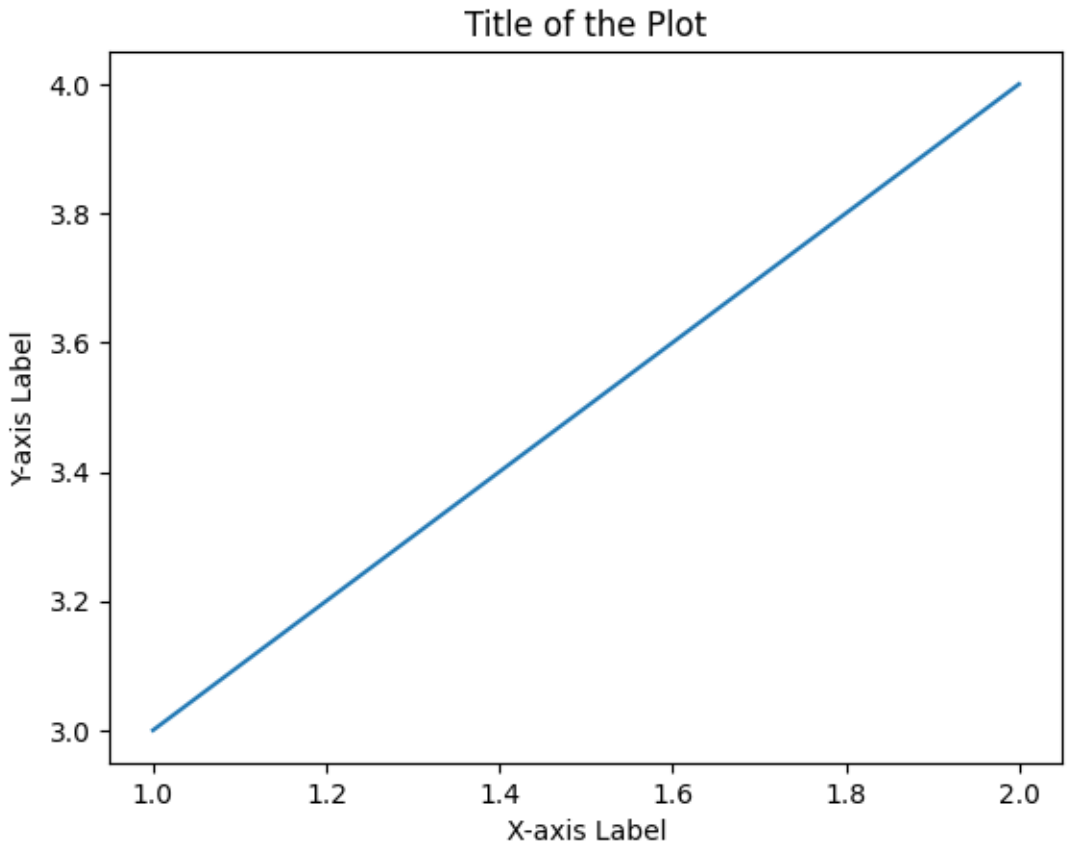
OUTPUT:

```
   Name  Age
0  jOHN   25
1  aLICE  30
2   bOB   35
3  dIANA  40
```

Q22: PROGRAM

```
import matplotlib.pyplot as plt
x = [1,2]
y = [3,4]
plt.plot(x, y)
plt.xlabel('X-axis Label')
plt.ylabel('Y-axis Label')
plt.title('Title of the Plot')
plt.show()
```

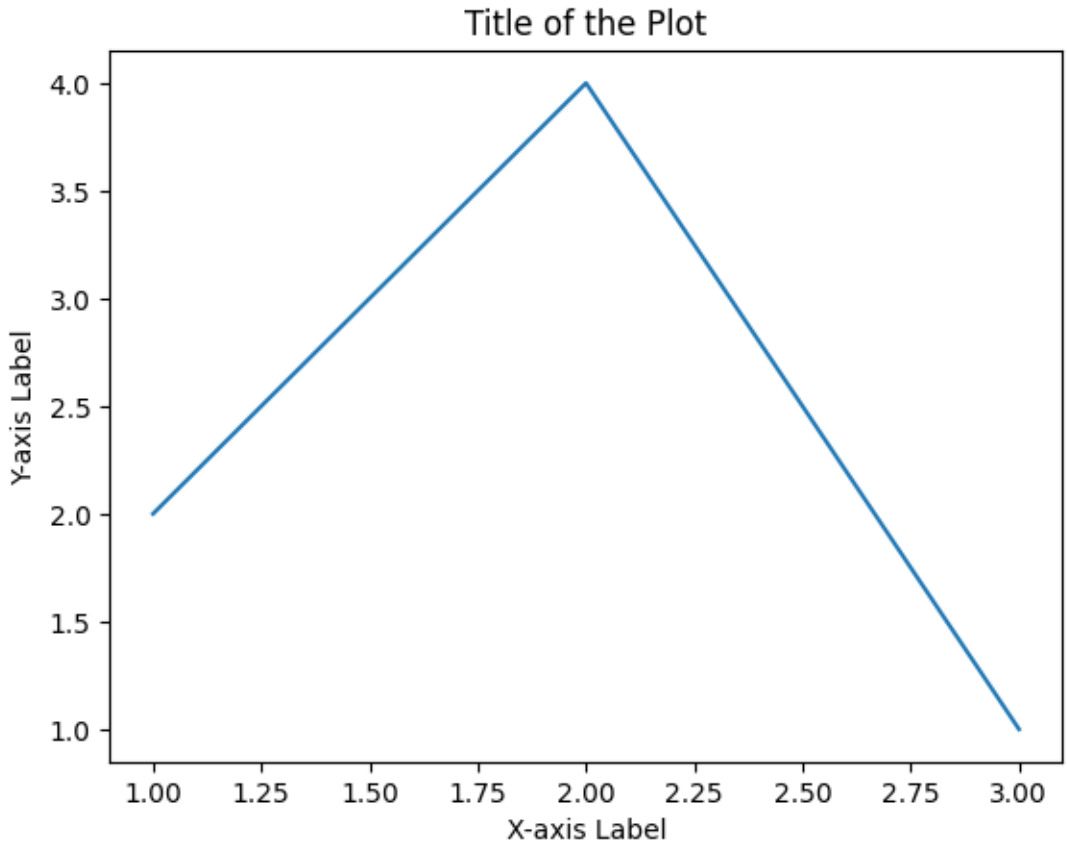
OUTPUT:



Q23: PROGRAM

```
import matplotlib.pyplot as plt
x = [1,2,3]
y = [2,4,1]
plt.plot(x, y)
plt.xlabel('X-axis Label')
plt.ylabel('Y-axis Label')
plt.title('Title of the Plot')
plt.show()
```

OUTPUT:

