In [2]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from bokeh.layouts import row
from distributed.utils import palette
from pyasn1_modules.rfc2985 import gender
from sqlalchemy import custom_op

### path here but cut out ###

df_transactions = pd.read_csv(path_transactions)
df_avg_transactions = pd.read_csv(path_avg_transaction)
df_credit_profile = pd.read_csv(path_credit_profile)
df_customers = pd.read_csv(path_customers)
```

In [4]:

Working with dataset

I.Customer tables

1.Explore customers - annual income

In [5]:

```
df_customers.shape
```

Out[5]:

```
(1000, 8)
```

In [6]:

```
df_customers.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 8 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   cust_id         1000 non-null   int64
 1   name            1000 non-null   object
 2   gender          1000 non-null   object
 3   age             1000 non-null   int64
 4   location        1000 non-null   object
 5   occupation      1000 non-null   object
 6   annual_income   950 non-null    float64
 7   marital_status  1000 non-null   object
dtypes: float64(1), int64(2), object(5)
memory usage: 62.6+ KB
```

In [7]:

```
df_customers.describe()
```

Out[7]:

	cust_id	age	annual_income
count	1000.000000	1000.000000	950.000000
mean	500.500000	36.405000	139410.314737
std	288.819436	15.666155	112416.802007
min	1.000000	1.000000	2.000000
25%	250.750000	26.000000	47627.500000
50%	500.500000	32.000000	112218.500000
75%	750.250000	46.000000	193137.500000
max	1000.000000	135.000000	449346.000000

The table above showed the problems of max and min value from age and annual income value. So that we need to determine the outliers of 2 this columns after get rid of null value

In [8]:

```
df_customers.head()
```

Out[8]:

	cust_id	name	gender	age	location	occupation	annual_income	marital_status
0	1	Manya Acharya	Female	2	City	Business Owner	358211.0	Married
1	2	Anjali Pandey	Female	47	City	Consultant	65172.0	Single
2	3	Aaryan Chauhan	Male	21	City	Freelancer	22378.0	Married
3	4	Rudra Bali	Male	24	Rural	Freelancer	33563.0	Married
4	5	Advait Malik	Male	48	City	Consultant	39406.0	Married

1.2 Get rid of null value for dataset annual income

In [9]:

```
#Check if any null value
df_customers.isna().sum()
```

Out[9]:

```
cust_id            0
name               0
gender             0
age                0
location           0
occupation         0
annual_income     50
marital_status     0
dtype: int64
```

In [154…

```
df_customers[df_customers['annual_income'].isna()].head(5)
```

Out[154…

	cust_id	name	gender	age	location	occupation	annual_income	marital_status	age_group
14	15	Sanjana Malik	Female	25.0	Rural	Artist	NaN	Married	18-25
82	83	Reyansh Mukherjee	Male	27.0	City	Freelancer	NaN	Single	26-48
97	98	Virat Puri	Male	47.0	Suburb	Business Owner	NaN	Married	26-48
102	103	Aarav Shah	Male	32.0	City	Data Scientist	NaN	Married	26-48
155	156	Kiaan Saxena	Male	24.0	City	Fullstack Developer	NaN	Married	18-25

In [11]:
```
# To replace null value from annual income, we decide to replace by median income of each occupation is a better wa
# Set up get median income of each occupation
df_get_median_annual_income_from_occupation = df_customers.groupby('occupation')['annual_income'].median()
df_get_median_annual_income_from_occupation
```

Out[11]:
```
occupation
Accountant               65265.0
Artist                   45794.0
Business Owner          261191.5
Consultant               58017.0
Data Scientist          135759.0
Freelancer               46759.0
Fullstack Developer      76774.0
Name: annual_income, dtype: float64
```

In [ ]:
```

```

In [12]:
```
#Test annual income when pass occupation name in dataframe
df_get_median_annual_income_from_occupation['Freelancer']
```

Out[12]:
```
46759.0
```

In [13]:
```
#Set up function to try to retrieve the annual income whenever pass each occupation which corresponding with positi
#The meaning of this function is when we use row which represent for a whole row of dataset, we may call any rows o
def get_income_na(row):
    if pd.isnull(row['annual_income']):
        return df_get_median_annual_income_from_occupation[row['occupation']]
    else :
        return row['annual_income']
```

In [14]:
```
# Test call function get_income_na when pass row is the dist include annual income is null and 1 name of occupation
get_income_na({'annual_income':None, "occupation":'Freelancer'})
```

Out[14]:
```
46759.0
```

In [15]:
```
#Manipulate to this function to get the new column which replace any annual null income . Look parallel the income
df_customers['annual_income'] = df_customers.apply(lambda row: df_get_median_annual_income_from_occupation[row['occ
                                                    if pd.isnull(row['annual_income']) else row['annual_income'], a
```

In [16]:

```
#Check if any null value still
df_customers.isnull().sum()
```

Out[16]:

```
cust_id           0
name              0
gender            0
age               0
location          0
occupation        0
annual_income     0
marital_status    0
dtype: int64
```

In [17]:

```
df_customers[df_customers['annual_income'].isna()]
```

Out[17]:

cust_id	name	gender	age	location	occupation	annual_income	marital_status

1.3 Determine outliers of annual income

The confirmation for minimum annual income is 100

In [18]:

```
df_customers[df_customers['annual_income']<100]
```

Out[18]:

	cust_id	name	gender	age	location	occupation	annual_income	marital_status
31	32	Veer Mistry	Male	50	City	Business Owner	50.0	Married
262	263	Vivaan Tandon	Male	53	Suburb	Business Owner	50.0	Married
316	317	Yuvraj Saxena	Male	47	City	Consultant	50.0	Married
333	334	Avani Khanna	Female	29	City	Data Scientist	50.0	Married
340	341	Priya Sinha	Female	33	Rural	Fullstack Developer	50.0	Married
543	544	Advait Batra	Male	54	City	Consultant	2.0	Married
592	593	Priya Gandhi	Female	32	City	Business Owner	50.0	Married
633	634	Rudra Mehtani	Male	26	City	Data Scientist	2.0	Married
686	687	Vihaan Jaiswal	Male	40	City	Business Owner	2.0	Married
696	697	Ishan Negi	Male	47	City	Consultant	20.0	Married

In [19]:

```
#Check the annual income which less than minimum income 100000
df_customers[df_customers['annual_income']<100].shape
```

Out[19]:

```
(10, 8)
```

In [20]:

```
# We need to replace all this wrong number by annual income corresponding occupation
```

1st Solution : Using row with lambda

In [21]:

```
df_customers['annual_income'] = df_customers.apply(lambda row: df_get_median_annual_income_from_occupation[row['occ
                                                   if (row['annual_income'] < 100) else row['annual_income'], axis
```

In [ ]:

```

```

2nd Solution : Using interrows and df.at

In [22]:

```
df_customers.at[6 , 'gender']
```

Out[22]:
```
'Female'
```

In [23]:
```
for index, row in df_customers.iterrows():
    if row['annual_income']<100:
        df_customers.at[index, 'annual_income'] = df_get_median_annual_income_from_occupation[row['occupation']]
```

In [24]:
```
df_customers.describe()
```

Out[24]:

	cust_id	age	annual_income
count	1000.000000	1000.000000	1000.000000
mean	500.500000	36.405000	140483.548500
std	288.819436	15.666155	110463.002934
min	1.000000	1.000000	5175.000000
25%	250.750000	26.000000	49620.500000
50%	500.500000	32.000000	115328.000000
75%	750.250000	46.000000	195514.250000
max	1000.000000	135.000000	449346.000000

In [25]:
```
df_customers.iloc[[316,333]]
```

Out[25]:

	cust_id	name	gender	age	location	occupation	annual_income	marital_status
316	317	Yuvraj Saxena	Male	47	City	Consultant	58017.0	Married
333	334	Avani Khanna	Female	29	City	Data Scientist	135759.0	Married

In [26]:
```
#Check higher limit
income_mean = df_customers['annual_income'].mean()
income_std = df_customers['annual_income'].std()
```

