

```
1 # IMPORTANT: SOME KAGGLE DATA SOURCES ARE PRIVATE
2 # RUN THIS CELL IN ORDER TO IMPORT YOUR KAGGLE DATA SOURCES.
3 import kagglehub
4 kagglehub.login()
5
6
7 # IMPORTANT: RUN THIS CELL IN ORDER TO IMPORT YOUR KAGGLE DATA SOURCES.
8 # THEN FEEL FREE TO DELETE THIS CELL.
9 # NOTE: THIS NOTEBOOK ENVIRONMENT DIFFERS FROM KAGGLE'S PYTHON
10 # ENVIRONMENT SO THERE MAY BE MISSING LIBRARIES USED BY YOUR
11 # NOTEBOOK.
12
13 kagglehub.dataset_download('kaggle/vij24/bank-01')
14 kagglehub.dataset_download('kaggle/vij24/bank-full-version1')
15
16 print('Data source import complete.')
```

```
1 # This Python 3 environment comes with many helpful analytics libraries installed
2 # It is defined by the kaggle/python Docker image: https://github.com/kaggle/docker-python
3 # For example, here's several helpful packages to load
4
5 import numpy as np # linear algebra
6 import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
7
8 # Input data files are available in the read-only "../input/" directory
9 # For example, running this (by clicking run or pressing Shift+Enter) will list all files under the input directory
10
11 import os
12 for dirname, _, filenames in os.walk('/kaggle/input'):
13     for filename in filenames:
14         print(os.path.join(dirname, filename))
15
16 # You can write up to 20GB to the current directory (/kaggle/working/) that gets preserved as output when you create a version using "Save & Run All"
17 # You can also write temporary files to /kaggle/temp/, but they won't be saved outside of the current session
```

```
1 # /kaggle/input/bank-full-version1/bank-full.csv
2 # /kaggle/input/bank-01/bank.csv
3
4 import pandas as pd
5 import numpy as np
6 import matplotlib.pyplot as plt
7 import seaborn as sns
```

Problem Description:

ABC Bank wants to sell it's term deposit product to customers and before launching the product they want to develop a model which help them in understanding whether a particular customer will buy their product or not (based on customer's past interaction with bank or other Financial Institution).

Business Understanding:

Bank wants to use ML model to shortlist customer whose chances of buying the product is more so that their marketing channel (tele marketing, SMS/email marketing etc) can focus only to those customers whose chances of buying the product is more. This will save resource and their time (which is directly involved in the cost (resource billing)). Develop model with Duration and without duration feature and report the performance of the model. Duration feature is not recommended as this will be difficult to explain the result to business and also it will be difficult for business to campaign based on duration.

Data Set Information :

The data is related with direct marketing campaigns of a Portuguese banking institution. The marketing campaigns were based on phone calls. Often, more than one contact to the same client was required, in order to access if the product (bank term deposit) would be ('yes') or not ('no') subscribed.

The classification goal is to predict if the client will subscribe (yes/no) a term deposit (variable y).

Attribute Information:

# Input variables:

bank client data:

- # 1 - age (numeric)
- # 2 - job : type of job (categorical: 'admin','blue-collar','entrepreneur','housemaid','management','retired','self-employed','services','student','technician','unemployed','unknown')
- # 3 - marital : marital status (categorical: 'divorced','married','single','unknown'; note: 'divorced' means divorced or widowed)
- # 4 - education (categorical: 'basic.4y','basic.6y','basic.9y','high.school','illiterate','professional.course','university.degree','unknown')
- # 5 - default: has credit in default? (categorical: 'no','yes','unknown')
- # 6 - housing: has housing loan? (categorical: 'no','yes','unknown')
- # 7 - loan: has personal loan? (categorical: 'no','yes','unknown')

related with the last contact of the current campaign:

- # 8 - contact: contact communication type (categorical: 'cellular','telephone')
- # 9 - month: last contact month of year (categorical: 'jan', 'feb', 'mar', ..., 'nov', 'dec')
- # 10 - day\_of\_week: last contact day of the week (categorical: 'mon','tue','wed','thu','fri')
- # 11 - duration: last contact duration, in seconds (numeric). Important note: this attribute highly affects the output target (e.g., if duration=0 then y='no'). Yet, the duration is not known before a call is performed. Also, after the end of the call y is obviously known. Thus, this input should only be included for benchmark purposes and should be discarded if the intention is to have a realistic predictive model.

other attributes:

- # 12 - campaign: number of contacts performed during this campaign and for this client (numeric, includes last contact
- # 13 - pdays: number of days that passed by after the client was last contacted from a previous campaign (numeric; 999 means client was not previously contacted
- # 14 - previous: number of contacts performed before this campaign and for this client (numeric
- # 15 - poutcome: outcome of the previous marketing campaign (categorical: 'failure','nonexistent','success')

social and economic context attribute

- # 16 - emp.var.rate: employment variation rate - quarterly indicator (numeric
  - # 17 - cons.price.idx: consumer price index - monthly indicator (numeric
  - # 18 - cons.conf.idx: consumer confidence index - monthly indicator (numeric
  - # 19 - euribor3m: euribor 3 month rate - daily indicator (numeric
  - # 20 - nr.employed: number of employees - quarterly indicator (numeric)
- Output variable (desired target)
- # 21 - y - has the client subscribed a term deposit? (binary: 'yes','no')
- o) 'no')

```
1 bank_data = pd.read_csv("/kaggle/input/bank-full-version/bank-full.csv")

1 import pandas as pd
2
3 # Load your CSV file
4 bank_data = pd.read_csv("/kaggle/input/bank-full-version/bank-full.csv")
5
6 # Display column names
7 print(bank_data.columns)
8

Index(['sl. no', 'age', 'job', 'marital', 'education', 'default', 'balance',
      'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'y'],
      dtype='object')

1 bank_data.head()

sl. no age job marital education default balance housing loan contact day month duration campaign pdays previous poutcome y
0 1 58 management married tertiary no 2143 yes no unknown 5 may 261 1 -1 0 unknown no
1 2 44 technician single secondary no 29 yes no unknown 5 may 151 1 -1 0 unknown no
2 3 33 entrepreneur married secondary no 2 yes yes unknown 5 may 76 1 -1 0 unknown no
3 4 47 blue-collar married unknown no 1506 yes no unknown 5 may 92 1 -1 0 unknown no
4 5 33 unknown single unknown no 1 no no unknown 5 may 198 1 -1 0 unknown no

1 bank_data

sl. no age job marital education default balance housing loan contact day month duration campaign pdays previous poutcome y
0 1 58 management married tertiary no 2143 yes no unknown 5 may 261 1 -1 0 unknown no
1 2 44 technician single secondary no 29 yes no unknown 5 may 151 1 -1 0 unknown no
2 3 33 entrepreneur married secondary no 2 yes yes unknown 5 may 76 1 -1 0 unknown no
3 4 47 blue-collar married unknown no 1506 yes no unknown 5 may 92 1 -1 0 unknown no
4 5 33 unknown single unknown no 1 no no unknown 5 may 198 1 -1 0 unknown no
... ... ..
45206 45207 51 technician married tertiary no 825 no no cellular 17 nov 977 3 -1 0 unknown yes
45207 45208 71 retired divorced primary no 1729 no no cellular 17 nov 456 2 -1 0 unknown yes
45208 45209 72 retired married secondary no 5715 no no cellular 17 nov 1127 5 184 3 success yes
45209 45210 57 blue-collar married secondary no 668 no no telephone 17 nov 508 4 -1 0 unknown no
45210 45211 37 entrepreneur married secondary no 2971 no no cellular 17 nov 361 2 188 11 other no
45211 rows x 18 columns

1 bank_data.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 45211 entries, 0 to 45210
Data columns (total 18 columns):
# Column Non-Null Count Dtype
---
0 sl. no 45211 non-null int64
1 age 45211 non-null int64
2 job 45211 non-null object
3 marital 45211 non-null object
4 education 45211 non-null object
5 default 45211 non-null object
6 balance 45211 non-null int64
7 housing 45211 non-null object
8 loan 45211 non-null object
9 contact 45211 non-null object
10 day 45211 non-null int64
11 month 45211 non-null object
12 duration 45211 non-null int64
13 campaign 45211 non-null int64
14 pdays 45211 non-null int64
15 previous 45211 non-null int64
16 poutcome 45211 non-null object
17 y 45211 non-null object
dtypes: int64(8), object(10)
memory usage: 6.2+ MB
```

1 Start coding or generate with AI.



Double-click (or enter) to edit

Data Cleaning

Handle Duplicates

## Remove duplicates

```
1 bank_data = bank_data.drop_duplicates()
2 bank_data
```

	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	1	58	management	married	tertiary	no	2143	yes	no	unknown	5	may	261	1	-1	0	unknown	no
1	2	44	technician	single	secondary	no	29	yes	no	unknown	5	may	151	1	-1	0	unknown	no
2	3	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may	76	1	-1	0	unknown	no
3	4	47	blue-collar	married	unknown	no	1506	yes	no	unknown	5	may	92	1	-1	0	unknown	no
4	5	33	unknown	single	unknown	no	1	no	no	unknown	5	may	198	1	-1	0	unknown	no
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45206	45207	51	technician	married	tertiary	no	825	no	no	cellular	17	nov	977	3	-1	0	unknown	yes
45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes
45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes
45209	45210	57	blue-collar	married	secondary	no	668	no	no	telephone	17	nov	508	4	-1	0	unknown	no
45210	45211	37	entrepreneur	married	secondary	no	2971	no	no	cellular	17	nov	361	2	188	11	other	no

45211 rows x 18 columns

## Handle missing values

```
1 # Check for missing values in all datasets
2 print(bank_data.isnull().sum())
```

```
sl. no      0
age         0
job         0
marital     0
education   0
default     0
balance     0
housing     0
loan        0
contact     0
day         0
month       0
duration    0
campaign    0
pdays     0
previous    0
poutcome    0
y           0
dtype: int64
```

## Exploratory Data Analysis (EDA)

```
1 # Importing the external libraries
2 import pandas as pd
3
4 # Importing the data
5 bank_data=pd.read_csv("../kaggle/input/bank-full-version1/bank-full.csv")
```

```
1 bank_data
```

	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	1	58	management	married	tertiary	no	2143	yes	no	unknown	5	may	261	1	-1	0	unknown	no
1	2	44	technician	single	secondary	no	29	yes	no	unknown	5	may	151	1	-1	0	unknown	no
2	3	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may	76	1	-1	0	unknown	no
3	4	47	blue-collar	married	unknown	no	1506	yes	no	unknown	5	may	92	1	-1	0	unknown	no
4	5	33	unknown	single	unknown	no	1	no	no	unknown	5	may	198	1	-1	0	unknown	no
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45206	45207	51	technician	married	tertiary	no	825	no	no	cellular	17	nov	977	3	-1	0	unknown	yes
45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes
45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes
45209	45210	57	blue-collar	married	secondary	no	668	no	no	telephone	17	nov	508	4	-1	0	unknown	no
45210	45211	37	entrepreneur	married	secondary	no	2971	no	no	cellular	17	nov	361	2	188	11	other	no