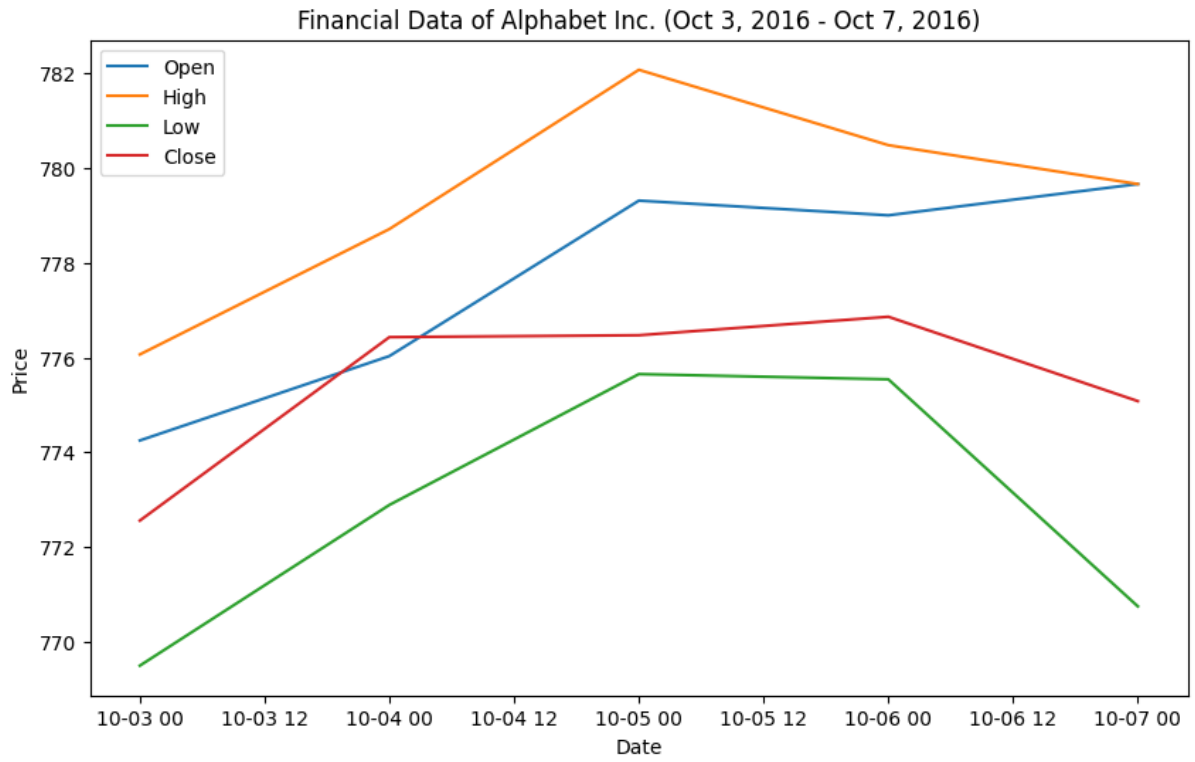


Q24: PROGRAM

```
import pandas as pd

import matplotlib.pyplot as plt
financial_data = {
    'Date': ['10-03-16', '10-04-16', '10-05-16', '10-06-16', '10-07-16'],
    'Open': [774.25, 776.030029, 779.309998, 779, 779.659973],
    'High': [776.065002, 778.710022, 782.070007, 780.47998, 779.659973],
    'Low': [769.5, 772.890015, 775.650024, 775.539978, 770.75],
    'Close': [772.559998, 776.429993, 776.469971, 776.859985, 775.080017]
}
```

```
df = pd.DataFrame(financial_data)
df['Date'] = pd.to_datetime(df['Date'], format='%m-%d-%y')
plt.figure(figsize=(10, 6))
plt.plot(df['Date'], df['Open'], label='Open')
plt.plot(df['Date'], df['High'], label='High')
plt.plot(df['Date'], df['Low'], label='Low')
plt.plot(df['Date'], df['Close'], label='Close')
plt.xlabel('Date')
plt.ylabel('Price')
plt.title('Financial Data of Alphabet Inc. (Oct 3, 2016 - Oct 7, 2016)')
plt.legend()
plt.show()
```

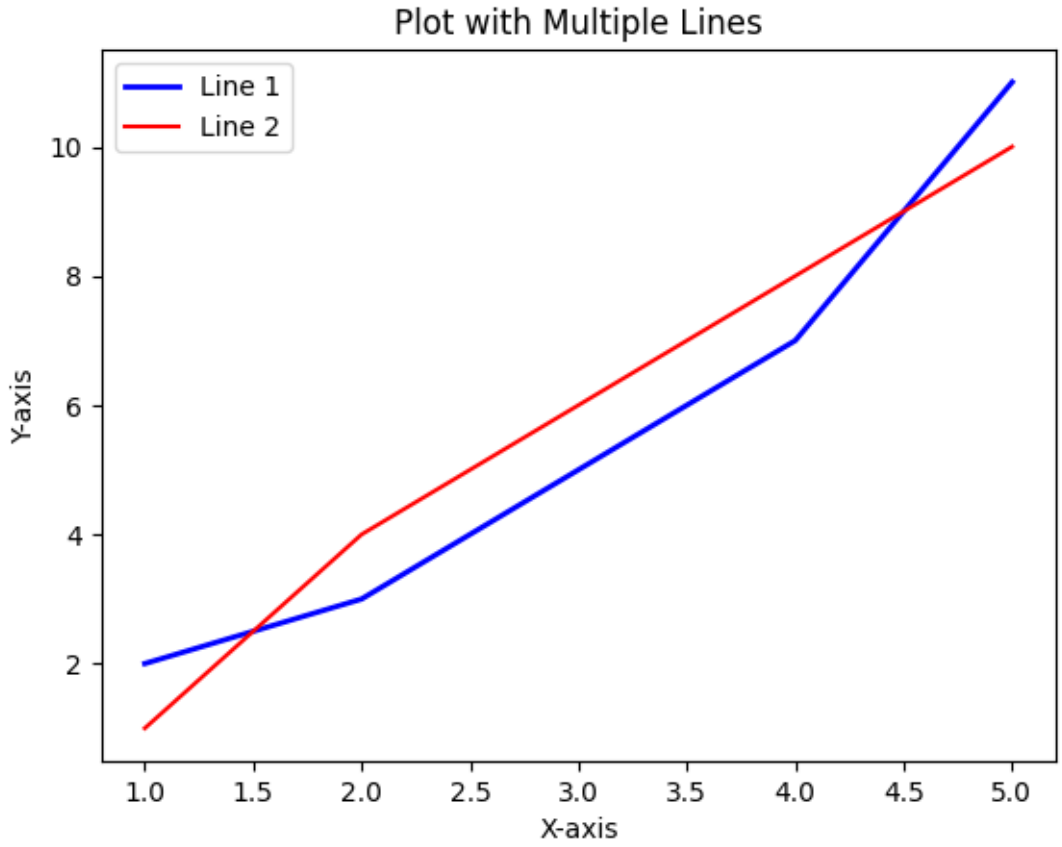
OUTPUT:



Q25: PROGRAM

```
import matplotlib.pyplot as plt
x = [1, 2, 3, 4, 5]
y1 = [2, 3, 5, 7, 11]
y2 = [1, 4, 6, 8, 10]
plt.plot(x, y1, label='Line 1', color='blue', linewidth=2)
plt.plot(x, y2, label='Line 2', color='red', linewidth=1.5)
plt.legend()
plt.xlabel('X-axis')
plt.ylabel('Y-axis')
plt.title('Plot with Multiple Lines')
plt.show()
```

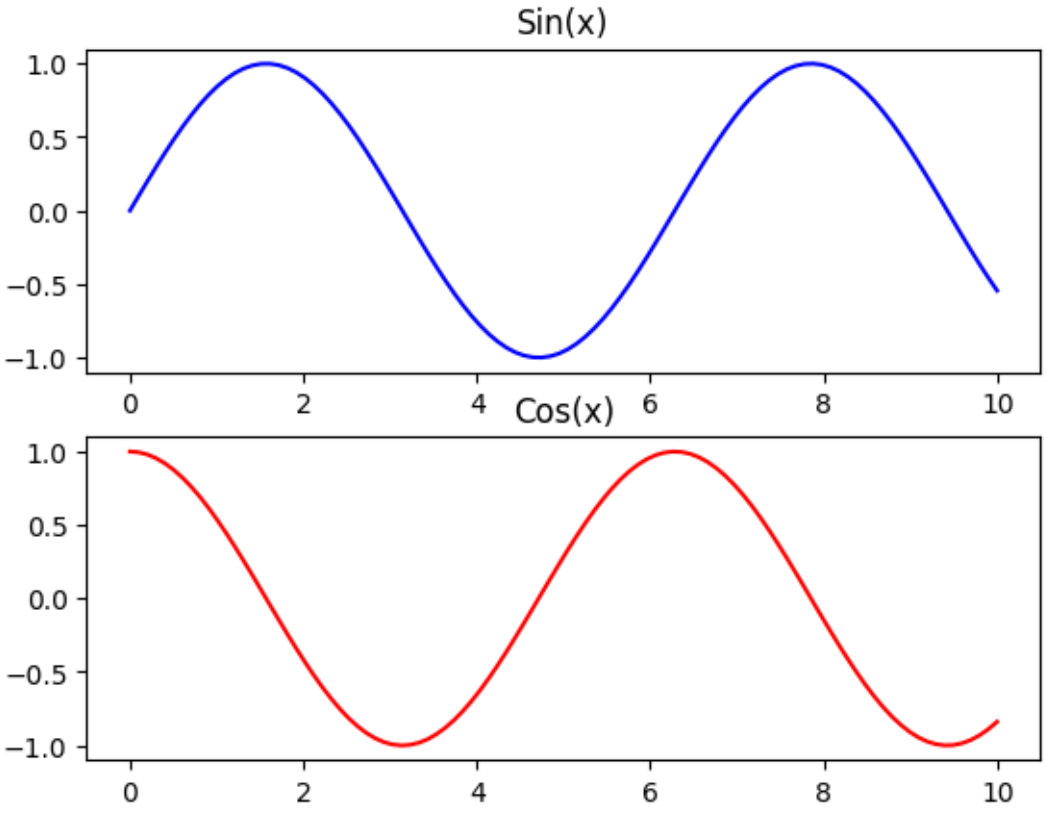
OUTPUT:

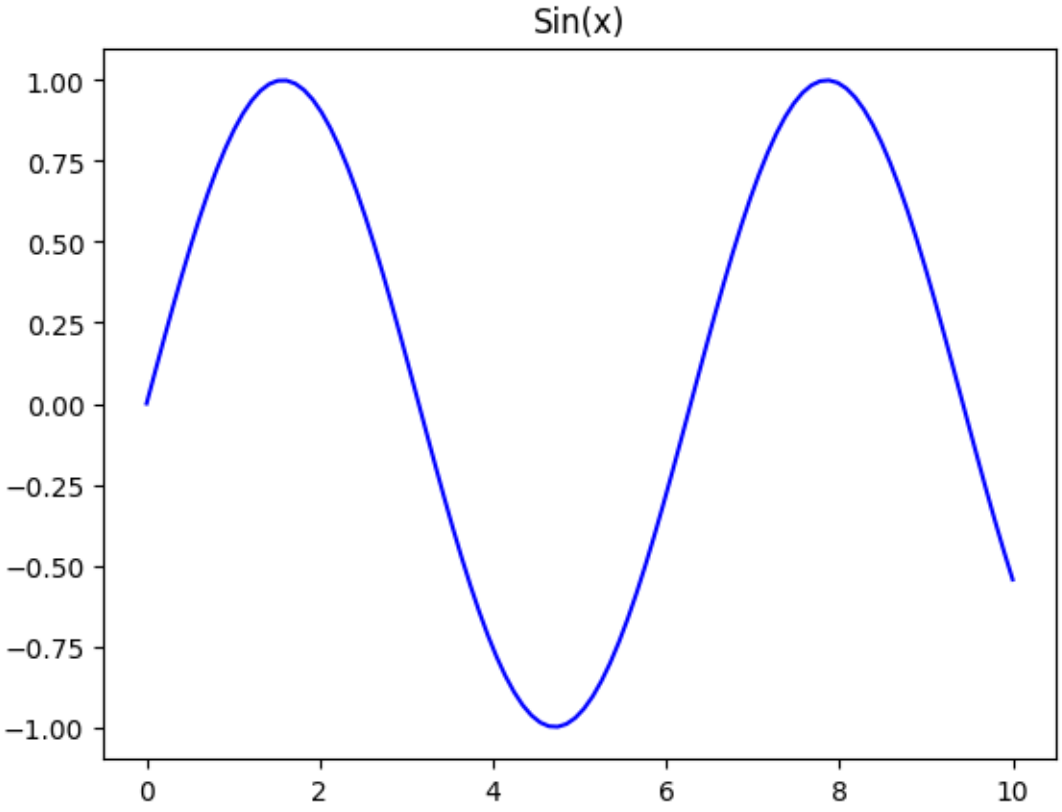


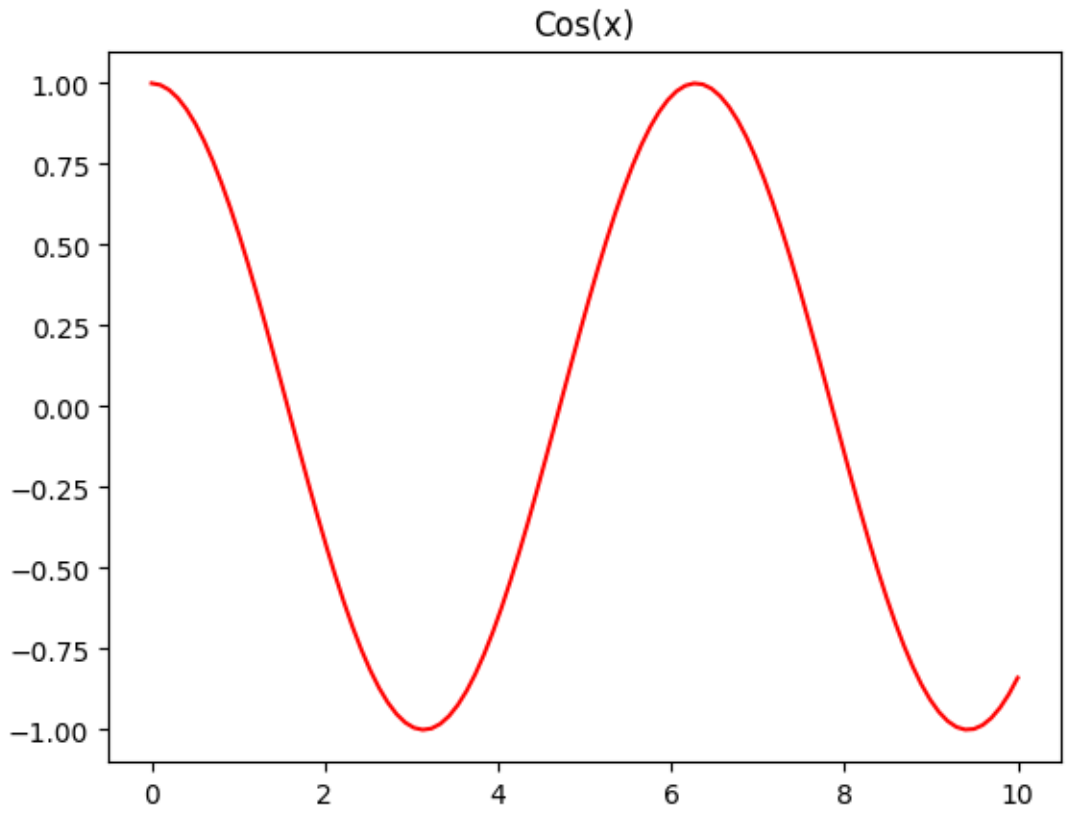
Q26: PROGRAM

```
import matplotlib.pyplot as plt
import numpy as np
x = np.linspace(0, 10, 100)
y1 = np.sin(x)
y2 = np.cos(x)
fig, axs = plt.subplots(2)
axs[0].plot(x, y1, color='blue')
axs[0].set_title('Sin(x)')
axs[1].plot(x, y2, color='red')
axs[1].set_title('Cos(x)')
plt.show()

plt.figure(1)
plt.plot(x, y1, color='blue')
plt.title('Sin(x)')
plt.show()

plt.figure(2)
plt.plot(x, y2, color='red')
plt.title('Cos(x)')
plt.show()
```

OUTPUT:


Sin(x)
1.0
0.5
0.0
−0.5
−1.0
0
2
4
6
8
10
Cos(x)
1.0
0.5
0.0
−0.5
−1.0
0
2
4
6
8
10