```
higher_limit_income = income_mean + 3*income_std
higher_limit_income
```

Out[26]:

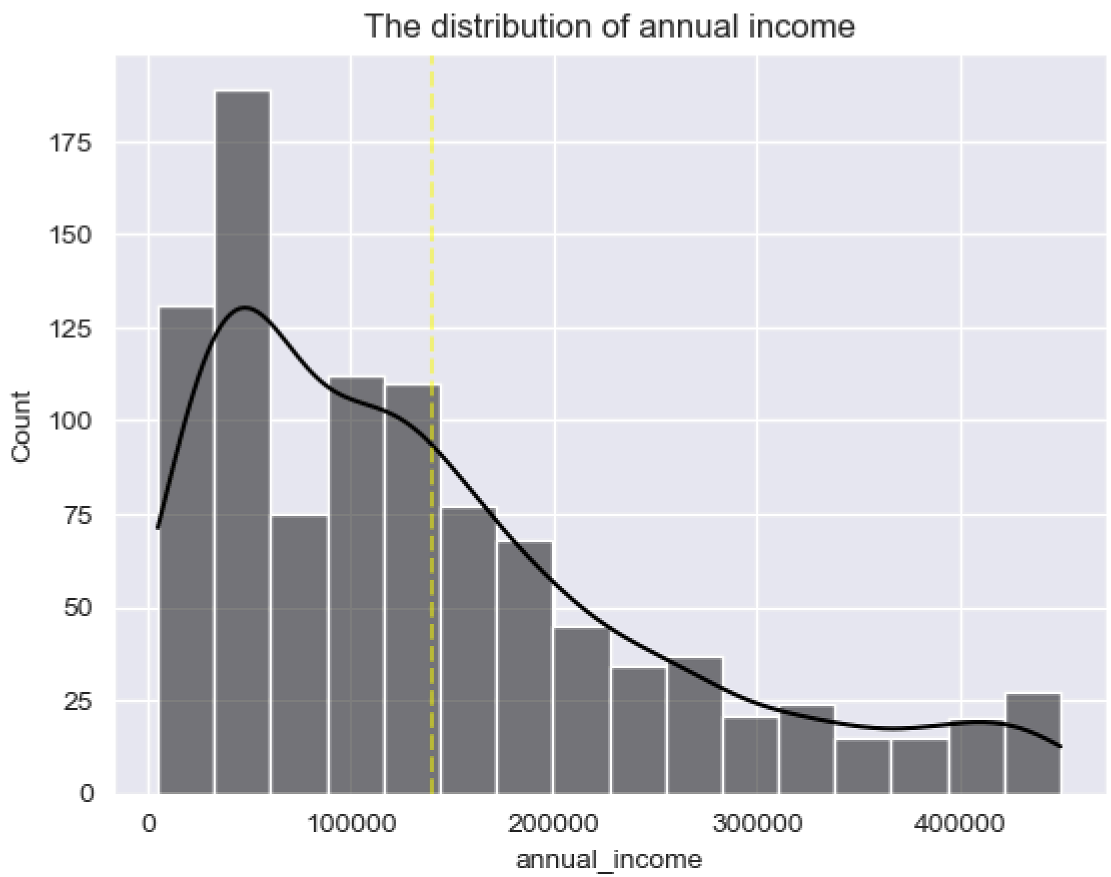
```
471872.5573024922
```

The higher limit income is greater than max annual income so that dont have outliers for max annual income

1.4 Data visualization annual income

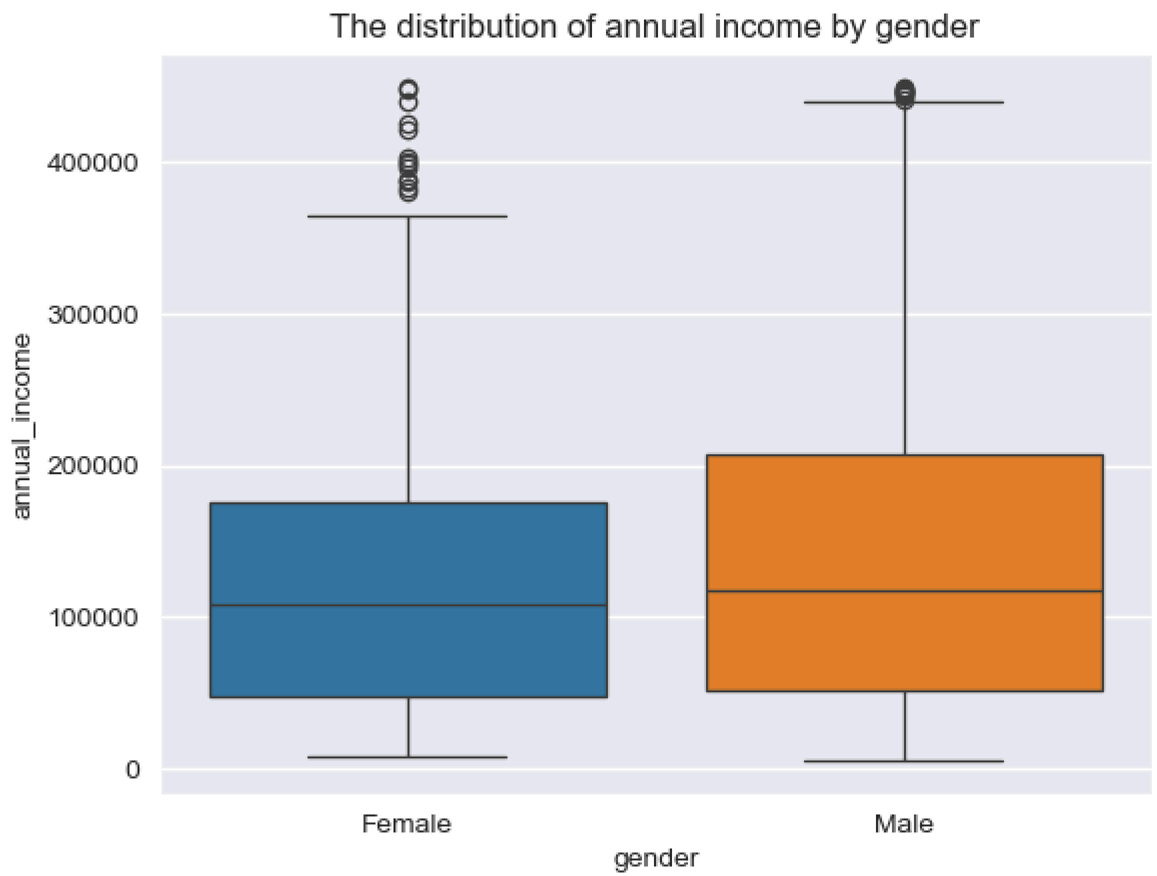
In [27]:

```
sns.histplot(df_customers['annual_income'], color='black',kde=True)
plt.axvline(df_customers['annual_income'].mean(), color='yellow', linestyle='--', label='Mean', alpha=0.5)
plt.title('The distribution of annual income')
plt.show()
```



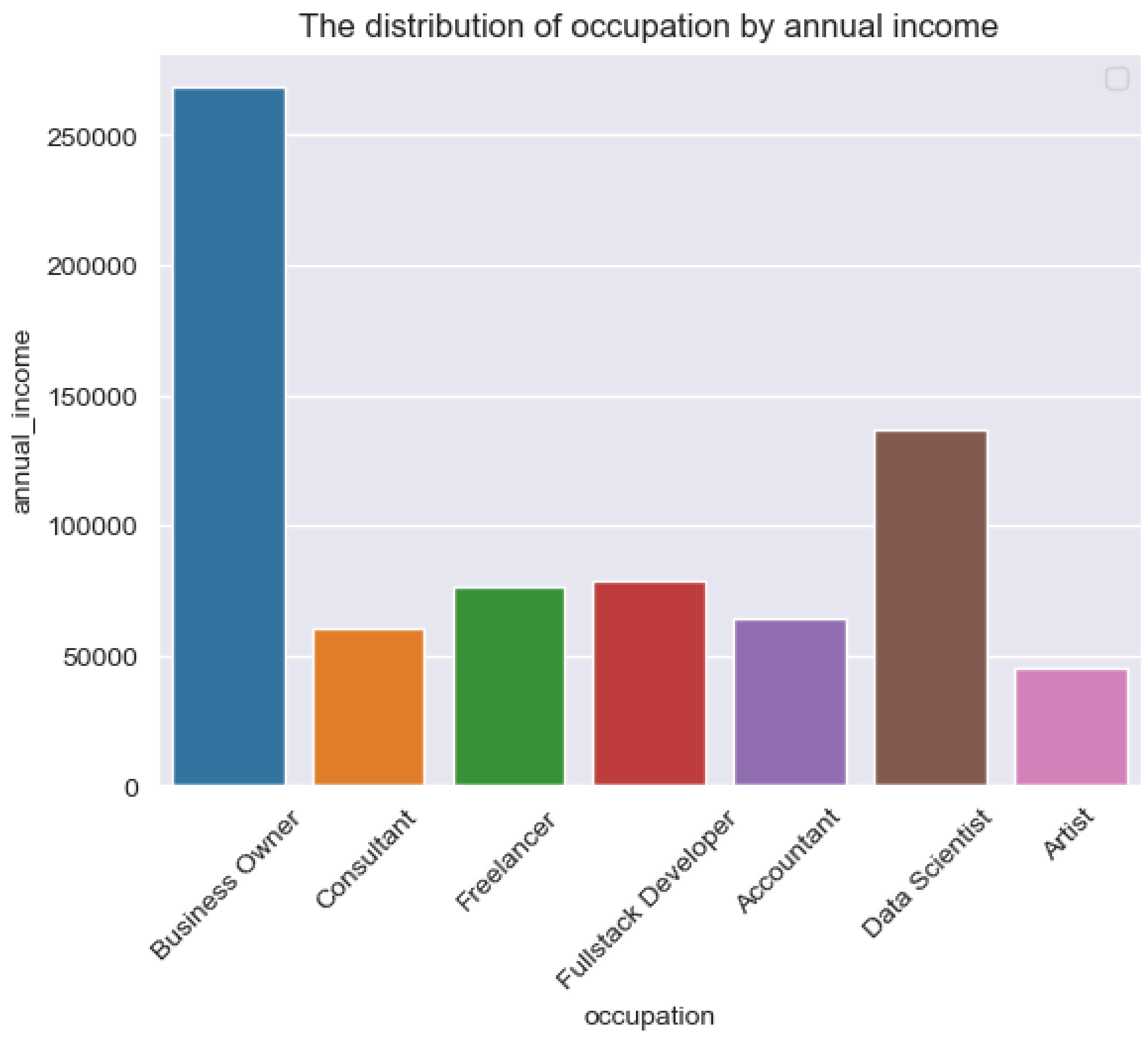
```
In [28]: sns.boxplot(x = df_customers['gender'], y = df_customers['annual_income'], palette='tab10')
         plt.title('The distribution of annual income by gender')
         plt.show()
```

```
/var/folders/q3/xgl4pwjd7lbg8skj81tsl0xr0000gn/T/ipykernel_17788/3173385115.py:1: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `
hue` and set `legend=False` for the same effect.

  sns.boxplot(x = df_customers['gender'], y = df_customers['annual_income'], palette='tab10')
```



```
In [29]: sns.barplot(y = df_customers['annual_income'], x = df_customers['occupation'], palette='tab10', errorbar=None)
         plt.xticks(rotation=45)
         plt.title('The distribution of occupation by annual income')
         plt.legend()
         plt.show()
```

```
/var/folders/q3/xgl4pwjd7lbg8skj81tsl0xr0000gn/T/ipykernel_17788/1015977316.py:1: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `
hue` and set `legend=False` for the same effect.

  sns.barplot(y = df_customers['annual_income'], x = df_customers['occupation'], palette='tab10', errorbar=None)
/var/folders/q3/xgl4pwjd7lbg8skj81tsl0xr0000gn/T/ipykernel_17788/1015977316.py:4: UserWarning: No artists with label
s found to put in legend.  Note that artists whose label start with an underscore are ignored when legend() is calle
d with no argument.
  plt.legend()
```



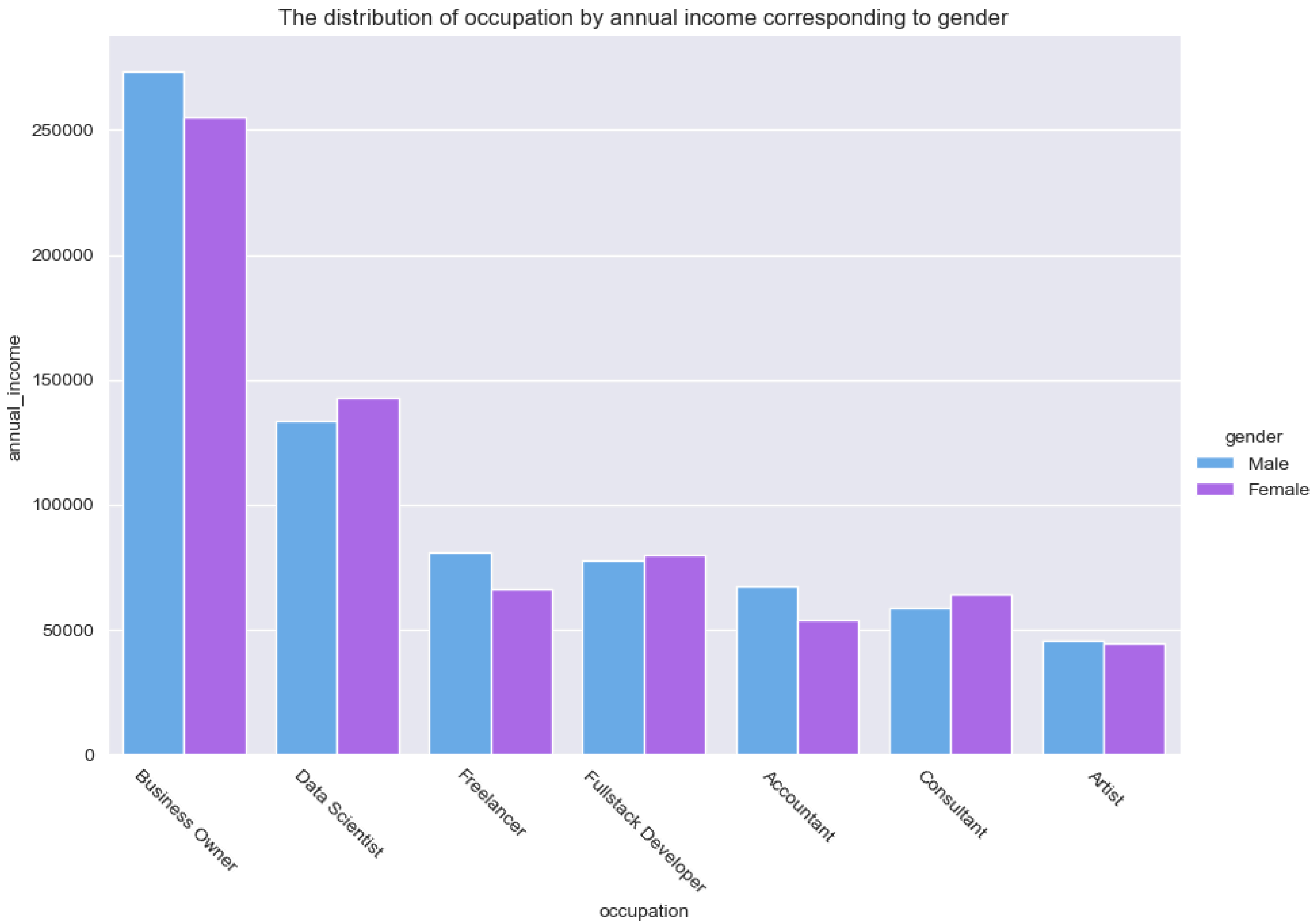
```
In [30]: #Arrange annual income
         df_income_occupation = df_customers.groupby(['occupation','gender'])['annual_income'].mean().reset_index().sort_val
         df_income_occupation
```

Out[30]:

	occupation	gender	annual_income
5	Business Owner	Male	273767.408213
4	Business Owner	Female	255017.512195
8	Data Scientist	Female	143047.171875
9	Data Scientist	Male	133807.450000
11	Freelancer	Male	81027.794872
12	Fullstack Developer	Female	79954.915254
13	Fullstack Developer	Male	77914.606742
1	Accountant	Male	67602.416667
10	Freelancer	Female	66143.555556
6	Consultant	Female	64203.312500
7	Consultant	Male	58980.000000
0	Accountant	Female	53687.000000
3	Artist	Male	45696.960000
2	Artist	Female	44563.615385

In [31]:

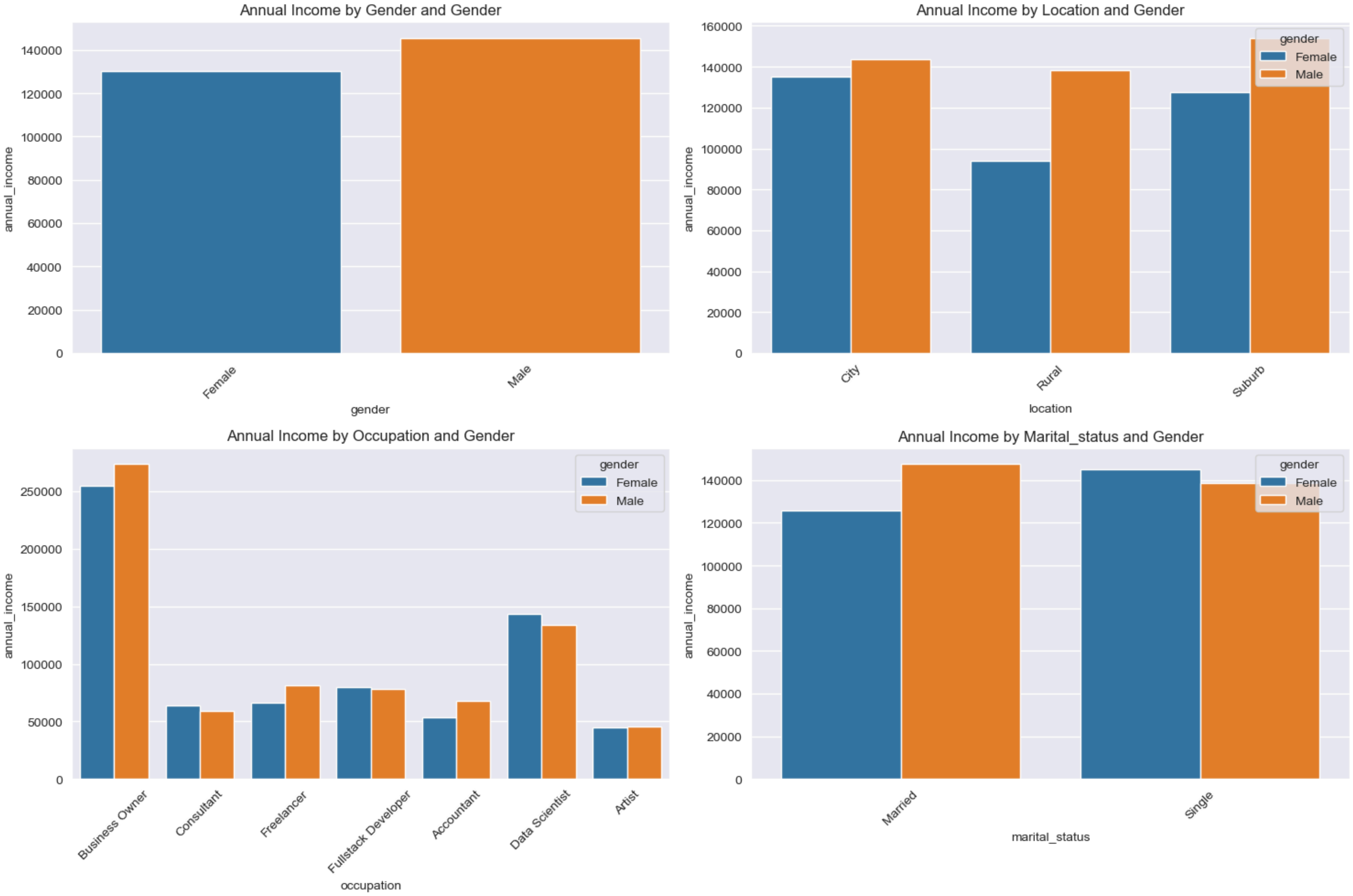
```
sns.catplot( df_income_occupation ,
             kind="bar",
             x = 'occupation',
             y = 'annual_income',
             hue = 'gender',
             errorbar=None,
             palette = 'cool',
             height=6,
             aspect=1.5
             )
plt.xticks(rotation=-45)
plt.title('The distribution of occupation by annual income corresponding to gender')
plt.show()
```