45211 rows x 18 columns

```
1 new_bank_data = bank_data.sort_values(by='balance', ascending=True)
```

```
1 #Outlier Detection and Handling:
2 #Identify and remove outliers in the 'balance' column:
3 Q1 = new_bank_data['balance'].quantile(0.25)
4 Q3 = new_bank_data['balance'].quantile(0.75)
5 IQR= Q3-Q1
6
7 print(Q1)
8 print(Q3)
9 print(IQR)
```

```
72.0
1428.0
1356.0
```

```
1 bank_data1=bank_data[~((bank_data['balance']<(Q1-1.5*IQR))|(bank_data['balance']>(Q3+1.5*IQR)))]
2 print(bank_data1)
```

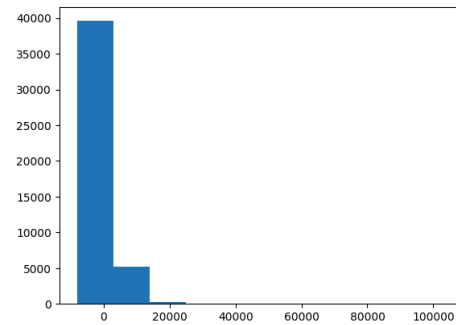
	sl. no	age	job	marital	education	default	balance \		
0	1	58	management	married	tertiary	no	2143		
1	2	44	technician	single	secondary	no	29		
2	3	33	entrepreneur	married	secondary	no	2		
3	4	47	blue-collar	married	unknown	no	1506		
4	5	33	unknown	single	unknown	no	1		
...	...	...	...	...	...	...	...		
45205	45206	25	technician	single	secondary	no	595		
45206	45207	51	technician	married	tertiary	no	825		
45207	45208	71	retired	divorced	primary	no	1729		
45209	45210	57	blue-collar	married	secondary	no	668		
45210	45211	37	entrepreneur	married	secondary	no	2971		
	housing	loan	contact	day	month	duration	campaign	pdays	previous \
0	yes	no	unknown	5	may	261	1	-1	0
1	yes	no	unknown	5	may	151	1	-1	0
2	yes	yes	unknown	5	may	76	1	-1	0
3	yes	no	unknown	5	may	92	1	-1	0
4	no	no	unknown	5	may	198	1	-1	0
...	...	...	...	...	...	...	...	...	...
45205	no	yes	cellular	17	nov	386	2	-1	0
45206	no	no	cellular	17	nov	977	3	-1	0
45207	no	no	cellular	17	nov	456	2	-1	0
45209	no	no	telephone	17	nov	508	4	-1	0
45210	no	no	cellular	17	nov	361	2	188	11
	poutcome	y							
0	unknown	no							
1	unknown	no							
2	unknown	no							

```
3 unknown no
4 unknown no
...
45285 unknown yes
45286 unknown yes
45287 unknown yes
45289 unknown no
45218 other no
```

```
[40482 rows x 18 columns]
```

```
1 # Histogram
2 import matplotlib.pyplot as plt
3 plt.hist(new_bank_data['balance'])
```

```
(array([3.9587e+04, 5.2330e+03, 2.9400e+02, 5.8000e+01, 2.1000e+01,
        7.0000e+00, 6.0000e+00, 1.0000e+00, 2.0000e+00, 2.0000e+00]),
array([-8019. , 2995.6, 14010.2, 25024.8, 36039.4, 47054. ,
        58068.6, 69083.2, 80097.8, 91112.4, 102127. ]),
<BarContainer object of 10 artists>)
```



```
1 # Importing the external libraries
2 import pandas as pd
3
4 # Importing the data
5 Bank_data=pd.read_csv("/kaggle/input/bank-full-version1/bank-full.csv")
```

```
1 Bank_data
```

```
sl. no age job marital education default balance housing loan contact day month duration campaign pdays previous poutcome y
0 1 58 management married tertiary no 2143 yes no unknown 5 may 261 1 -1 0 unknown no
1 2 44 technician single secondary no 29 yes no unknown 5 may 151 1 -1 0 unknown no
2 3 33 entrepreneur married secondary no 2 yes yes unknown 5 may 76 1 -1 0 unknown no
3 4 47 blue-collar married unknown no 1506 yes no unknown 5 may 92 1 -1 0 unknown no
4 5 33 unknown single unknown no 1 no no unknown 5 may 198 1 -1 0 unknown no
...
45206 45207 51 technician married tertiary no 825 no no cellular 17 nov 977 3 -1 0 unknown yes
45207 45208 71 retired divorced primary no 1729 no no cellular 17 nov 456 2 -1 0 unknown yes
45208 45209 72 retired married secondary no 5715 no no cellular 17 nov 1127 5 184 3 success yes
45209 45210 57 blue-collar married secondary no 668 no no telephone 17 nov 508 4 -1 0 unknown no
45210 45211 37 entrepreneur married secondary no 2971 no no cellular 17 nov 361 2 188 11 other no
45211 rows x 18 columns
```

```
1 #Handling Missing Data: Remove columns that have more than 50% missing values:
2 Bank_data.dropna(axis=1,thresh=0.5)
```

```
sl. no age job marital education default balance housing loan contact day month duration campaign pdays previous poutcome y
0 1 58 management married tertiary no 2143 yes no unknown 5 may 261 1 -1 0 unknown no
1 2 44 technician single secondary no 29 yes no unknown 5 may 151 1 -1 0 unknown no
2 3 33 entrepreneur married secondary no 2 yes yes unknown 5 may 76 1 -1 0 unknown no
3 4 47 blue-collar married unknown no 1506 yes no unknown 5 may 92 1 -1 0 unknown no
4 5 33 unknown single unknown no 1 no no unknown 5 may 198 1 -1 0 unknown no
...
45206 45207 51 technician married tertiary no 825 no no cellular 17 nov 977 3 -1 0 unknown yes
45207 45208 71 retired divorced primary no 1729 no no cellular 17 nov 456 2 -1 0 unknown yes
45208 45209 72 retired married secondary no 5715 no no cellular 17 nov 1127 5 184 3 success yes
45209 45210 57 blue-collar married secondary no 668 no no telephone 17 nov 508 4 -1 0 unknown no
45210 45211 37 entrepreneur married secondary no 2971 no no cellular 17 nov 361 2 188 11 other no
45211 rows x 18 columns
```

```
1 import pandas as pd
2 Bank_data = Bank_data['balance'].interpolate()
3 print(Bank_data)
```

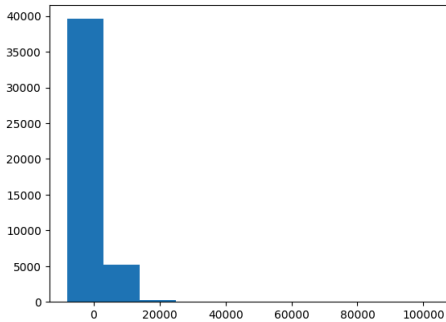
```
0 2143
1 29
2 2
3 1506
4 1
...
45206 825
45207 1729
45208 5715
45209 668
45210 2971
Name: balance, Length: 45211, dtype: int64
```

```
1 import pandas as pd
2 Bank_data=Bank_data['balance'].interpolate(method='linear')
3 print(Bank_data)
```

```
0 2143
1 29
2 2
3 1506
4 1
...
45206 825
45207 1729
45208 5715
45209 668
45210 2971
Name: balance, Length: 45211, dtype: int64
```

```
1 # Histogram
2 import matplotlib.pyplot as plt
3 plt.hist(Bank_data['balance'])
```

```
(array([3.9587e+04, 5.2330e+03, 2.9400e+02, 5.8000e+01, 2.1000e+01,
       7.0000e+00, 6.0000e+00, 1.0000e+00, 2.0000e+00, 2.0000e+00]),
array([-8019. , 2995.6, 14010.2, 25024.8, 36039.4, 47054. ,
       58068.6, 69083.2, 80097.8, 91112.4, 102127. ]),
<BarContainer object of 10 artists>)
```



```
1 # Importing the external libraries
2 import pandas as pd
3
4 # Importing the data
5 bank_data = pd.read_csv("../kaggle/input/bank-full-version1/bank-full.csv")
```

```
1 bank_data.info()
```

```
sl. no      0
age         0
job         0
marital     0
education   0
default     0
balance     0
housing     0
loan        0
contact     0
day         0
month       0
duration    0
campaign    0
pdays      0
previous    0
poutcome    0
y           0
dtype: int64
```

```
1 bank_data.columns
```

```
Index(['sl. no', 'age', 'job', 'marital', 'education', 'default', 'balance',
       'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign',
       'pdays', 'previous', 'poutcome', 'y'],
      dtype='object')
```

```
1 bank_data.values
```

```
array([[1, 58, 'management', ..., 0, 'unknown', 'no'],
       [2, 44, 'technician', ..., 0, 'unknown', 'no'],
       [3, 33, 'entrepreneur', ..., 0, 'unknown', 'no'],
       ...,
       [45209, 72, 'retired', ..., 3, 'success', 'yes'],
       [45210, 57, 'blue-collar', ..., 0, 'unknown', 'no'],
       [45211, 37, 'entrepreneur', ..., 11, 'other', 'no']], dtype=object)
```

```
1 bank_data.dtypes
```

```
sl. no      int64
age         int64
job         object
marital     object
education   object
default     object
balance     int64
housing     object
loan        object
contact     object
day         int64
month       object
duration    int64
campaign    int64
pdays      int64
previous    int64
poutcome    object
y           object
dtype: object
```

```
1 bank_data.describe()
```