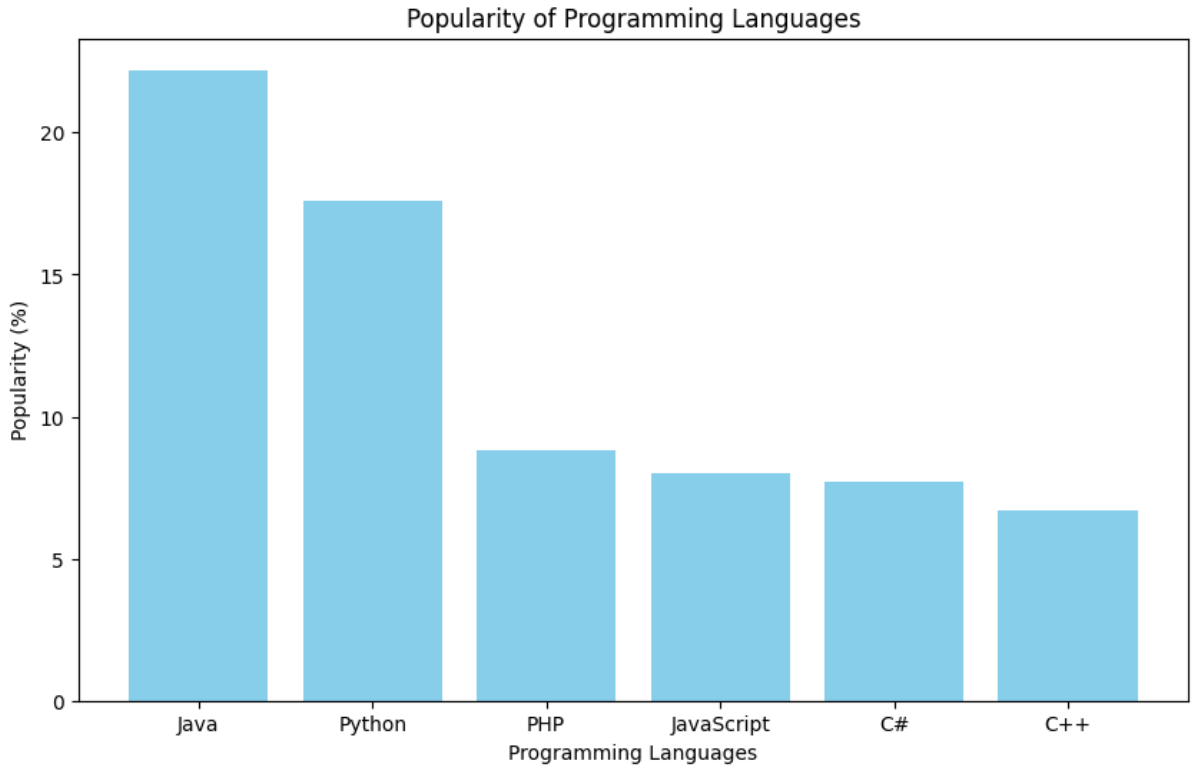

Sin(x)
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
2
4
6
8
10



Q27: PROGRAM

```
import matplotlib.pyplot as plt
languages = ['Java', 'Python', 'PHP', 'JavaScript', 'C#', 'C++']
popularity = [22.2, 17.6, 8.8, 8, 7.7, 6.7]
plt.figure(figsize=(10, 6))
plt.bar(languages, popularity, color='skyblue')
plt.xlabel('Programming Languages')
plt.ylabel('Popularity (%)')
plt.title('Popularity of Programming Languages')
plt.show()
```

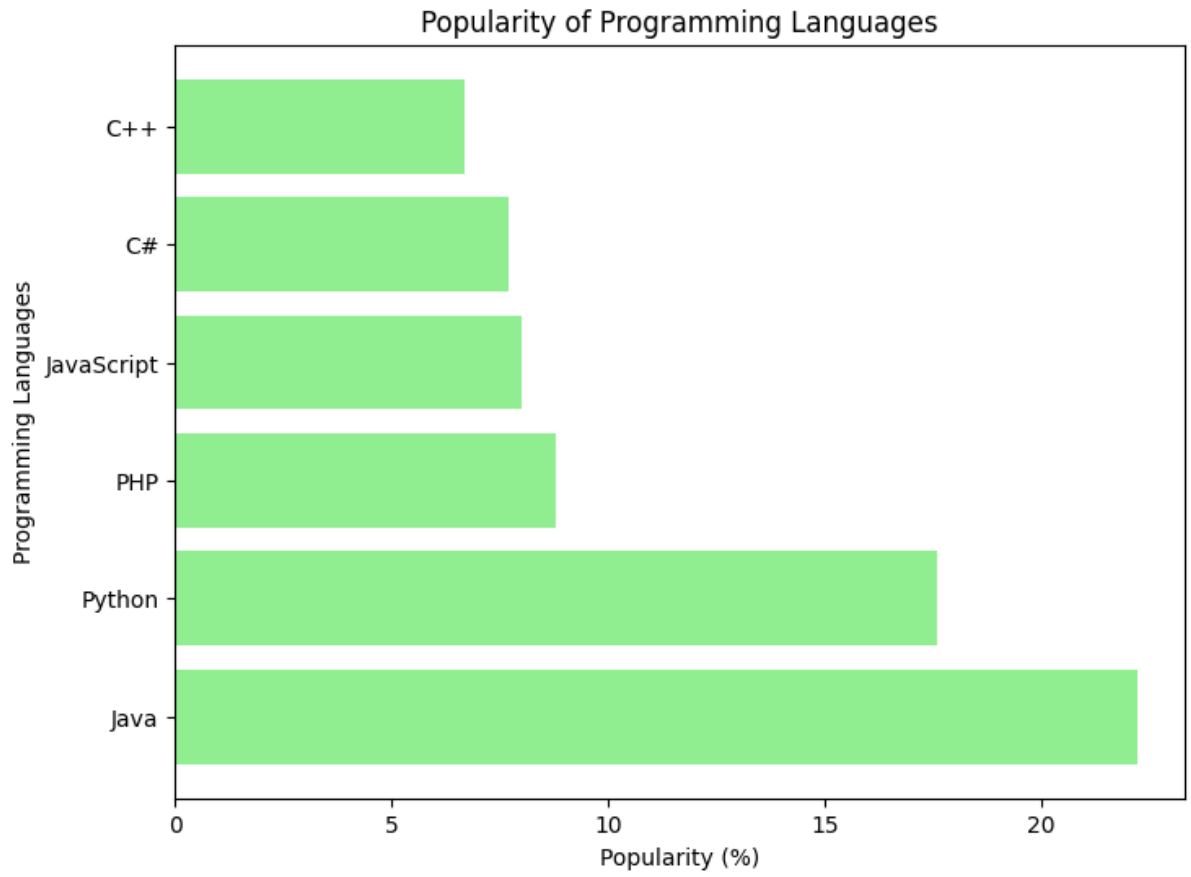
OUTPUT:



Q28: PROGRAM

```
import matplotlib.pyplot as plt
languages = ['Java', 'Python', 'PHP', 'JavaScript', 'C#', 'C++']
popularity = [22.2, 17.6, 8.8, 8, 7.7, 6.7]
plt.figure(figsize=(8, 6))
plt.barh(languages, popularity, color='lightgreen')
plt.xlabel('Popularity (%)')
plt.ylabel('Programming Languages')
plt.title('Popularity of Programming Languages')
plt.show()
```

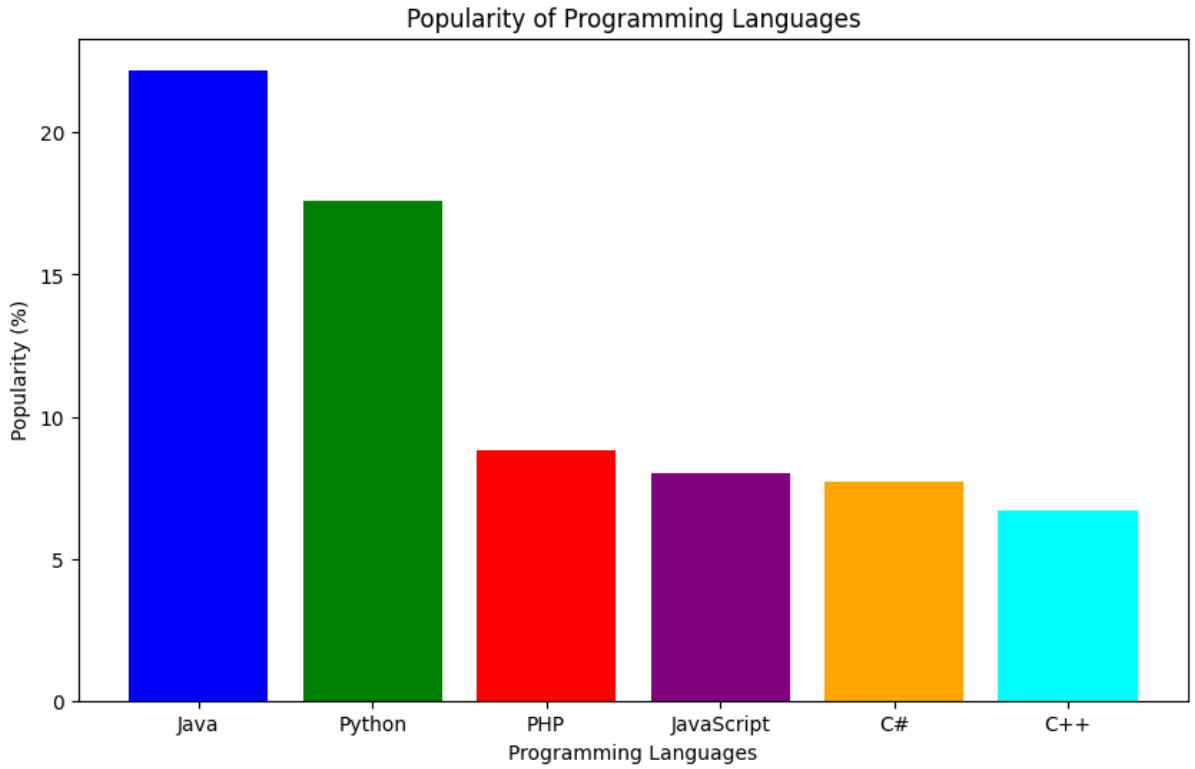
OUTPUT:



Q29: PROGRAM

```
import matplotlib.pyplot as plt
languages = ['Java', 'Python', 'PHP', 'JavaScript', 'C#', 'C++']
popularity = [22.2, 17.6, 8.8, 8, 7.7, 6.7]
colors = ['blue', 'green', 'red', 'purple', 'orange', 'cyan']
plt.figure(figsize=(10, 6))
plt.bar(languages, popularity, color=colors)
plt.xlabel('Programming Languages')
plt.ylabel('Popularity (%)')
plt.title('Popularity of Programming Languages')
plt.show()
```

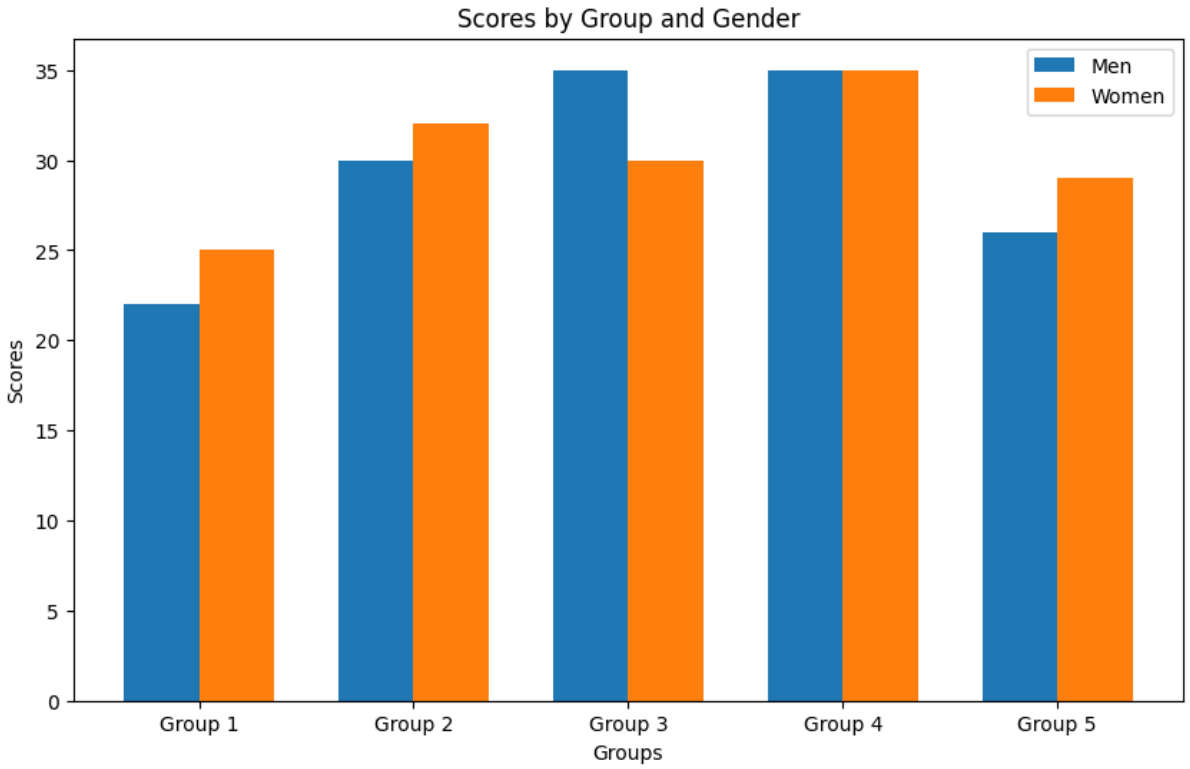
OUTPUT:



Q30: PROGRAM

```
import numpy as np
import matplotlib.pyplot as plt
men_means = (22, 30, 35, 35, 26)
women_means = (25, 32, 30, 35, 29)
group_labels = ['Group 1', 'Group 2', 'Group 3', 'Group 4', 'Group 5']
bar_width = 0.35
index = np.arange(len(group_labels))
plt.figure(figsize=(10, 6))
plt.bar(index, men_means, bar_width, label='Men')
plt.bar(index + bar_width, women_means, bar_width, label='Women')
plt.xlabel('Groups')
plt.ylabel('Scores')
plt.title('Scores by Group and Gender')
plt.xticks(index + bar_width / 2, group_labels)
plt.legend()
plt.show()
```

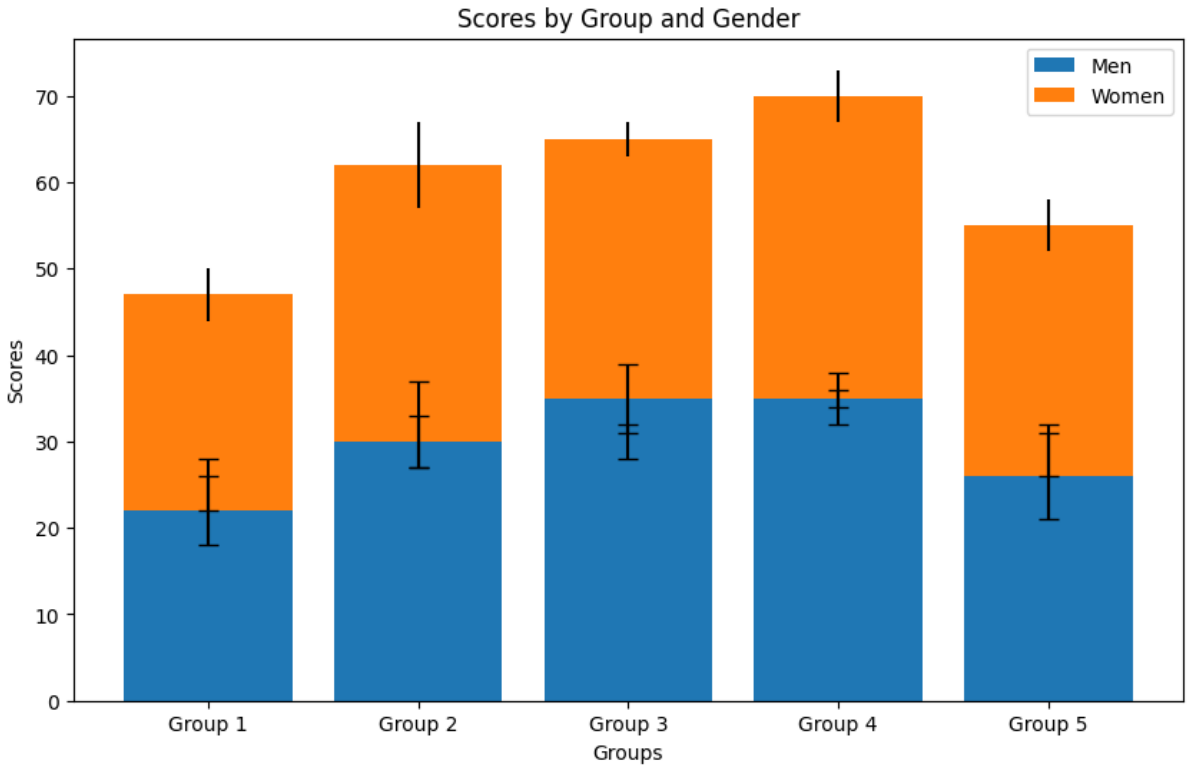
OUTPUT:



Q31: PROGRAM

```
import numpy as np
import matplotlib.pyplot as plt
men_means = (22, 30, 35, 35, 26)
women_means = (25, 32, 30, 35, 29)
men_std = (4, 3, 4, 1, 5)
women_std = (3, 5, 2, 3, 3)
group_labels = ['Group 1', 'Group 2', 'Group 3', 'Group 4', 'Group 5']
bottom_positions = np.array(men_means)
plt.figure(figsize=(10, 6))
bars1 = plt.bar(range(len(group_labels)), men_means, yerr=men_std, label='Men')
bars2 = plt.bar(range(len(group_labels)), women_means, yerr=women_std,
bottom=bottom_positions, label='Women')
plt.xlabel('Groups')
plt.ylabel('Scores')
plt.title('Scores by Group and Gender')
plt.xticks(range(len(group_labels)), group_labels)
plt.legend()
plt.errorbar(range(len(group_labels)), men_means, yerr=men_std, fmt='none', ecolor='black',
capsize=5)
plt.errorbar(range(len(group_labels)), women_means, yerr=women_std, fmt='none', ecolor='black',
capsize=5)
plt.show()
```

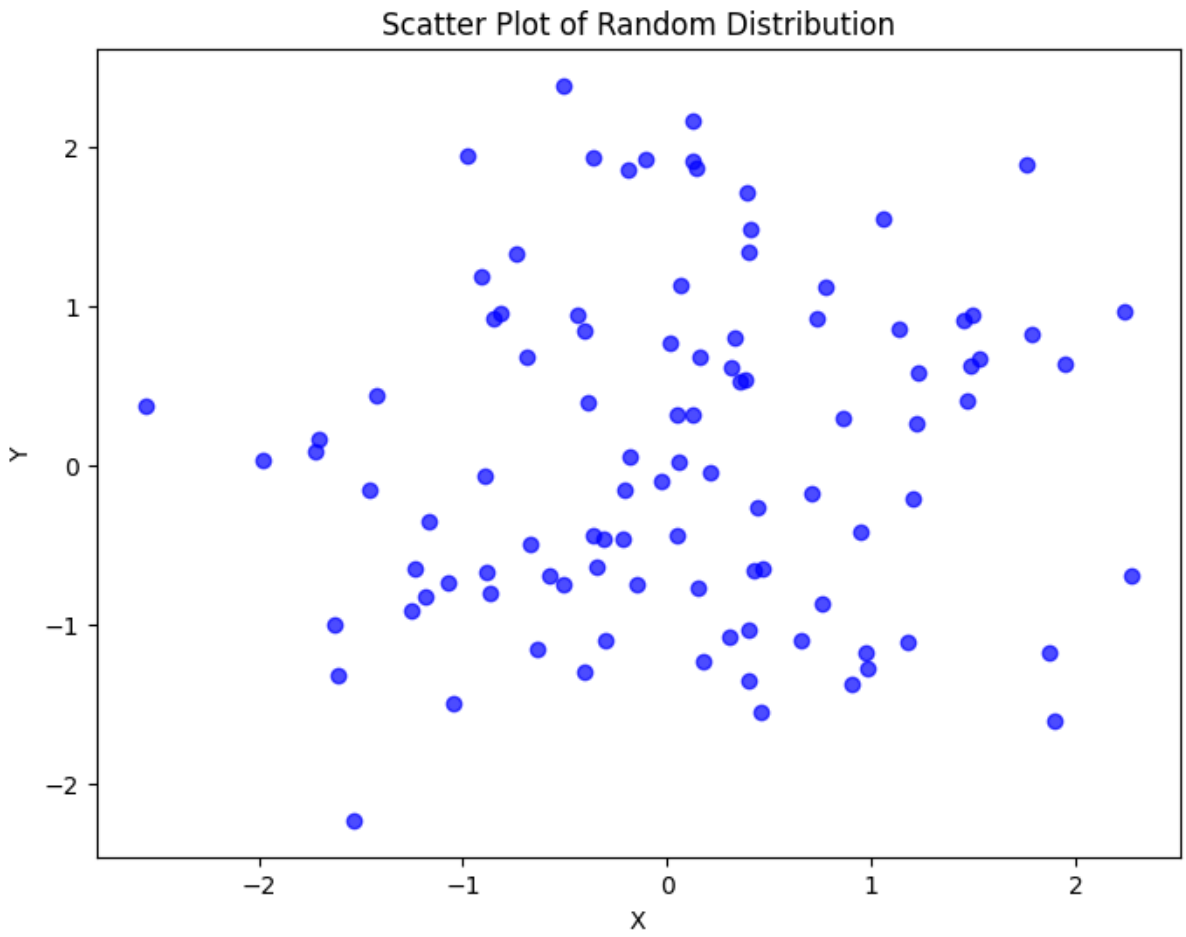
OUTPUT:



Q32: PROGRAM

```
import numpy as np
import matplotlib.pyplot as plt
np.random.seed(0)
x = np.random.randn(100)
y = np.random.randn(100)
plt.figure(figsize=(8, 6))
plt.scatter(x, y, color='blue', alpha=0.7)
plt.xlabel('X')
plt.ylabel('Y')
plt.title('Scatter Plot of Random Distribution')
plt.show()
```

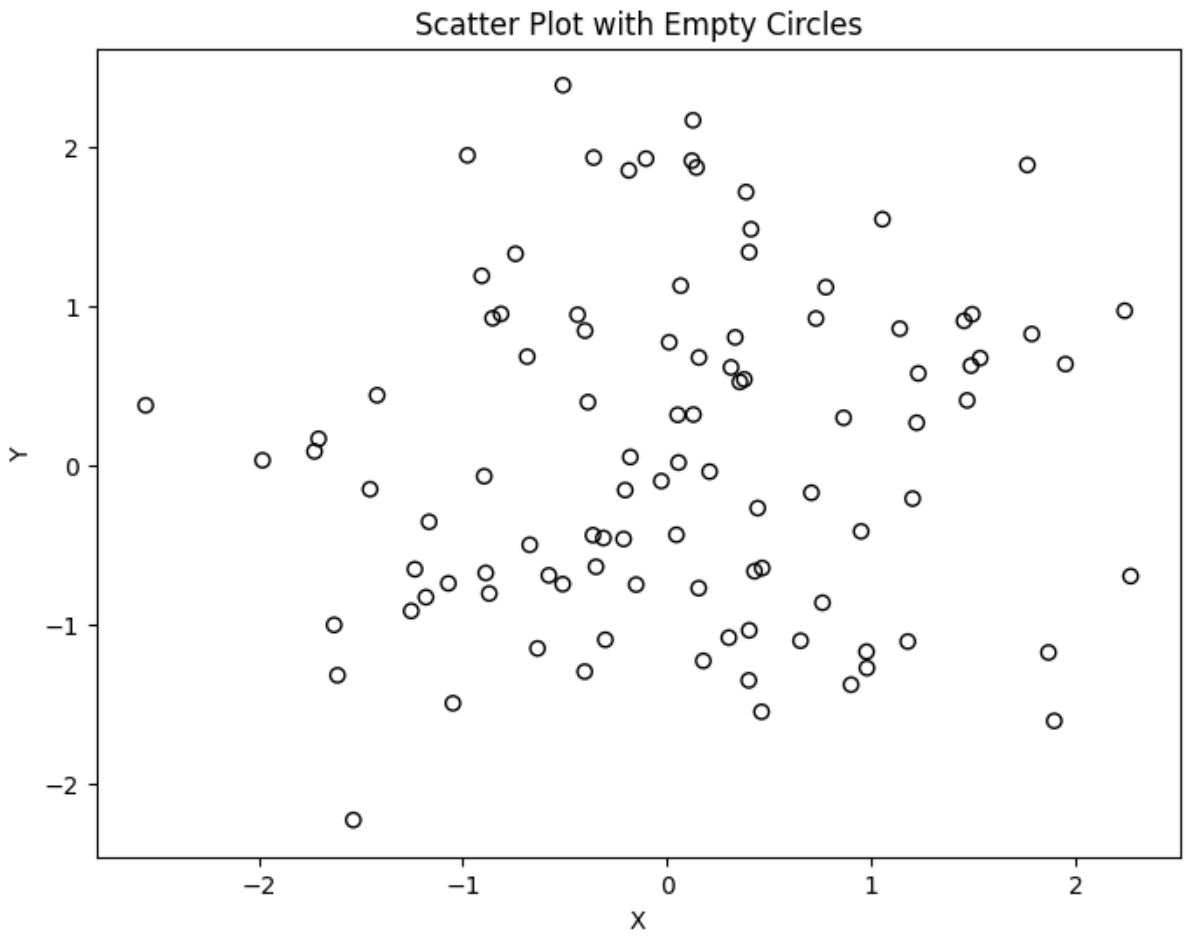
OUTPUT:



Q33: PROGRAM

```
import numpy as np
import matplotlib.pyplot as plt
np.random.seed(0)
x = np.random.randn(100)
y = np.random.randn(100)
plt.figure(figsize=(8, 6))
plt.scatter(x, y, color='blue', edgecolor='black', facecolor='none')
plt.xlabel('X')
plt.ylabel('Y')
plt.title('Scatter Plot with Empty Circles')
plt.show()
```

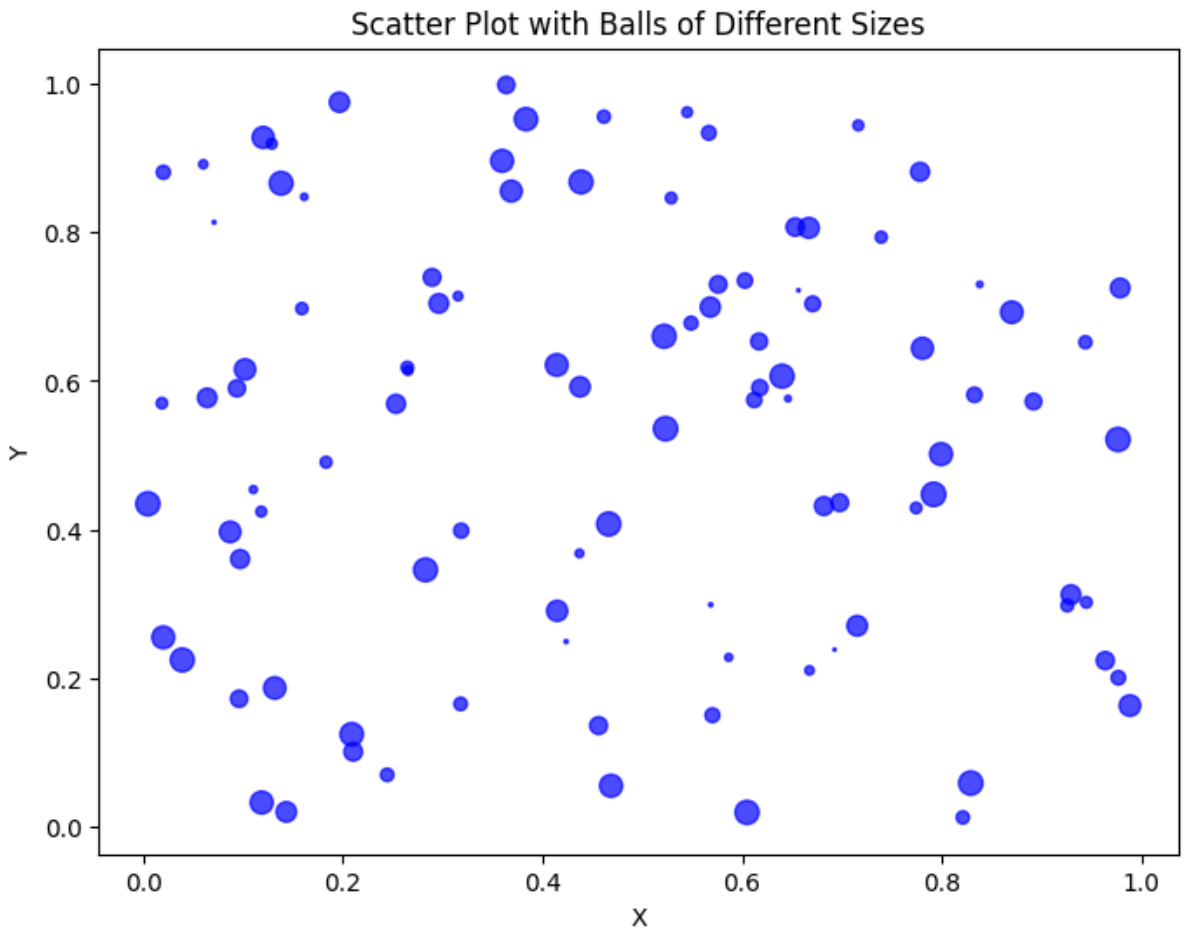
OUTPUT:



Q34: PROGRAM

```
import numpy as np
import matplotlib.pyplot as plt
np.random.seed(0)
x = np.random.rand(100)
y = np.random.rand(100)
sizes = np.random.rand(100) * 100
plt.figure(figsize=(8, 6))
plt.scatter(x, y, s=sizes, color='blue', alpha=0.7)
plt.xlabel('X')
plt.ylabel('Y')
plt.title('Scatter Plot with Balls of Different Sizes')
plt.show()
```

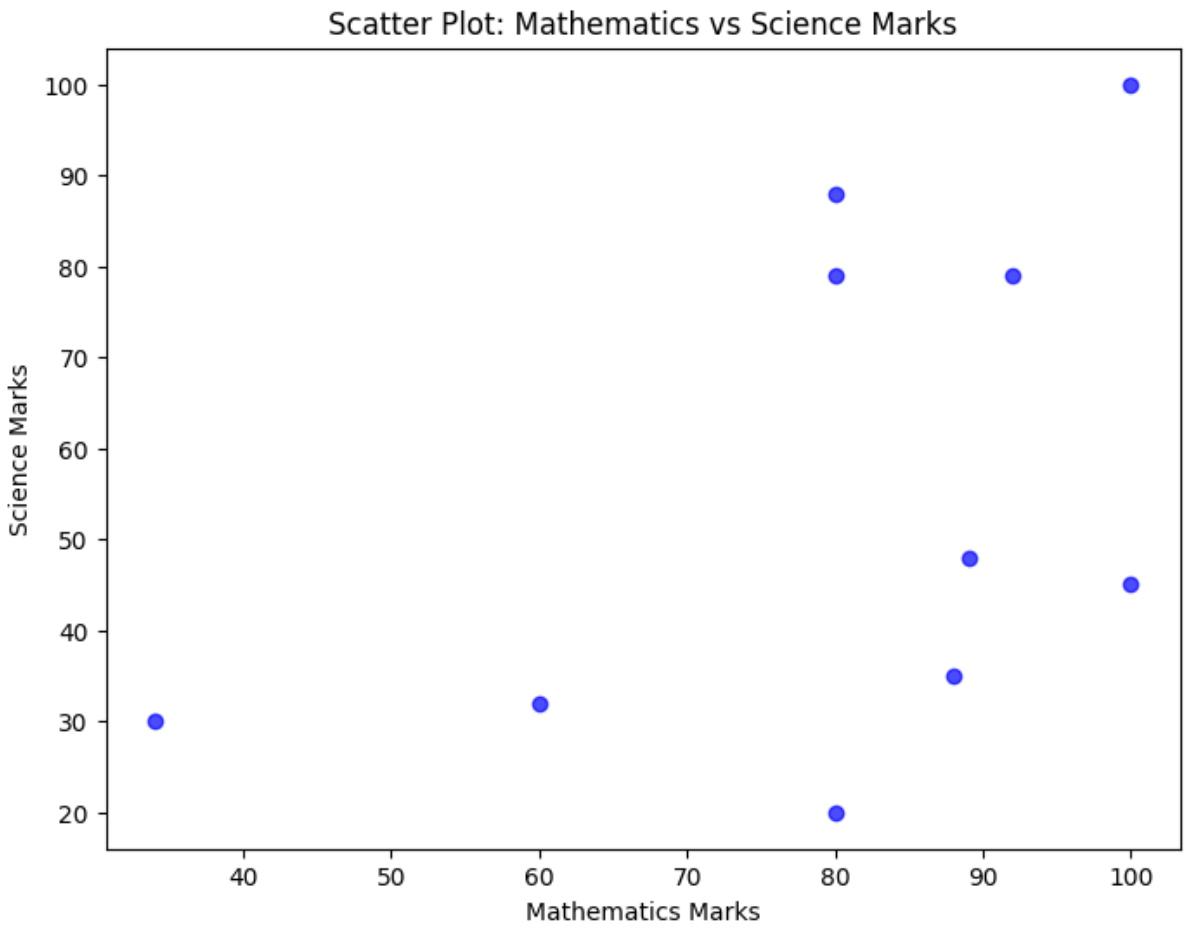
OUTPUT:



Q35: PROGRAM

```
import matplotlib.pyplot as plt
math_marks = [88, 92, 80, 89, 100, 80, 60, 100, 80, 34]
science_marks = [35, 79, 79, 48, 100, 88, 32, 45, 20, 30]
marks_range = [10, 20, 30, 40, 50, 60, 70, 80, 90, 100]
plt.figure(figsize=(8, 6))
plt.scatter(math_marks, science_marks, color='blue', alpha=0.7)
plt.xlabel('Mathematics Marks')
plt.ylabel('Science Marks')
plt.title('Scatter Plot: Mathematics vs Science Marks')
plt.show()
```

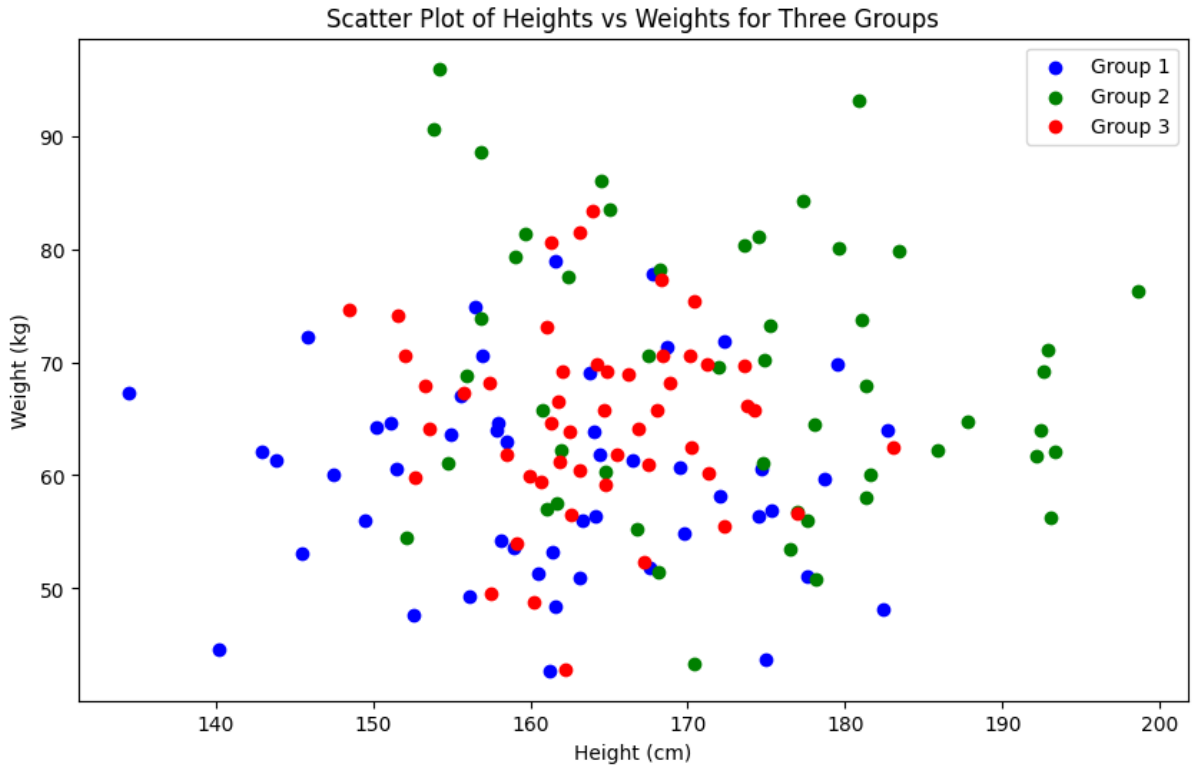
OUTPUT:



Q36: PROGRAM

```
import matplotlib.pyplot as plt
import numpy as np
np.random.seed(0)
num_samples = 50
heights_group1 = np.random.normal(loc=160, scale=10, size=num_samples)
weights_group1 = np.random.normal(loc=60, scale=10, size=num_samples)
heights_group2 = np.random.normal(loc=170, scale=12, size=num_samples)
weights_group2 = np.random.normal(loc=70, scale=12, size=num_samples)
heights_group3 = np.random.normal(loc=165, scale=8, size=num_samples)
weights_group3 = np.random.normal(loc=65, scale=8, size=num_samples)
plt.figure(figsize=(10, 6))
plt.scatter(heights_group1, weights_group1, color='blue', label='Group 1')
plt.scatter(heights_group2, weights_group2, color='green', label='Group 2')
plt.scatter(heights_group3, weights_group3, color='red', label='Group 3')
plt.xlabel('Height (cm)')
plt.ylabel('Weight (kg)')
plt.title('Scatter Plot of Heights vs Weights for Three Groups')
plt.legend()
plt.show()
```

OUTPUT:



Q37: PROGRAM

```
import pandas as pd
data = {'X': [78, 85, 96, 80, 86],
        'Y': [84, 94, 89, 83, 86],
        'Z': [86, 97, 96, 72, 83]}
df = pd.DataFrame(data)
print(df)
```

OUTPUT:

```
X  Y  Z
0  78  84  86
1  85  94  97
2  96  89  96
3  80  83  72
4  86  86  83
```

Q38: PROGRAM

```
import pandas as pd
import numpy as np
exam_data = {'name': ['Anastasia', 'Dima', 'Katherine', 'James', 'Emily','Michael', 'Matthew', 'Laura',
'Kevin', 'Jonas'],
          'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19],
          'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1],
```

```
        'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes']}
labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j']
df = pd.DataFrame(exam_data, index=labels)
print(df)
```

OUTPUT:

```
name  score  attempts qualify
a  Anastasia   12.5        1     yes
b       Dima    9.0        3      no
c  Katherine   16.5        2     yes
d      James    NaN        3      no
e      Emily    9.0        2      no
f    Michael   20.0        3     yes
g    Matthew   14.5        1     yes
h      Laura    NaN        1      no
i      Kevin    8.0        2      no
j      Jonas   19.0        1     yes
```

Q39: PROGRAM

```
import pandas as pd
import numpy as np
exam_data = {'name': ['Anastasia', 'Dima', 'Katherine', 'James', 'Emily','Michael', 'Matthew', 'Laura',
'Kevin', 'Jonas'],
        'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19],
        'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1],
        'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes']}
labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j']
df = pd.DataFrame(exam_data, index=labels)
first_3_rows = df.head(3)
print("First 3 rows of the DataFrame:")
print(first_3_rows)
```

OUTPUT:

```
First 3 rows of the DataFrame:
      name  score  attempts qualify
a  Anastasia   12.5        1     yes
b       Dima    9.0        3      no
c  Katherine   16.5        2     yes
```

Q40: PROGRAM

```
import pandas as pd
import numpy as np
exam_data = {'name': ['Anastasia', 'Dima', 'Katherine', 'James', 'Emily','Michael', 'Matthew', 'Laura',
'Kevin', 'Jonas'],
        'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19],
```

```
        'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1],
        'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes']}
labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j']
df = pd.DataFrame(exam_data, index=labels)
selected_columns = df[['name', 'score']]
print(selected_columns)
```

OUTPUT:

```
      name  score
a  Anastasia   12.5
b       Dima    9.0
c  Katherine   16.5
d      James    NaN
e      Emily    9.0
f    Michael   20.0
g    Matthew   14.5
h      Laura    NaN
i      Kevin    8.0
j      Jonas   19.0
```