```
In [32]: list_factor = ['gender', 'location','occupation', 'marital_status']
```

In [33]:

```
# Set up the number of rows and columns for subplots (2x2 grid in this case)
n_rows = 2
n_cols = 2
fig, axes = plt.subplots(n_rows, n_cols, figsize=(15, 10))

# Flatten the axes array for easy iteration
axes = axes.flatten()

# Plot each factor as a separate bar chart with 'gender' as hue
for idx, factor in enumerate(list_factor):
    sns.barplot(
        data=df_customers,
        x=factor,
        y='annual_income',
        hue='gender',  # Add hue for gender comparison
        palette='tab10',
        ax=axes[idx],
        errorbar=None
    )
    axes[idx].set_title(f'Annual Income by {factor.capitalize()} and Gender')
    axes[idx].tick_params(axis='x', rotation=45)

# Hide any empty subplots if the number of factors is less than grid size
for j in range(len(list_factor), n_rows * n_cols):
    fig.delaxes(axes[j])

# Adjust layout for better spacing
plt.tight_layout()
plt.show()
```


Annual Income by Gender and Gender

Annual Income by Location and Gender

Annual Income by Occupation and Gender

Annual Income by Marital_status and Gender

2. Explore customers - Age

In [124…

```
df_customers['age'].describe()
```

Out[124…

```
count    1000.000000
mean       36.405000
std        15.666155
min         1.000000
25%        26.000000
50%        32.000000
75%        46.000000
max       135.000000
Name: age, dtype: float64
```

In [125…

```
# Check if any null value in age column ?
df_customers.isnull().sum()
```

Out[125…

```
cust_id           0
name              0
gender            0
age               0
location          0
occupation        0
annual_income    50
marital_status    0
dtype: int64
```

The business manager has told me that age is valid only if it is between 15 and 80 years.

In [126…

```
#Findout the data of range age 15-80
df_customers[(df_customers['age']<15) | (df_customers['age']>80)]
```

Out[126…

```
     cust_id              name  gender  age  location          occupation  annual_income  marital_status
  0        1    Manya Acharya  Female    2      City      Business Owner       358211.0         Married
 41       42      Aaryan Shah    Male  110      City              Artist         7621.0         Married
165      166        Sia Dutta  Female    1      City          Freelancer        39721.0          Single
174      175     Rohan Sharma    Male  110      City          Freelancer        23723.0         Married
222      223      Arjun Batra    Male  110    Suburb          Freelancer       210987.0         Married
277      278     Aarav Tandon    Male  110      City          Consultant        96522.0          Single
295      296     Ayush Pandey    Male    1     Rural          Accountant        55254.0         Married
325      326       Virat Goel    Male  110      City          Accountant        61021.0          Single
610      611      Rehan Verma    Male  135     Rural      Business Owner       444776.0         Married
692      693        Dhruv Jha    Male    1      City      Business Owner        83045.0         Married
703      704     Aanya Sharma  Female  110      City          Freelancer        43404.0          Single
709      710      Anika Verma  Female  110      City      Data Scientist        98417.0         Married
728      729      Rehan Yadav    Male  135      City      Business Owner       382836.0         Married
832      833        Ridhi Raj  Female  110      City Fullstack Developer        95379.0          Single
845      846    Rohan Jaiswal    Male    1      City          Consultant        20838.0         Married
855      856     Aanya Taneja  Female    2      City Fullstack Developer        30689.0         Married
895      896  Krishna Goswami    Male    1      City          Freelancer        31533.0         Married
923      924      Kunal Patel    Male  110      City          Freelancer        51629.0         Married
951      952     Virat Shetty    Male  135      City      Data Scientist        49677.0         Married
991      992        Arya Dube    Male  135      City Fullstack Developer        93267.0          Single
```

In [127…