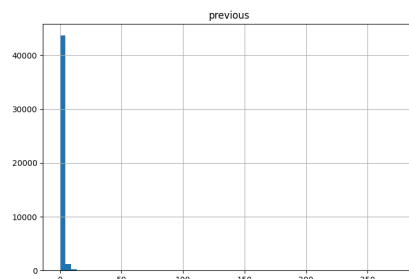
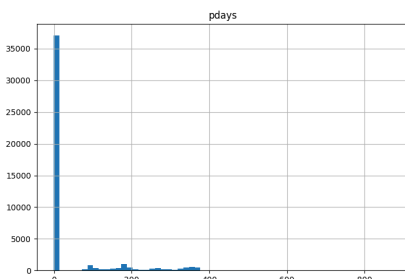
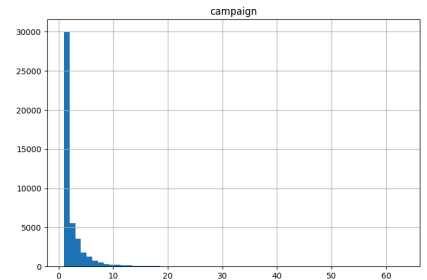
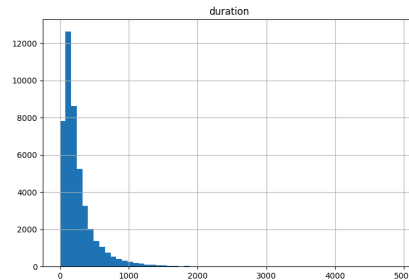
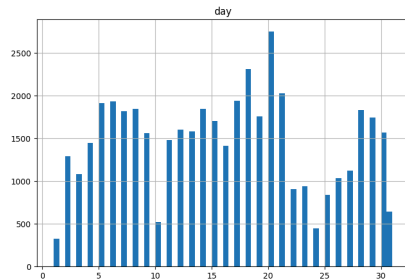
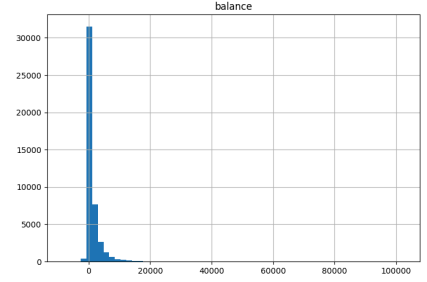
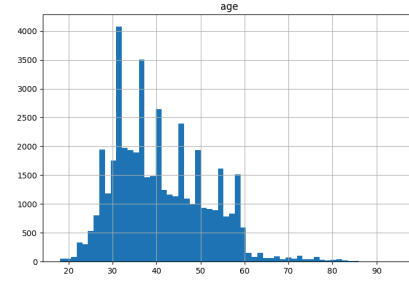
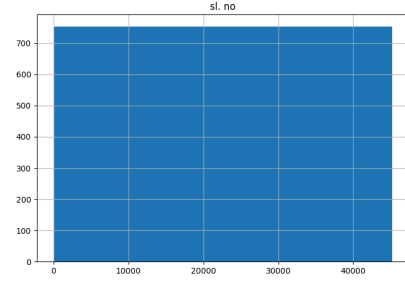
	sl. no	age	balance	day	duration	campaign	pdays	previous
count	45211.000000	45211.000000	45211.000000	45211.000000	45211.000000	45211.000000	45211.000000	45211.000000
mean	22606.000000	40.936210	1362.272058	15.806419	258.163080	2.763841	40.197828	0.580323
std	13051.435847	10.618762	3044.765829	8.322476	257.527812	3.098021	100.128746	2.303441
min	1.000000	18.000000	-8019.000000	1.000000	0.000000	1.000000	-1.000000	0.000000
25%	11303.500000	33.000000	72.000000	8.000000	103.000000	1.000000	-1.000000	0.000000
50%	22606.000000	39.000000	448.000000	16.000000	180.000000	2.000000	-1.000000	0.000000
75%	33908.500000	48.000000	1428.000000	21.000000	319.000000	3.000000	-1.000000	0.000000
max	45211.000000	95.000000	102127.000000	31.000000	4918.000000	63.000000	871.000000	275.000000

```
1 bank_data.nunique()
```

```
sl. no      45211
age         77
job         12
marital     3
education   4
default     2
balance     7168
housing     2
loan        2
contact     3
day         31
month       12
duration    1573
campaign    48
pdays      559
previous    41
poutcome    4
y           2
dtype: int64
```

```
1 bank_data.hist(bins=40, figsize=(10,20))
```

```
array([[<Axes: title='center': 'sl. no'>,\n      <Axes: title='center': 'age'>,\n      <Axes: title='center': 'balance'>]],\n      [[<Axes: title='center': 'day'>],\n      <Axes: title='center': 'duration'>],\n      <Axes: title='center': 'campaign'>],\n      [[<Axes: title='center': 'pdays'>],\n      <Axes: title='center': 'previous'>], <Axes: >]], dtype=object)
```



```
1 prev_zeroac = Bank_data[Bank_data['previous'] == 0]
```

```
1 prev_zeroac['poutcome'].unique()
```

```
array(['unknown'], dtype=object)
```

```
1 prev_oneac = Bank_data[Bank_data['previous'] > 0]
```

```
1 prev_oneac['poutcome'].unique()
```

```
array(['failure', 'other', 'success', 'unknown'], dtype=object)
```

```
1\n2 Bank_Datafr = Bank_data.loc[(Bank_data['housing'] == 'no') & (Bank_data['loan'] == 'no') & (Bank_data['contact'] == 'telephone')]
```

```
1 Bank_Datafr
```

```
array([[<Axes: title='center': 'sl. no'>,\n      <Axes: title='center': 'age'>,\n      <Axes: title='center': 'balance'>],\n      [[<Axes: title='center': 'day'>],\n      <Axes: title='center': 'duration'>],\n      <Axes: title='center': 'campaign'>],\n      [[<Axes: title='center': 'pdays'>],\n      <Axes: title='center': 'previous'>], <Axes: >]], dtype=object)
```

	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
12660	12661	31	technician	single	secondary	no	19	no	no	telephone	4	jul	65	2	-1	0	unknown	no
12665	12666	25	blue-collar	single	secondary	no	192	no	no	telephone	4	jul	112	2	-1	0	unknown	no
12674	12675	36	unemployed	divorced	primary	no	0	no	no	telephone	4	jul	304	3	-1	0	unknown	no
12716	12717	49	technician	married	primary	no	486	no	no	telephone	7	jul	229	5	-1	0	unknown	no
12750	12751	46	unknown	married	unknown	no	2911	no	no	telephone	7	jul	41	9	-1	0	unknown	no
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45141	45142	77	unknown	married	unknown	no	397	no	no	telephone	8	nov	207	1	185	3	success	no
45154	45155	63	retired	married	primary	no	3738	no	no	telephone	9	nov	301	1	456	4	failure	no
45166	45167	41	unemployed	single	tertiary	no	79	no	no	telephone	9	nov	394	1	390	2	success	yes
45170	45171	19	student	single	primary	no	245	no	no	telephone	10	nov	98	2	110	2	other	no
45209	45210	57	blue-collar	married	secondary	no	668	no	no	telephone	17	nov	508	4	-1	0	unknown	no

1509 rows x 18 columns

```
1 Bank_Datafr['default'].unique()
```

```
array(['no', 'yes'], dtype=object)
```

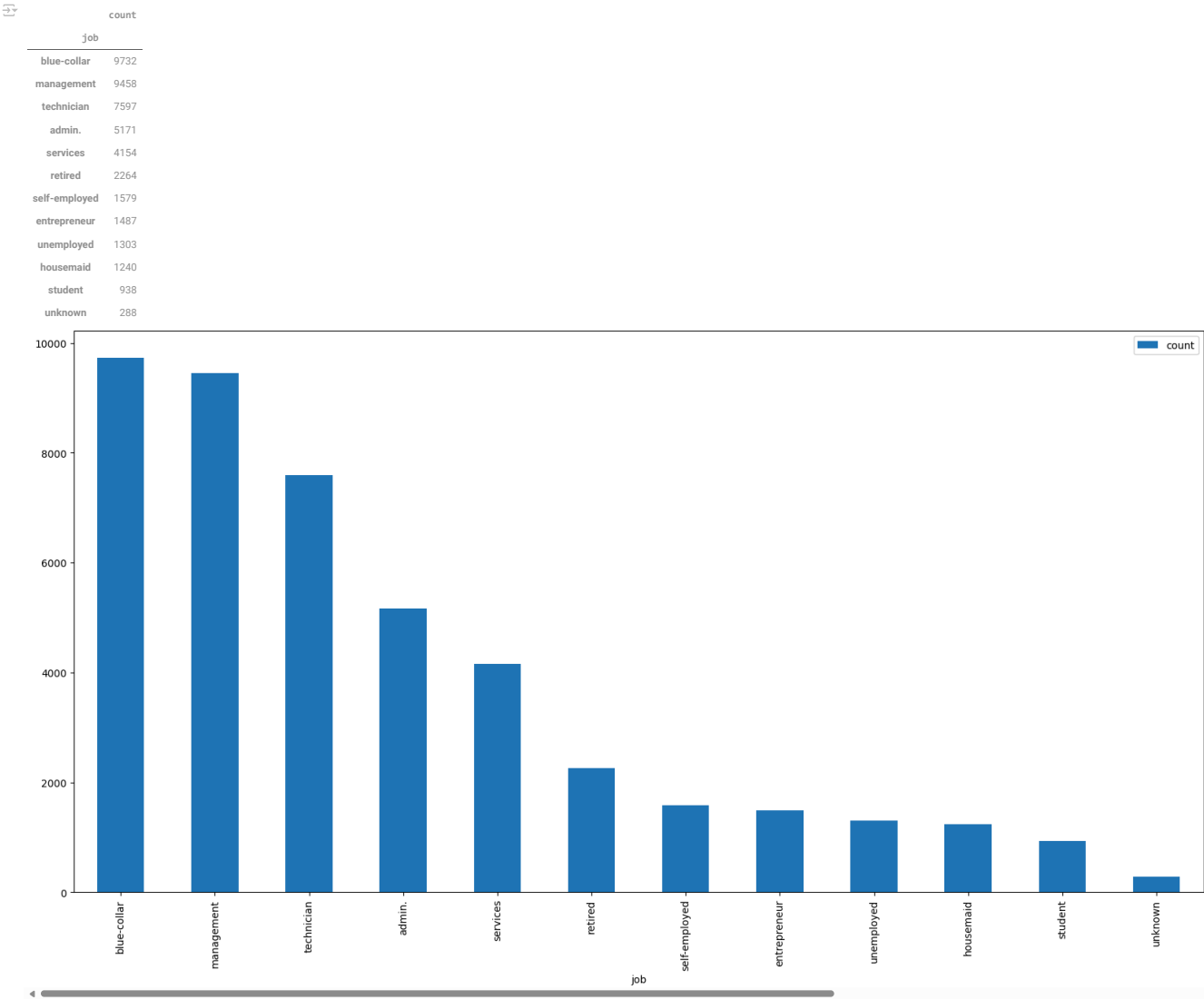
```
1 # Importing the external libraries\n2 import pandas as pd\n3\n4 # Importing the data\n5 Bank_data=pd.read_csv("/kaggle/input/bank-full-version1/bank-full.csv")
```

```
1 Bank_data
```

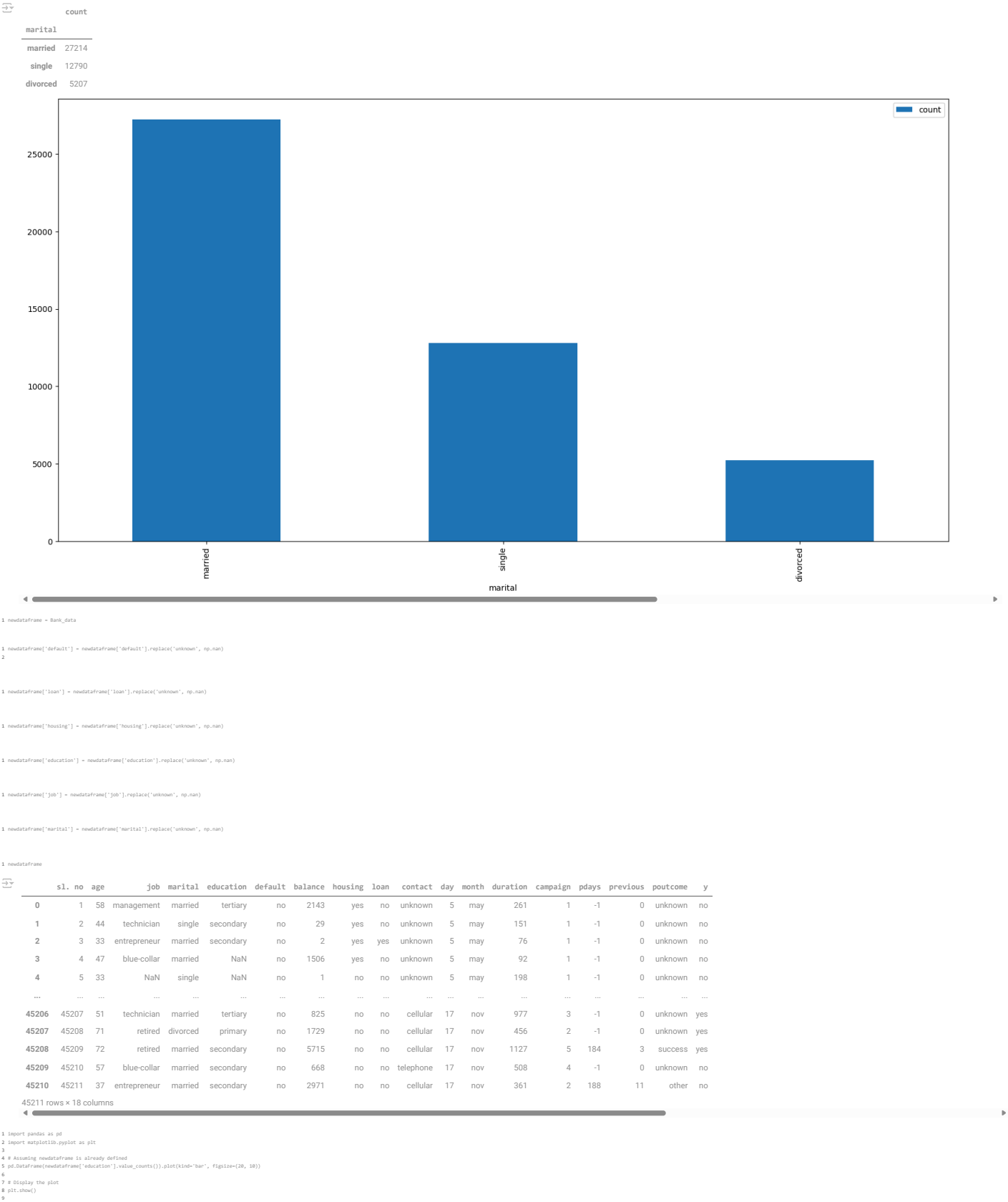
	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y	
	0	1	58	management	married	tertiary	no	2143	yes	no	unknown	5	may	261	1	-1	0	unknown	no
	1	2	44	technician	single	secondary	no	29	yes	no	unknown	5	may	151	1	-1	0	unknown	no
	2	3	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may	76	1	-1	0	unknown	no
	3	4	47	blue-collar	married	unknown	no	1506	yes	no	unknown	5	may	92	1	-1	0	unknown	no
	4	5	33	unknown	single	unknown	no	1	no	no	unknown	5	may	198	1	-1	0	unknown	no
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45206	45207	51	technician	married	tertiary	no	825	no	no	cellular	17	nov	977	3	-1	0	unknown	yes	
45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes	
45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes	
45209	45210	57	blue-collar	married	secondary	no	668	no	no	telephone	17	nov	508	4	-1	0	unknown	no	
45210	45211	37	entrepreneur	married	secondary	no	2971	no	no	cellular	17	nov	361	2	188	11	other	no	

45211 rows x 18 columns

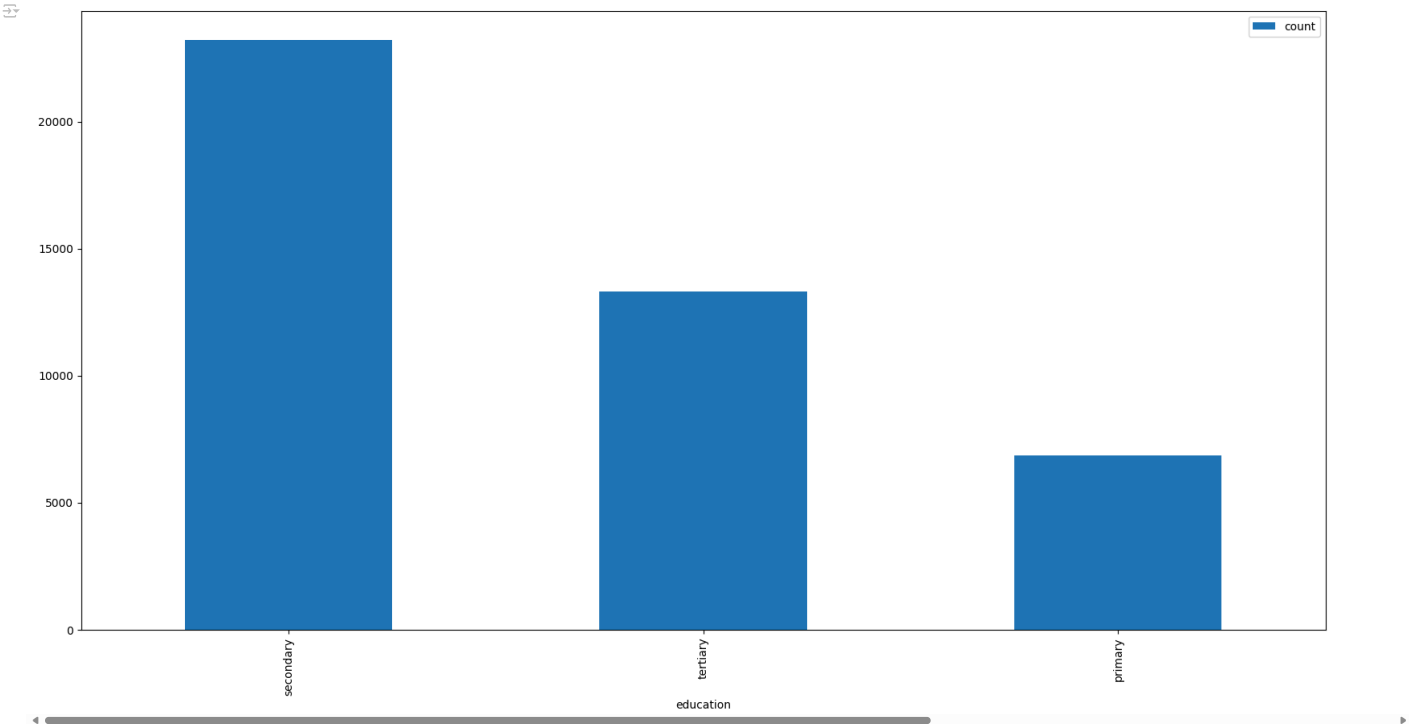
```
1 pd.DataFrame(Bank_data['job'].value_counts()).plot(kind='bar', figsize=(20,10))
2 pd.DataFrame(Bank_data['job'].value_counts())
```



```
1 pd.DataFrame(Bank_data['marital'].value_counts()).plot(kind='bar', figsize=(20,10))
2 pd.DataFrame(Bank_data['marital'].value_counts())
```







```
1 newdataframe.loan().sum()

2
3 sl. no    0
4 age      0
5 job      288
6 marital   0
7 education 1857
8 default   0
9 balance   0
10 housing   0
11 loan      0
12 contact   0
13 day       0
14 month     0
15 duration  0
16 campaign  0
17 pdays     0
18 previous  0
19 poutcome  0
20 y         0
21 dtype: int64

22
23 1 newdataframe1 = newdataframe.sort_values(by='age', ascending=True)

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25 1 newdataframe1

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```

```
8
9 print(agetmarital)
10
```

	married	single	divorced
age			
34	1131	650.0	149.0
35	1077	631.0	186.0
36	1076	538.0	192.0
33	1075	746.0	151.0
37	1073	453.0	170.0
...	...	...	...
89	2	NaN	1.0
92	2	NaN	NaN
93	2	NaN	NaN
88	2	NaN	NaN
95	1	NaN	1.0

[73 rows x 3 columns]

```
1 agetmarital.sort_index()
```

	married	single	divorced
age			
20	3	47.0	NaN
21	5	74.0	NaN
22	9	120.0	NaN
23	27	175.0	NaN
24	53	248.0	1.0
...	...	...	...
88	2	NaN	NaN
89	2	NaN	1.0
92	2	NaN	NaN
93	2	NaN	NaN
95	1	NaN	1.0

73 rows x 3 columns

```
1 newdataframe['education'].unique()
```

```
array(['tertiary', 'secondary', nan, 'primary'], dtype=object)
```

```
1 import pandas as pd
2
3
4 agetoeducation = pd.DataFrame()
5 agetoeducation['tertiary'] = newdataframe[newdataframe['education'] == 'tertiary']['age'].value_counts()
6 agetoeducation['secondary'] = newdataframe[newdataframe['education'] == 'secondary']['age'].value_counts()
7 agetoeducation['unknown'] = newdataframe[newdataframe['education'] == 'unknown']['age'].value_counts()
8 agetoeducation['primary'] = newdataframe[newdataframe['education'] == 'primary']['age'].value_counts()
9
10 print(ageteducation)
```

	tertiary	secondary	unknown	primary
age				
32	776	1088.0	NaN	179
33	760	1011.0	NaN	167
31	749	1065.0	NaN	139
34	718	1000.0	NaN	166
30	686	913.0	NaN	124
...	...	...	...	...
82	2	3.0	NaN	12
81	2	3.0	NaN	10
80	1	12.0	NaN	17
89	1	NaN	NaN	2
84	1	3.0	NaN	5

[65 rows x 4 columns]

```
1 agetoeducation.sort_index()
```

	tertiary	secondary	unknown	primary
age				
20	3	26.0	NaN	6
21	6	54.0	NaN	10
22	14	96.0	NaN	8
23	33	143.0	NaN	17
24	44	219.0	NaN	19
...	...	...	...	...
81	2	3.0	NaN	10
82	2	3.0	NaN	12
83	5	2.0	NaN	14
84	1	3.0	NaN	5
89	1	NaN	NaN	2

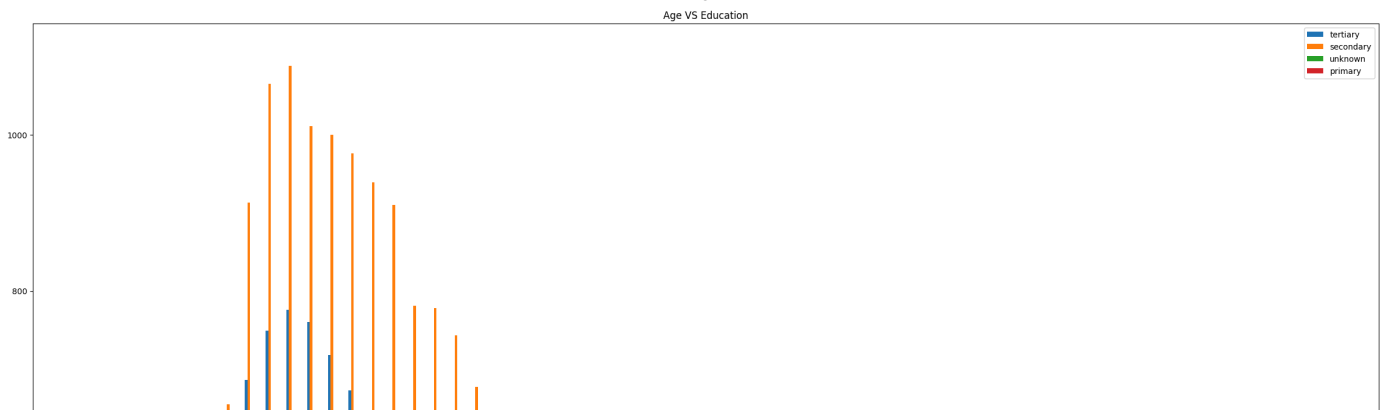
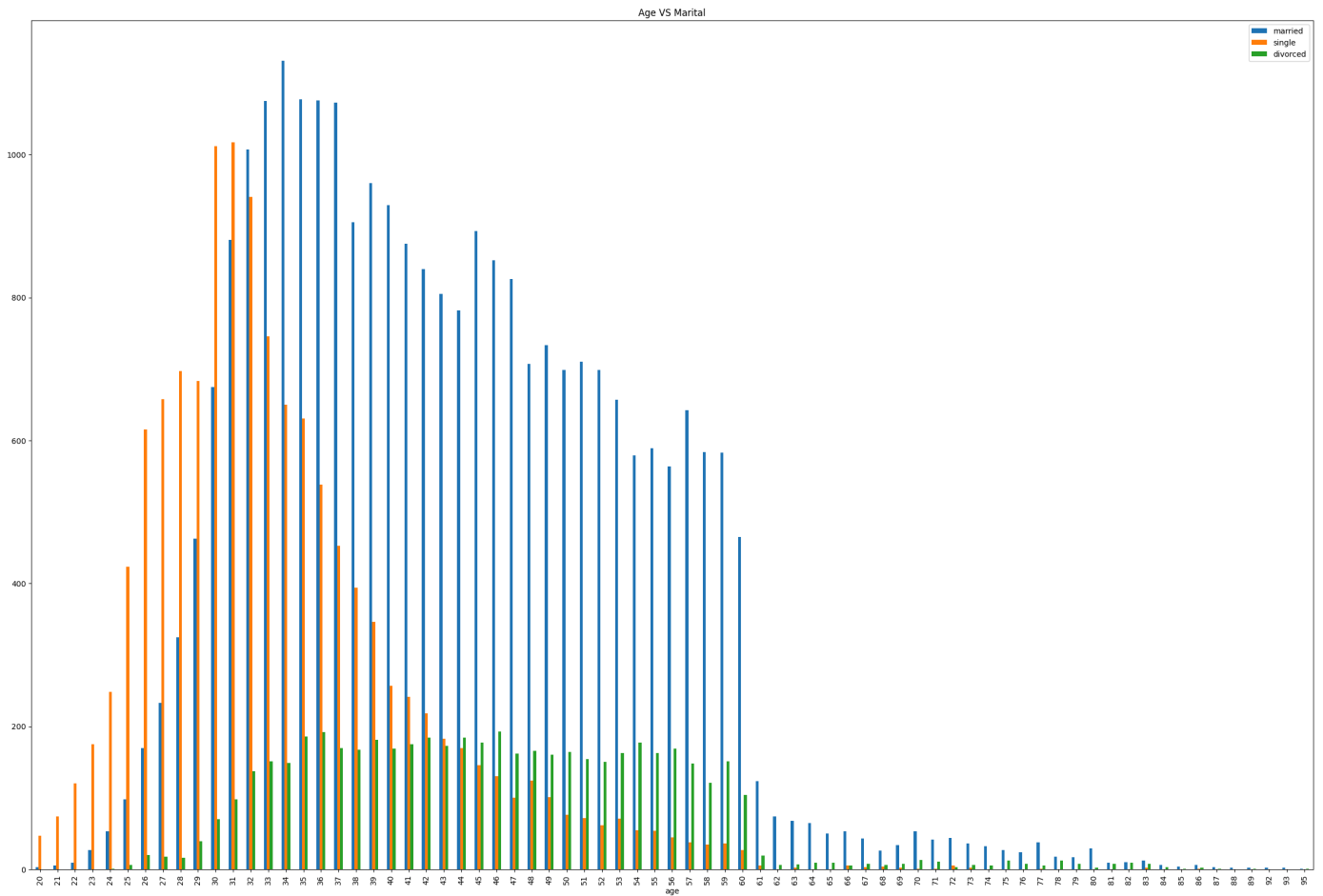
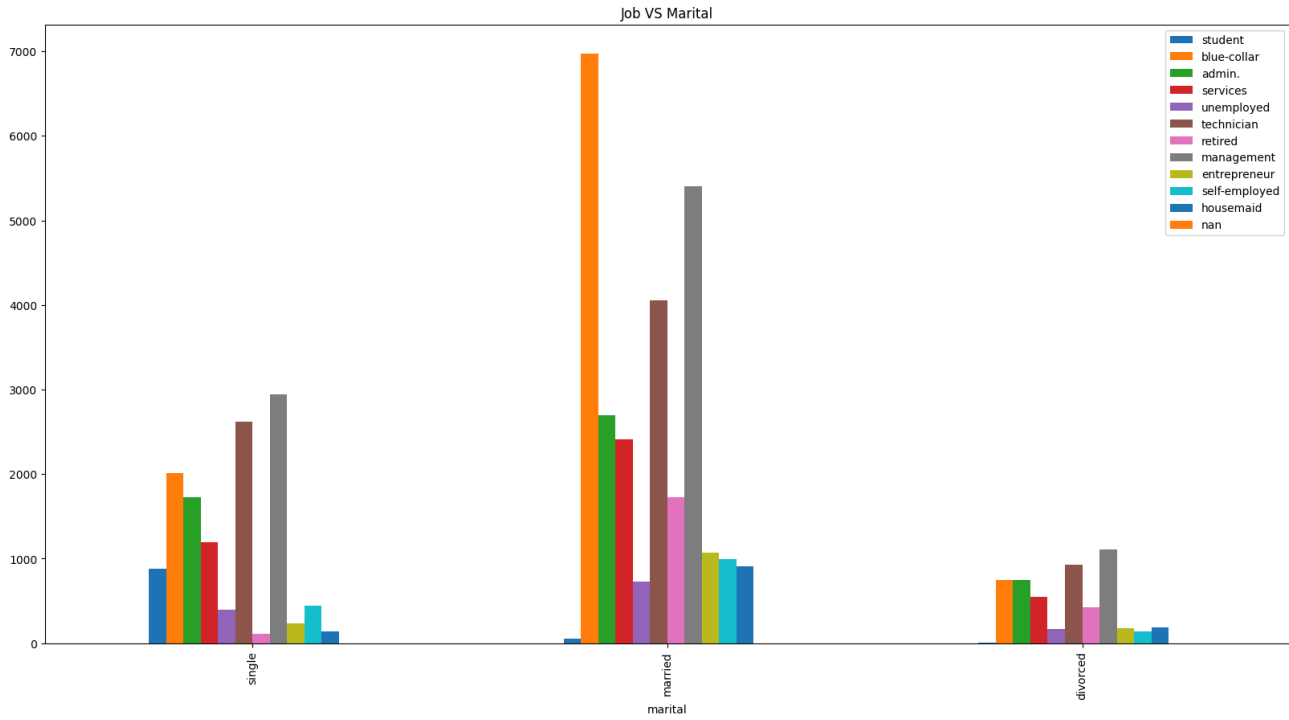
65 rows x 4 columns

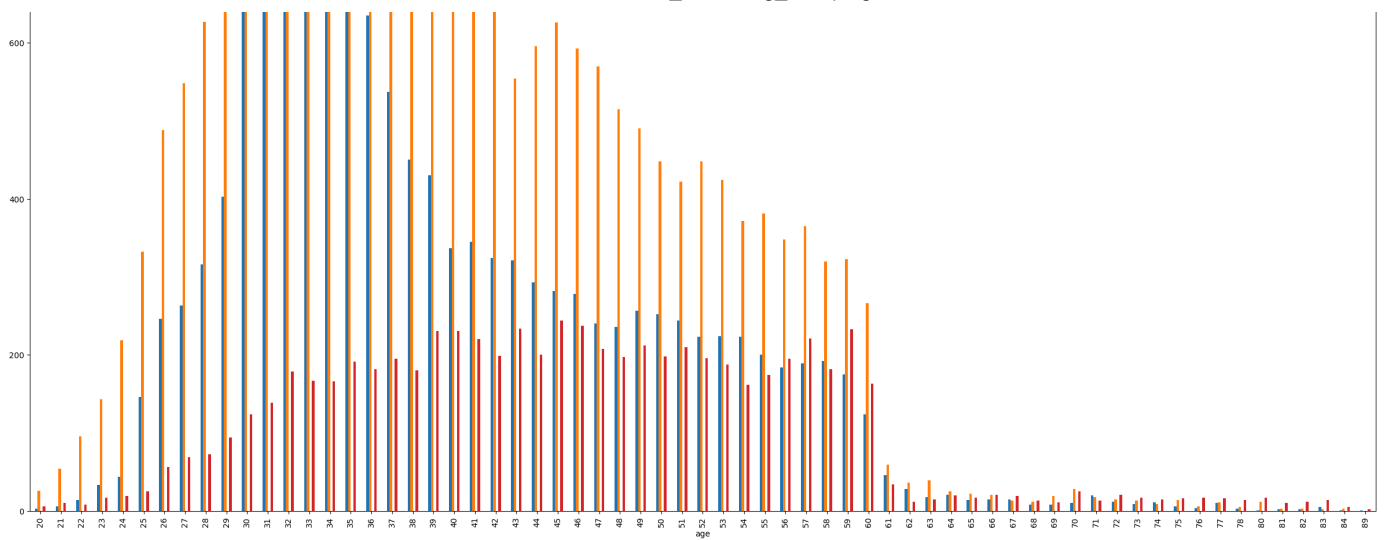
```
1 print(data_marital.columns)
2
```

```
Index(['student', 'blue-collar', 'admin.', 'services', 'unemployed',
      'technician', 'retired', 'management', 'entrepreneur', 'self-employed',
      'housemaid', 'nan'],
      dtype='object')
```

```
1 data_marital.plot.bar(title = "Job VS Marital", figsize=(20,20))
2 agetmarital.sort_index().plot.bar(title = "Age VS Marital", figsize = (30,20))
3 agetoeducation.sort_index().plot.bar(title = "Age VS Education", figsize = (30,20))
```

```
<Axes: title={'center': 'Age VS Education'}, xlabel='age'>
```





1 newdataframe

	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	1	58	management	married	tertiary	no	2143	yes	no	unknown	5	may	261	1	-1	0	unknown	no
1	2	44	technician	single	secondary	no	29	yes	no	unknown	5	may	151	1	-1	0	unknown	no
2	3	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may	76	1	-1	0	unknown	no
3	4	47	blue-collar	married	NaN	no	1506	yes	no	unknown	5	may	92	1	-1	0	unknown	no
4	5	33	NaN	single	NaN	no	1	no	no	unknown	5	may	198	1	-1	0	unknown	no
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45206	45207	51	technician	married	tertiary	no	825	no	no	cellular	17	nov	977	3	-1	0	unknown	yes
45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes
45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes
45209	45210	57	blue-collar	married	secondary	no	668	no	no	telephone	17	nov	508	4	-1	0	unknown	no
45210	45211	37	entrepreneur	married	secondary	no	2971	no	no	cellular	17	nov	361	2	188	11	other	no

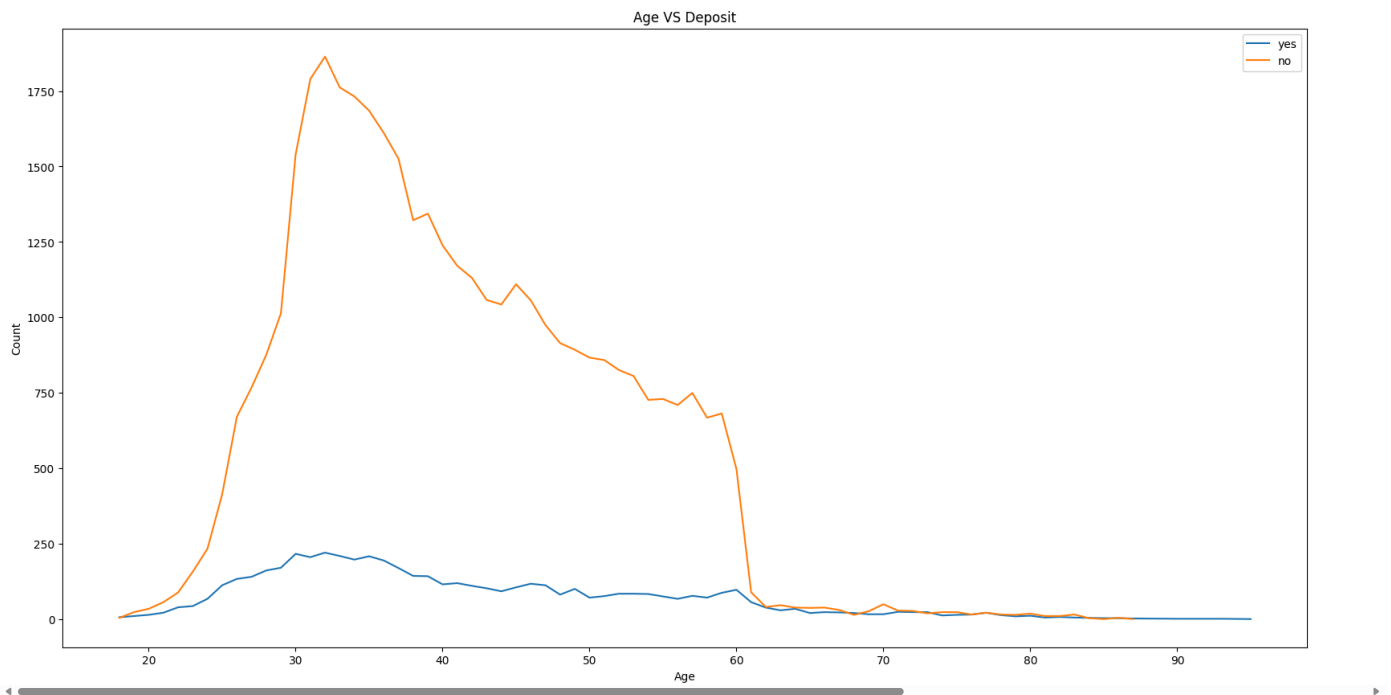
45211 rows x 18 columns

```
1 import pandas as pd
2
3
4 agotodedposit = pd.DataFrame()
5 agotodedposit['yes'] = newdataframe[newdataframe['y'] == 'yes']['age'].value_counts()
6 agotodedposit['no'] = newdataframe[newdataframe['y'] == 'no']['age'].value_counts()
7
8 print(agotodedposit)
```

	yes	no
age		
32	221	1864.0
30	217	1540.0
33	210	1762.0
35	209	1685.0
31	206	1790.0
...	...	...
87	3	1.0
90	2	NaN
92	2	NaN
93	2	NaN
95	1	1.0

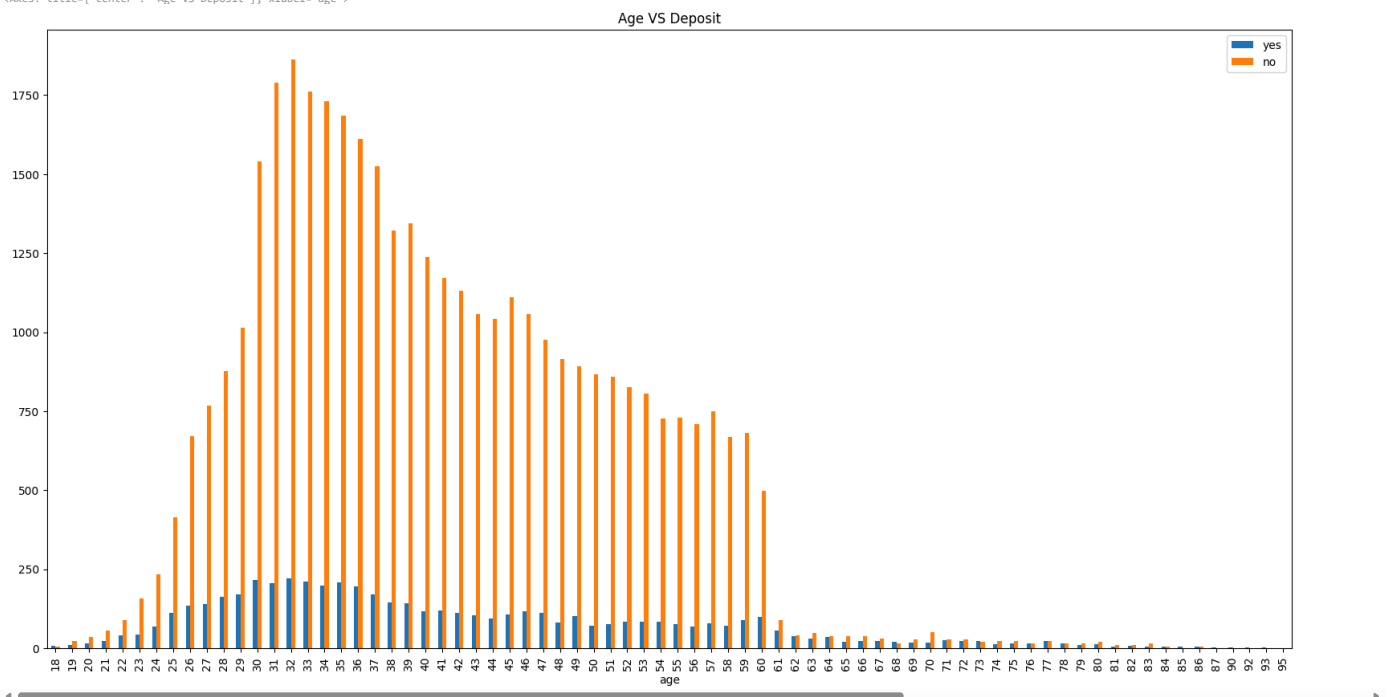
[74 rows x 2 columns]

```
1 import pandas as pd
2 import matplotlib.pyplot as plt
3
4
5 agotodedposit = pd.DataFrame()
6 agotodedposit['yes'] = newdataframe[newdataframe['y'] == 'yes']['age'].value_counts()
7 agotodedposit['no'] = newdataframe[newdataframe['y'] == 'no']['age'].value_counts()
8
9 # Plotting the line plot
10 agotodedposit.sort_index().plot(kind='line', title='Age VS Deposit', figsize=(20, 10))
11 plt.xlabel("Age")
12 plt.ylabel("Count")
13 plt.show()
14
```



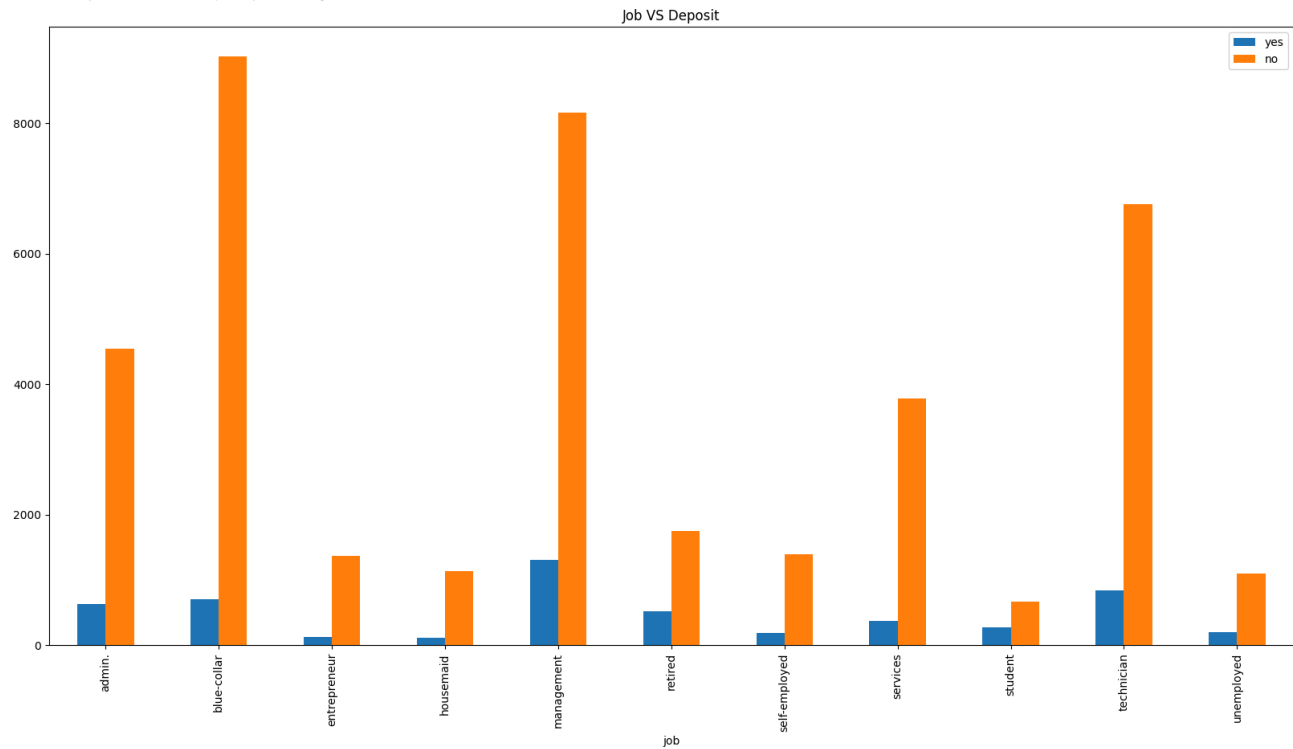
```
1 agtodeposit = pd.DataFrame()
2
3 agtodeposit['yes'] = newdataframe[newdataframe['y'] == 'yes']['age'].value_counts()
4 agtodeposit['no'] = newdataframe[newdataframe['y'] == 'no']['age'].value_counts()
5
6 agtodeposit.sort_index().plot.bar(title = "Age VS Deposit", figsize=(20,10))
```

<Axes: title='center': 'Age VS Deposit', xlabel='age'>

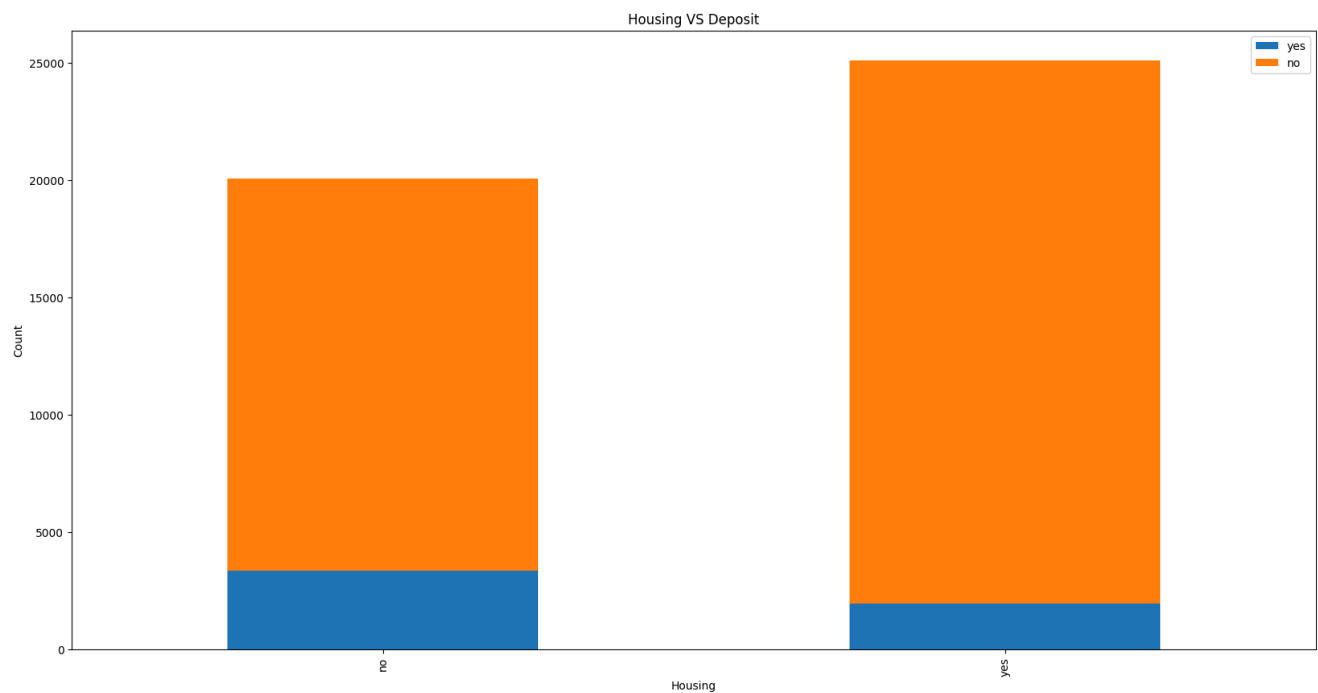


```
1 johtodeposit = pd.DataFrame()
2
3 johtodeposit['yes'] = newdataframe[newdataframe['y'] == 'yes']['job'].value_counts()
4 johtodeposit['no'] = newdataframe[newdataframe['y'] == 'no']['job'].value_counts()
5
6 johtodeposit.sort_index().plot.bar(title = "Job VS Deposit", figsize=(20,10))
```

```
<Axes: title='center': 'Job VS Deposit', xlabel='job'>
```



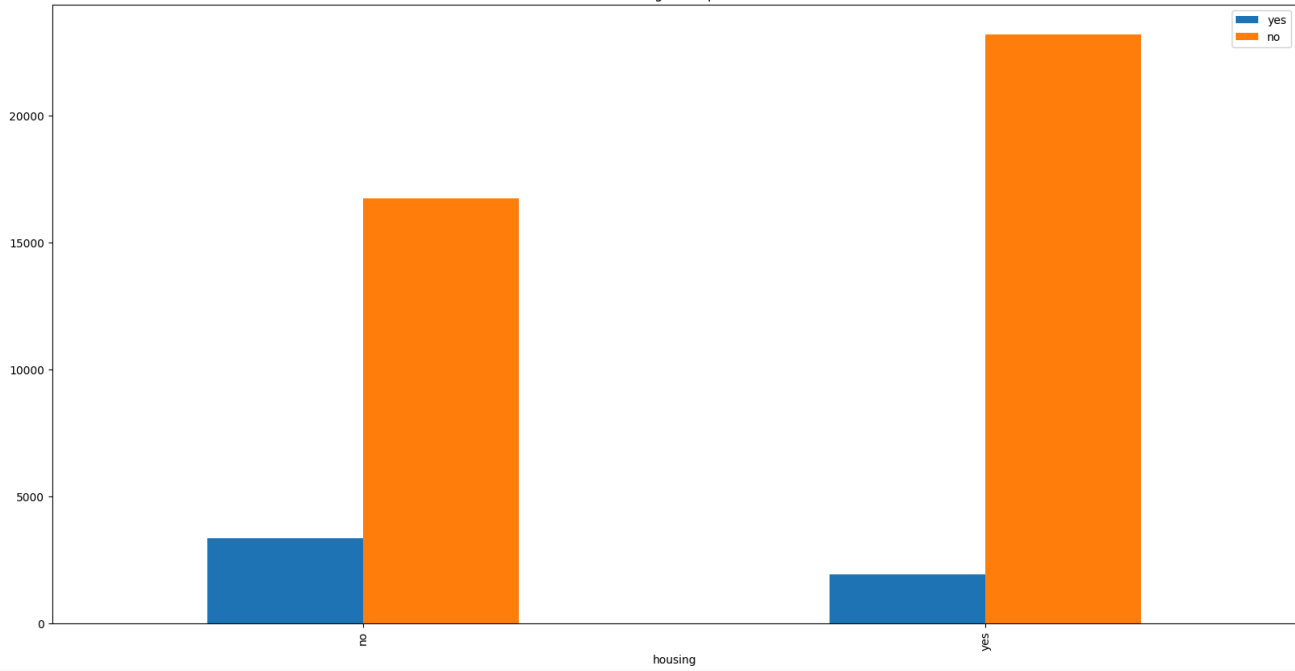
```
1 import pandas as pd
2 import matplotlib.pyplot as plt
3
4
5 housingtodeposit = pd.DataFrame()
6 housingtodeposit['yes'] = newdataframe[newdataframe['y'] == 'yes']['housing'].value_counts()
7 housingtodeposit['no'] = newdataframe[newdataframe['y'] == 'no']['housing'].value_counts()
8
9 # Plotting the stacked bar chart
10 housingtodeposit.sort_index().plot(kind='bar', stacked=True, title='Housing VS Deposit', figsize=(20, 10))
11 plt.xlabel("Housing")
12 plt.ylabel("Count")
13 plt.show()
14
```



```
1 housingtodeposit = pd.DataFrame()
2
3 housingtodeposit['yes'] = newdataframe[newdataframe['y'] == 'yes']['housing'].value_counts()
4 housingtodeposit['no'] = newdataframe[newdataframe['y'] == 'no']['housing'].value_counts()
5
6 housingtodeposit.sort_index().plot.bar(title = "Housing VS Deposit", figsize=(20,10))
```

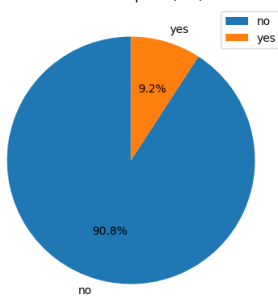
<Axes: title={'center': 'Housing VS Deposit'}, xlabel='housing'>

Housing VS Deposit

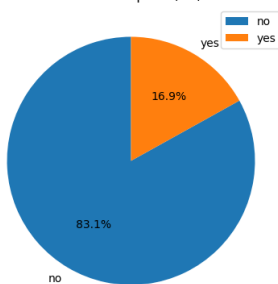


```
1 import pandas as pd
2 import matplotlib.pyplot as plt
3
4
5 loandeposit = pd.DataFrame()
6 loandeposit['yes'] = newdataframe[newdataframe['y'] == 'yes']['loan'].value_counts()
7 loandeposit['no'] = newdataframe[newdataframe['y'] == 'no']['loan'].value_counts()
8
9 plt.figure(figsize=(20, 10))
10
11 # Plotting the pie chart
12 loandeposit['yes'].plot.pie(autopct='%1.1f%%', startangle=90, title='Loan VS Deposit (Yes)', figsize=(10, 5), legend=True)
13 plt.ylabel('') # Hide y-label
14 plt.show()
15
16 plt.figure(figsize=(20, 10))
17 loandeposit['no'].plot.pie(autopct='%1.1f%%', startangle=90, title='Loan VS Deposit (No)', figsize=(10, 5), legend=True)
18 plt.ylabel('') # Hide y-label
19 plt.show()
20
```

Loan VS Deposit (Yes)



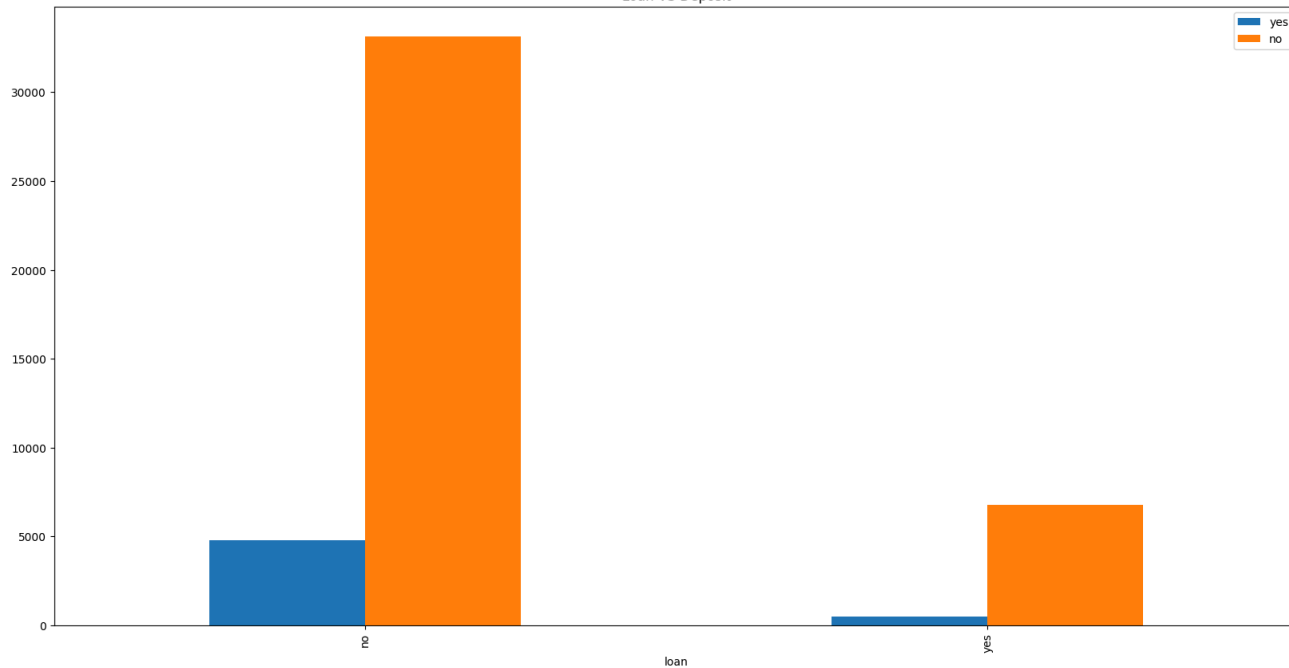
Loan VS Deposit (No)



```
1 loandeposit = pd.DataFrame()
2
3 loandeposit['yes'] = newdataframe[newdataframe['y'] == 'yes']['loan'].value_counts()
4 loandeposit['no'] = newdataframe[newdataframe['y'] == 'no']['loan'].value_counts()
5
6 loandeposit.sort_index().plot.bar(title = "Loan VS Deposit", figsize=(20,10))
```

```
<Axes: title='center': 'Loan VS Deposit', xlabel='loan'>
```

Loan VS Deposit



```
1 old_age = newdataframe[newdataframe['age'] > 65]
```

```
1 old_age
```

	sl.	no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
	28906	28907	66	housemaid	married	secondary	no	1929	no	no	cellular	2	feb	169	1	-1	0	unknown	no
	28924	28925	62	technician	married	secondary	no	973	no	no	cellular	2	feb	326	1	-1	0	unknown	yes
	28965	28966	62	retired	married	secondary	no	1495	no	no	cellular	2	feb	265	1	-1	0	unknown	yes
	29158	29159	83	retired	married	primary	no	425	no	no	telephone	2	feb	912	1	-1	0	unknown	no
	29261	29262	75	retired	divorced	primary	no	46	no	no	cellular	2	feb	294	1	-1	0	unknown	no
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	45191	45192	75	retired	divorced	tertiary	no	3810	yes	no	cellular	16	nov	262	1	183	1	failure	yes
	45195	45196	68	retired	married	secondary	no	1146	no	no	cellular	16	nov	212	1	187	6	success	yes
	45204	45205	73	retired	married	secondary	no	2850	no	no	cellular	17	nov	300	1	40	8	failure	yes
	45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes
	45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes
1041 rows x 18 columns																			

```
1 old_age[old_age['y'] == 'yes']
```

	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y	
	28924	28925	62	technician	married	secondary	no	973	no	no	cellular	2	feb	326	1	-1	0	unknown	yes
	28965	28966	62	retired	married	secondary	no	1495	no	no	cellular	2	feb	265	1	-1	0	unknown	yes
	29464	29465	68	retired	divorced	primary	no	250	no	no	cellular	3	feb	360	1	-1	0	unknown	yes
	29865	29866	75	retired	divorced	primary	no	3881	yes	no	cellular	4	feb	136	3	-1	0	unknown	yes
	29961	29962	69	retired	married	primary	no	324	no	no	cellular	4	feb	136	4	-1	0	unknown	yes
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	45191	45192	75	retired	divorced	tertiary	no	3810	yes	no	cellular	16	nov	262	1	183	1	failure	yes
	45195	45196	68	retired	married	secondary	no	1146	no	no	cellular	16	nov	212	1	187	6	success	yes
	45204	45205	73	retired	married	secondary	no	2850	no	no	cellular	17	nov	300	1	40	8	failure	yes
	45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes
	45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes
445 rows x 18 columns																			

```
1 old_age
```

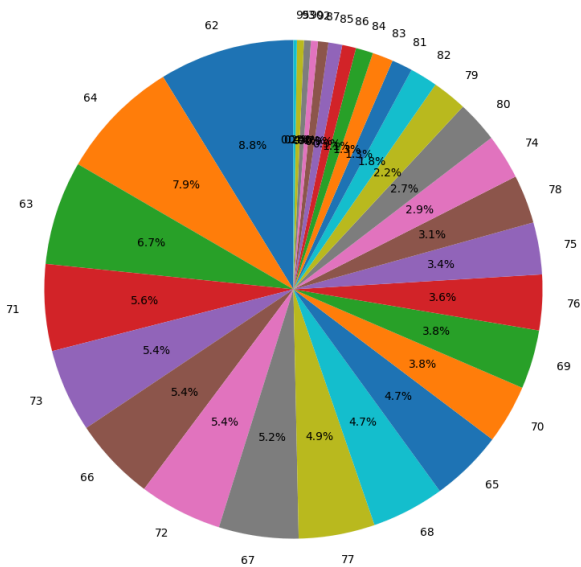
	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y	
	28906	28907	66	housemaid	married	secondary	no	1929	no	no	cellular	2	feb	169	1	-1	0	unknown	no
	28924	28925	62	technician	married	secondary	no	973	no	no	cellular	2	feb	326	1	-1	0	unknown	yes
	28965	28966	62	retired	married	secondary	no	1495	no	no	cellular	2	feb	265	1	-1	0	unknown	yes
	29158	29159	83	retired	married	primary	no	425	no	no	telephone	2	feb	912	1	-1	0	unknown	no
	29261	29262	75	retired	divorced	primary	no	46	no	no	cellular	2	feb	294	1	-1	0	unknown	no
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	45191	45192	75	retired	divorced	tertiary	no	3810	yes	no	cellular	16	nov	262	1	183	1	failure	yes
	45195	45196	68	retired	married	secondary	no	1146	no	no	cellular	16	nov	212	1	187	6	success	yes
	45204	45205	73	retired	married	secondary	no	2850	no	no	cellular	17	nov	300	1	40	8	failure	yes
	45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes
	45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes
1041 rows x 18 columns																			

```
1 import matplotlib.pyplot as plt
2
3 # Filter the data
4 yes_old_age = old_age[old_age['y'] == 'yes']
5
6 # Plotting the pie chart
7 yes_old_age['age'].value_counts().plot.pie(autopct='%1.1f%%', startangle=90, figsize=(10, 20))
8 plt.title('Age Distribution for yes Deposits')
9 plt.xlabel('') # hide x-label
10 plt.show()
11
```





Age Distribution for Yes Deposits



1 newdataframe



	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	1	58	management	married	tertiary	no	2143	yes	no	unknown	5	may	261	1	-1	0	unknown	no
1	2	44	technician	single	secondary	no	29	yes	no	unknown	5	may	151	1	-1	0	unknown	no
2	3	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may	76	1	-1	0	unknown	no
3	4	47	blue-collar	married	NaN	no	1506	yes	no	unknown	5	may	92	1	-1	0	unknown	no
4	5	33	NaN	single	NaN	no	1	no	no	unknown	5	may	198	1	-1	0	unknown	no
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45206	45207	51	technician	married	tertiary	no	825	no	no	cellular	17	nov	977	3	-1	0	unknown	yes
45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes
45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes
45209	45210	57	blue-collar	married	secondary	no	668	no	no	telephone	17	nov	508	4	-1	0	unknown	no
45210	45211	37	entrepreneur	married	secondary	no	2971	no	no	cellular	17	nov	361	2	188	11	other	no

45211 rows x 18 columns

1 newdataframe.rename(columns = {'y':'deposited'}, inplace = True)

1 newdataframe['default'] = newdataframe['default'].replace({'yes': 1, 'no': 0})

1 newdataframe['deposited'] = newdataframe['deposited'].replace({'yes': 1, 'no': 0})

1 newdataframe['housing'] = newdataframe['housing'].replace({'yes': 1, 'no': 0})

1 newdataframe['loan'] = newdataframe['loan'].replace({'yes': 1, 'no': 0})