```
df_customers[(df_customers['age']<15) | (df_customers['age']>80)].shape
```

Out[127…

```
(20, 8)
```

Replace the wrong value in age column

Solution 1

In [128…

```
df_get_median_age = df_customers.groupby('occupation')['age'].median()
df_get_median_age
```

Out[128…

```
occupation
Accountant              31.5
Artist                  26.0
Business Owner          51.0
Consultant              46.0
Data Scientist          32.0
Freelancer              24.0
Fullstack Developer     27.5
Name: age, dtype: float64
```

In [130…

```
df_customers['age'] = df_customers.apply(lambda row: df_get_median_age[row['occupation']]
                                         if (row['age'] < 15) or (row['age'] > 80) else row['age'], axis=1 )
```

In [131…

```
df_customers.iloc[[174,222]]
```

Out[131…

	cust_id	name	gender	age	location	occupation	annual_income	marital_status
174	175	Rohan Sharma	Male	24.0	City	Freelancer	23723.0	Married
222	223	Arjun Batra	Male	24.0	Suburb	Freelancer	210987.0	Married

In [132…

```
#check if any wrong numbers
df_customers[(df_customers['age']<15) | (df_customers['age']>80)].shape
```

Out[132…

```
(0, 8)
```

Solution 2

In [42]:

```
for index, row in df_customers.iterrows():
    if ( row['age'] < 15 or row['age'] > 80):
        df_customers.at[index, 'age'] = df_get_median_age[row['occupation']]
```

In [43]:

```
df_customers[(df_customers['age']<15) | (df_customers['age']>80)].shape
```

Out[43]:

```
(0, 8)
```

In [133…

```
df_customers.describe()
```

Out[133…

	cust_id	age	annual_income
count	1000.000000	1000.000000	950.000000
mean	500.500000	35.541500	139410.314737
std	288.819436	12.276634	112416.802007
min	1.000000	18.000000	2.000000
25%	250.750000	26.000000	47627.500000
50%	500.500000	32.000000	112218.500000
75%	750.250000	44.250000	193137.500000
max	1000.000000	64.000000	449346.000000

3. Analyze customer distribution per age group. Form the following age groups for your analysis,

```
a. Youngsters: 18 to 25 years
b. Mid age professionals: 26 to 48 years
c. Seniors: 49 to 65 years
```

Solution 1 :

In [45]:

```
# df_customers['age_group'] = df_customers['age'].apply(lambda x : 'Youngsters' if 18 <= x <=25
#                                                                       else 'Mid age professionals' if 26
#                                                                                                  else 'Seniors' if 49 <= x <= 65
#                                                                                                   else 'unknow'   )
```

Solution 2 : In term of finding the age group name

In [142…

```
edge = [18,25,48,65]
label = ['18-25','26-48','49-65']
df_customers['age_group'] = pd.cut(df_customers['age'], bins=edge, labels=label)
```

In [47]:

```
df_customers.head()
```

Out[47]:

	cust_id	name	gender	age	location	occupation	annual_income	marital_status	age_group
0	1	Manya Acharya	Female	51.0	City	Business Owner	358211.0	Married	49-65
1	2	Anjali Pandey	Female	47.0	City	Consultant	65172.0	Single	26-48
2	3	Aaryan Chauhan	Male	21.0	City	Freelancer	22378.0	Married	18-25
3	4	Rudra Bali	Male	24.0	Rural	Freelancer	33563.0	Married	18-25
4	5	Advait Malik	Male	48.0	City	Consultant	39406.0	Married	26-48

Analyze age group

In [48]:

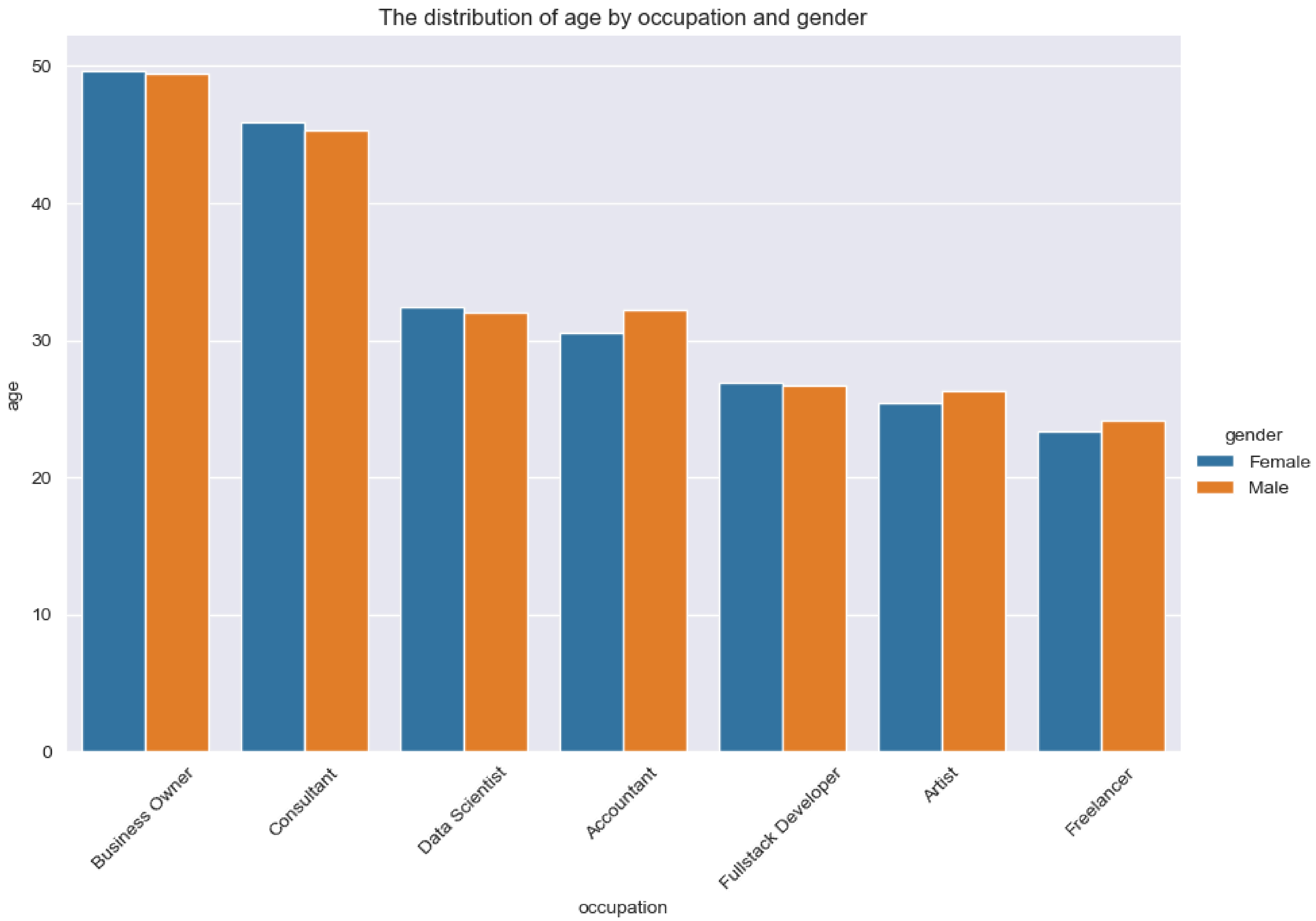
```
df_age = df_customers.groupby(['occupation', 'gender'])['age'].mean().reset_index().sort_values(by='age', ascending
df_age
```

Out[48]:

	occupation	gender	age
4	Business Owner	Female	49.682927
5	Business Owner	Male	49.429952
6	Consultant	Female	45.875000
7	Consultant	Male	45.292308
8	Data Scientist	Female	32.375000
1	Accountant	Male	32.250000
9	Data Scientist	Male	32.066667
0	Accountant	Female	30.500000
12	Fullstack Developer	Female	26.932203
13	Fullstack Developer	Male	26.657303
3	Artist	Male	26.320000
2	Artist	Female	25.461538
11	Freelancer	Male	24.121795
10	Freelancer	Female	23.347222

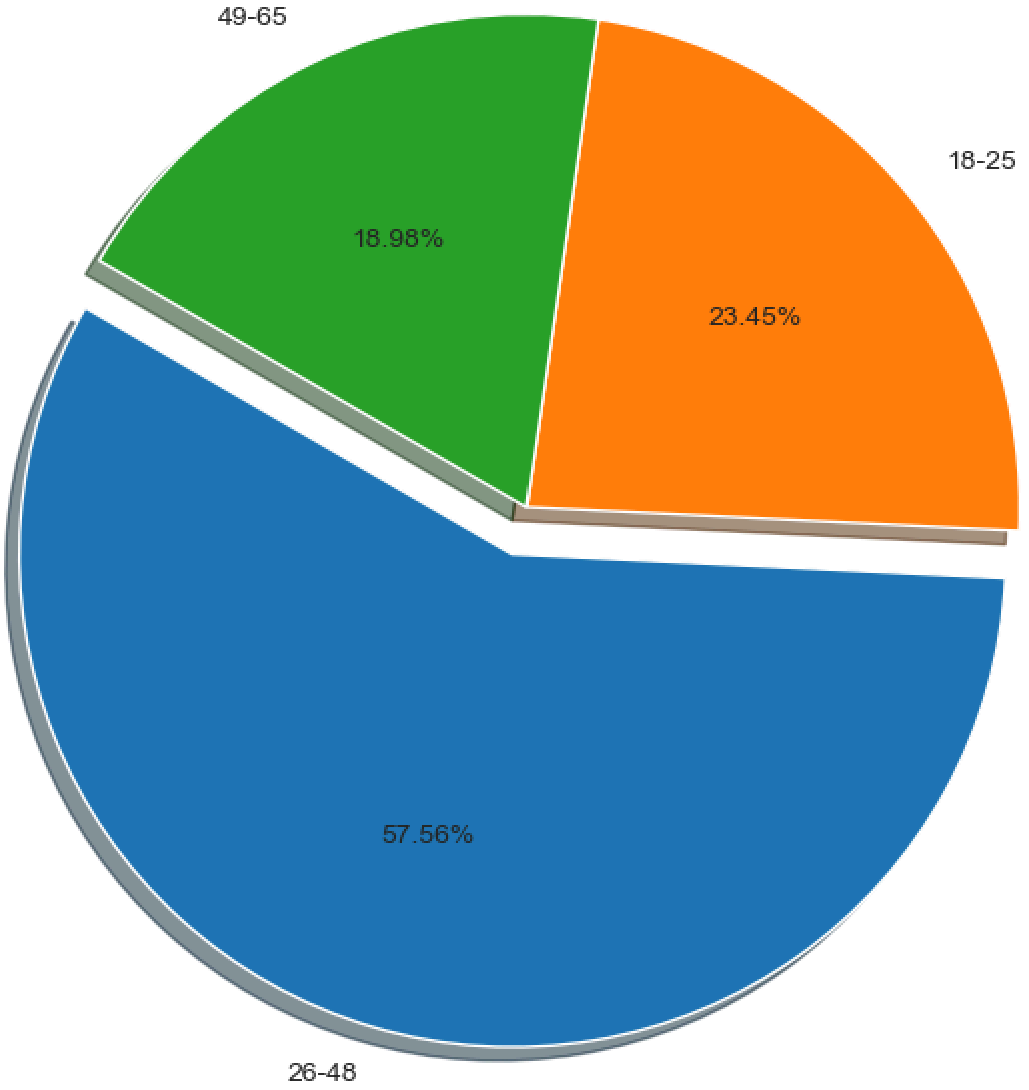
In [49]:

```
# Analyze age by occupation and gender
sns.catplot(df_age, kind='bar', x='occupation', y='age', hue='gender',palette='tab10', height=6, aspect=1.5)
plt.xticks(rotation=45)
plt.title('The distribution of age by occupation and gender')
plt.show()
```



```
In [50]: #Create the pie chart to compare the age group
         df_age_group = df_customers['age_group'].value_counts()
```

```
plt.figure(figsize=(11, 8))
plt.pie(df_age_group, labels = df_age_group.index ,  startangle = 150, autopct='%1.2f%%', explode=(0.1,0,0), shadow
plt.show()
```



4. Analyze customer distribution per location and gender

In [51]:

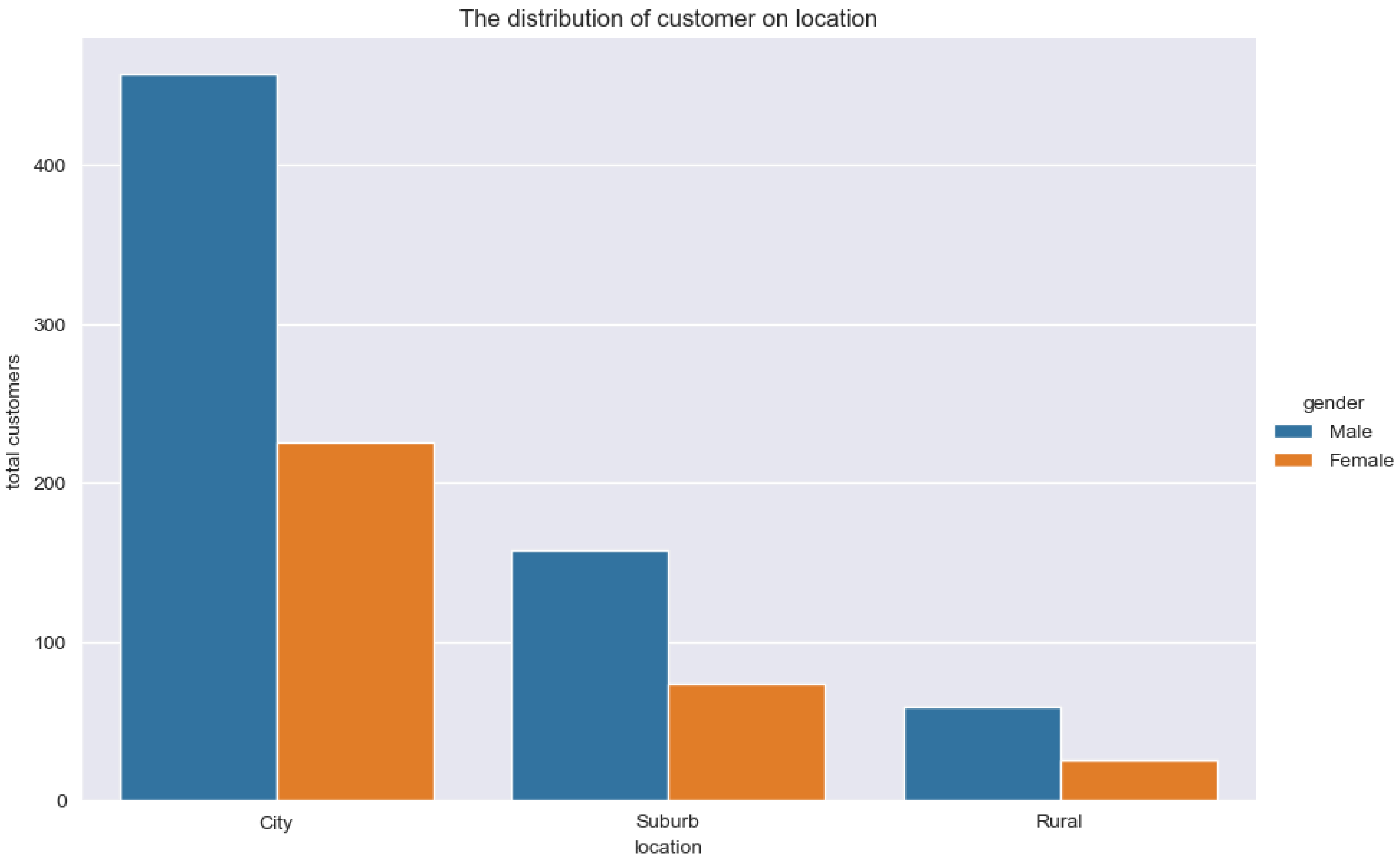
```
df_location_gender = df_customers.groupby('gender')['location'].value_counts().reset_index().sort_values(by='count'
df_location_gender
```

Out[51]:

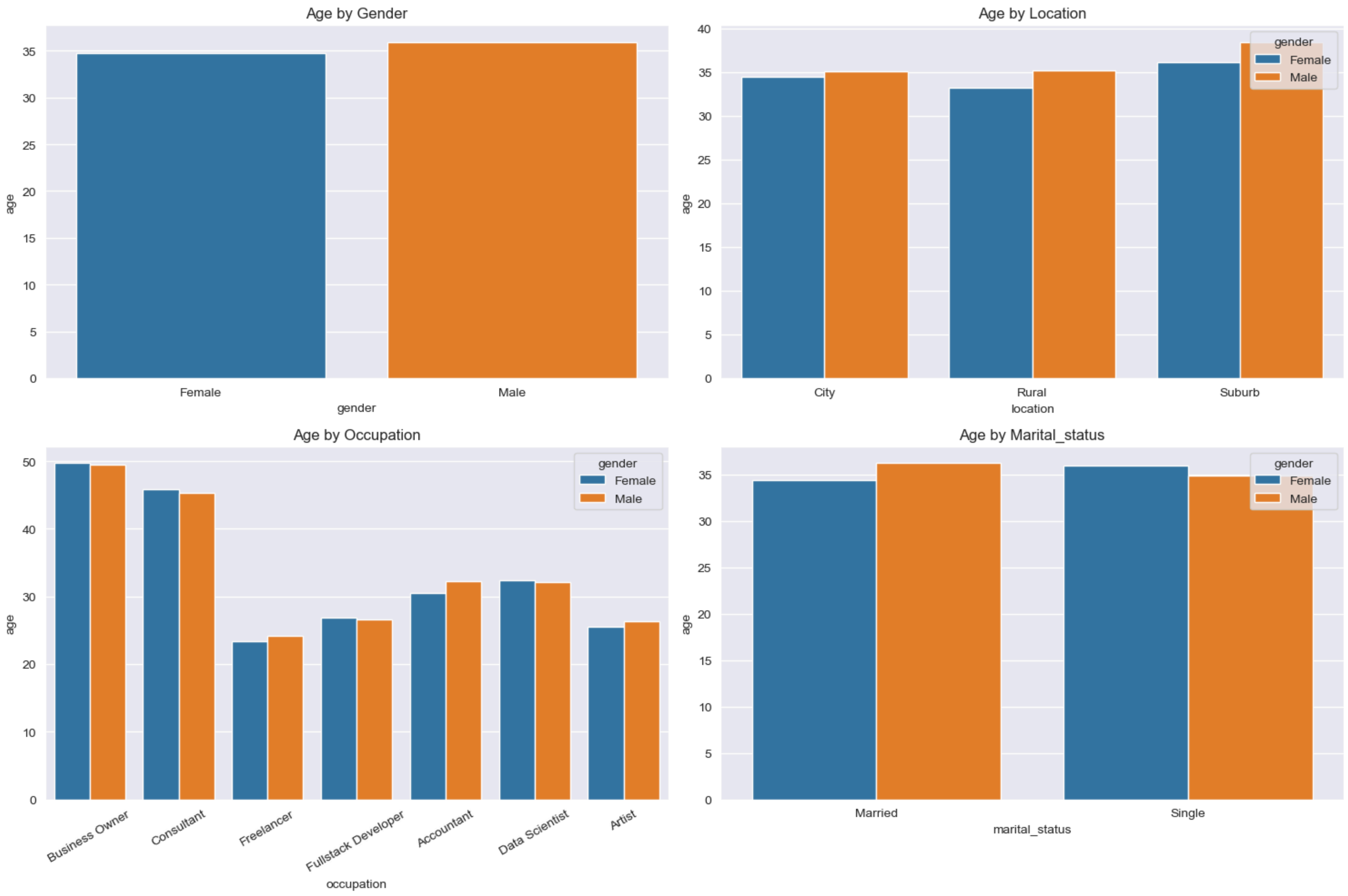
	gender	location	count
3	Male	City	457
0	Female	City	226
4	Male	Suburb	158
1	Female	Suburb	74
5	Male	Rural	59
2	Female	Rural	26

In [52]:

```
sns.catplot(df_location_gender,kind= 'bar', x ='location', y ='count', hue='gender', palette='tab10', height=6, asp
plt.title('The distribution of customer on location')
plt.ylabel('total customers')
plt.show()
```



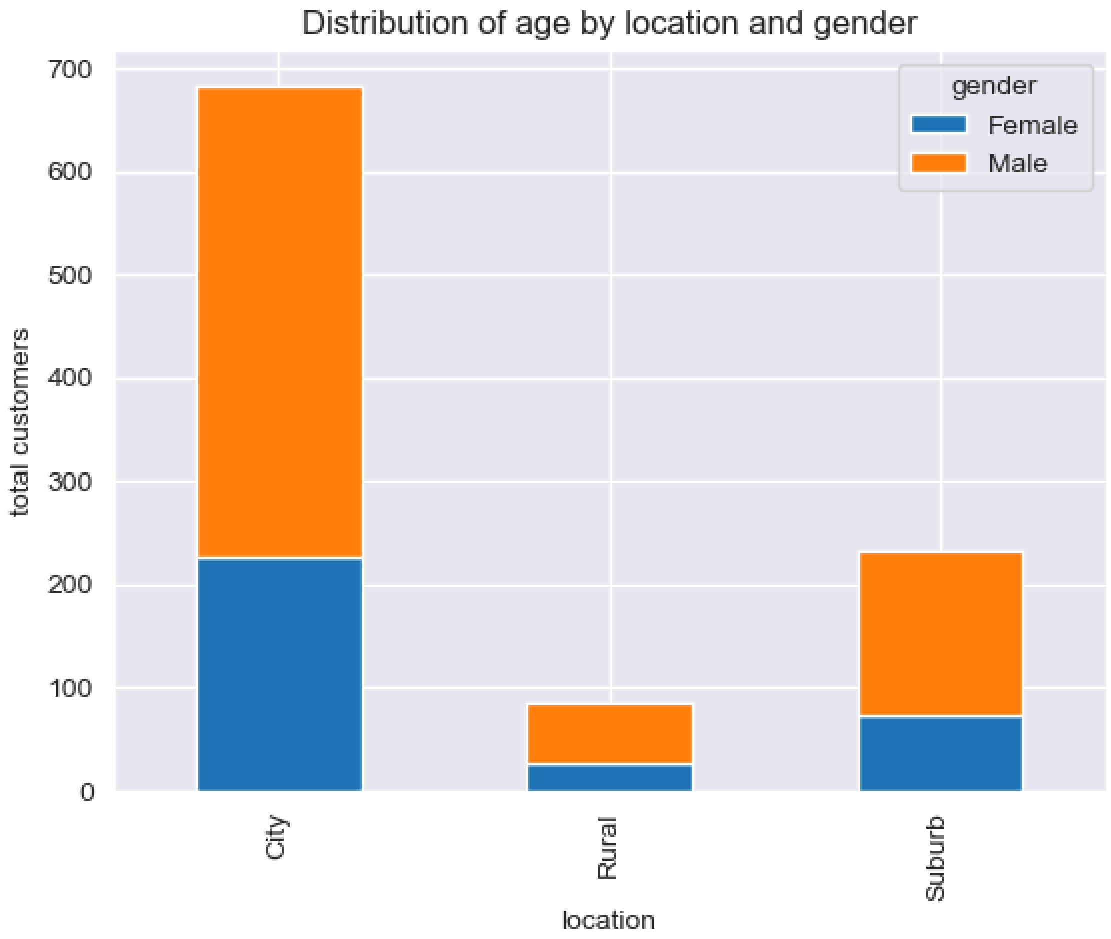
In [53]:
```
n_cols = 2
n_rows = 2
fig, axes = plt.subplots(n_rows, n_cols, figsize=(15, 10))
axes = axes.flatten()
for idx , factor in enumerate(list_factor):
    sns.barplot(
        df_customers,
        x = factor,
        y = 'age',
        hue = 'gender',
        palette = 'tab10',
        ax = axes[idx],
        errorbar = None
    )
    if factor =='occupation':
        axes[idx].tick_params(axis='x', rotation=30)
    axes[idx].set_title(f"Age by {factor.capitalize()}")
plt.tight_layout()
plt.show()
```



In [54]:

```
#stacked chart distribution age by gender on location
df_age_city_location = df_customers.groupby(['location','gender'])['age'].count().unstack('gender')
# df_age_city_location
df_age_city_location.plot(kind='bar', stacked=True, )
```

```
plt.ylabel('total customers')
plt.title('Distribution of age by location and gender')
plt.show()
```



```
In [ ]:
```

Explore Credit profiles Tables

In [55]:
```
df_credit_profile.shape
```

Out[55]:
```
(1004, 6)
```

In [56]:
```
df_credit_profile.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1004 entries, 0 to 1003
Data columns (total 6 columns):
 #   Column                        Non-Null Count  Dtype  
---  ------                        --------------  -----  
 0   cust_id                       1004 non-null   int64  
 1   credit_score                  1004 non-null   int64  
 2   credit_utilisation            1000 non-null   float64
 3   outstanding_debt              1000 non-null   float64
 4   credit_inquiries_last_6_months 1000 non-null   float64
 5   credit_limit                  935 non-null    float64
dtypes: float64(4), int64(2)
memory usage: 47.2 KB
```

In [57]:
```
df_credit_profile.describe()
```

Out[57]:

	cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit
count	1004.000000	1004.000000	1000.000000	1000.000000	1000.000000	935.000000
mean	500.850598	588.655378	0.498950	9683.597000	1.955000	19235.561497
std	288.315670	152.575244	0.233139	25255.893671	1.414559	24489.997195
min	1.000000	300.000000	0.103761	33.000000	0.000000	500.000000
25%	251.750000	459.000000	0.293917	221.000000	1.000000	750.000000
50%	502.500000	601.000000	0.487422	550.000000	2.000000	1250.000000
75%	749.250000	737.250000	0.697829	11819.500000	3.000000	40000.000000
max	1000.000000	799.000000	0.899648	209901.000000	4.000000	60000.000000

Clean duplicated from customer id. Because we may see the count is 1004 but the max is 1000, that's mean this data has the duplicated data.

In [58]:

```
df_credit_profile[df_credit_profile['cust_id'].duplicated(keep=False)]
```

Out[58]:

	cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit
516	517	308	NaN	NaN	NaN	NaN
517	517	308	0.113860	33.0	3.0	500.0
569	569	344	NaN	NaN	NaN	NaN
570	569	344	0.112599	37.0	0.0	500.0
607	606	734	NaN	NaN	NaN	NaN
608	606	734	0.193418	4392.0	1.0	40000.0
664	662	442	NaN	NaN	NaN	NaN
665	662	442	0.856039	266.0	2.0	500.0

In [59]:

```
df_credit_profile_clean_dup=df_credit_profile.drop_duplicates(subset='cust_id', keep='last')
```

In [60]:

```
df_credit_profile_clean_dup[df_credit_profile_clean_dup['cust_id'].duplicated(keep=False)].shape
```

Out[60]:

```
(0, 6)
```

In [61]:

```
df_credit_profile_clean_dup.head()
```

Out[61]:

	cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit
0	1	749	0.585171	19571.0	0.0	40000.0
1	2	587	0.107928	161644.0	2.0	1250.0
2	3	544	0.854807	513.0	4.0	1000.0
3	4	504	0.336938	224.0	2.0	1000.0
4	5	708	0.586151	18090.0	2.0	40000.0

Check if any null value in new data set

In [62]:

```
df_credit_profile_clean_dup.isna().sum()
```

Out[62]:

```
cust_id                            0
credit_score                       0
credit_utilisation                 0
outstanding_debt                   0
credit_inquiries_last_6_months     0
credit_limit                      65
dtype: int64
```

In [63]:

```
df_credit_profile_clean_dup[df_credit_profile_clean_dup['credit_limit'].isnull()]
```

Out[63]:

	cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit
10	11	679	0.557450	9187.0	2.0	NaN
35	36	790	0.112535	4261.0	1.0	NaN
37	38	514	0.296971	238.0	2.0	NaN
45	46	761	0.596041	24234.0	2.0	NaN
64	65	734	0.473715	13631.0	0.0	NaN
...	...	...	...	...	...	...
912	909	479	0.487555	320.0	3.0	NaN
931	928	311	0.832244	316.0	2.0	NaN
948	945	526	0.272734	227.0	1.0	NaN
954	951	513	0.175914	131.0	3.0	NaN
957	954	783	0.867421	46451.0	0.0	NaN

65 rows × 6 columns

In [64]:

```
df_credit_profile_clean_dup['credit_limit'].unique()
```

Out[64]:

```
array([40000.,  1250.,  1000.,   500.,   750.,    nan,  1500., 60000.,
       20000.])
```

We know the credit score range are from 300-900. So that we will define the range of credit score corresponding with credit limit

In [65]:

```
range_credit = [300,450,500,550,600,650,700,750,800]
labels_range_credit = [f"{range_credit[i]}-{range_credit[i+1]-1}" for i in range(len(range_credit) - 1)]
df_credit_profile_clean_dup.loc[:, 'credit_range'] = pd.cut(df_credit_profile_clean_dup['credit_score'], bins=range
/var/folders/q3/xgl4pwjd7lbg8skj81tsl0xr0000gn/T/ipykernel_17788/2857584911.py:3: 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#returnin
g-a-view-versus-a-copy
  df_credit_profile_clean_dup.loc[:, 'credit_range'] = pd.cut(df_credit_profile_clean_dup['credit_score'], bins=rang
e_credit, labels=labels_range_credit, right=False)
```

In [66]:

```
df_credit_profile_clean_dup.head()
```

Out[66]:

	cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit	credit_range
0	1	749	0.585171	19571.0	0.0	40000.0	700-749
1	2	587	0.107928	161644.0	2.0	1250.0	550-599
2	3	544	0.854807	513.0	4.0	1000.0	500-549
3	4	504	0.336938	224.0	2.0	1000.0	500-549
4	5	708	0.586151	18090.0	2.0	40000.0	700-749

In [ ]:

In [67]:

```
get_value_credit_range = df_credit_profile_clean_dup.groupby('credit_range')['credit_limit'].median()
get_value_credit_range
```

```
/var/folders/q3/xgl4pwjd7lbg8skj81tsl0xr0000gn/T/ipykernel_17788/896319512.py:1: FutureWarning: The default of obser
ved=False is deprecated and will be changed to True in a future version of pandas. Pass observed=False to retain cur
rent behavior or observed=True to adopt the future default and silence this warning.
  get_value_credit_range = df_credit_profile_clean_dup.groupby('credit_range')['credit_limit'].median()
```

```
Out[67]: credit_range
         300-449      500.0
         450-499      750.0
         500-549     1000.0
         550-599     1250.0
         600-649     1500.0
         650-699    20000.0
         700-749    40000.0
         750-799    60000.0
         Name: credit_limit, dtype: float64
```

Replace N/A from credit limit by taking the value from the credit range

Solution 1

```
In [68]: get_value_credit_range['750-799']
```

```
Out[68]: 60000.0
```

```
In [69]: df_credit_profile_clean_dup['credit_limit']=df_credit_profile_clean_dup.apply(lambda row: get_value_credit_range[ro
                                                                                       if pd.isnull(row['credit_limit']) els
```

```
/var/folders/q3/xgl4pwjd7lbg8skj81tsl0xr0000gn/T/ipykernel_17788/965864600.py:1: 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#returnin
g-a-view-versus-a-copy
  df_credit_profile_clean_dup['credit_limit']=df_credit_profile_clean_dup.apply(lambda row: get_value_credit_range[r
ow['credit_range']]
```

```
In [70]: df_credit_profile_clean_dup.isnull().sum()
```

```
Out[70]: cust_id                           0
         credit_score                      0
         credit_utilisation                0
         outstanding_debt                  0
         credit_inquiries_last_6_months    0
         credit_limit                      0
         credit_range                      0
         dtype: int64
```

```
In [71]: df_credit_profile_clean_dup.loc[[954,957]]
```

Out[71]:

	cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit	credit_range
954	951	513	0.175914	131.0	3.0	1000.0	500-549
957	954	783	0.867421	46451.0	0.0	60000.0	750-799

Check the outliers of this data set

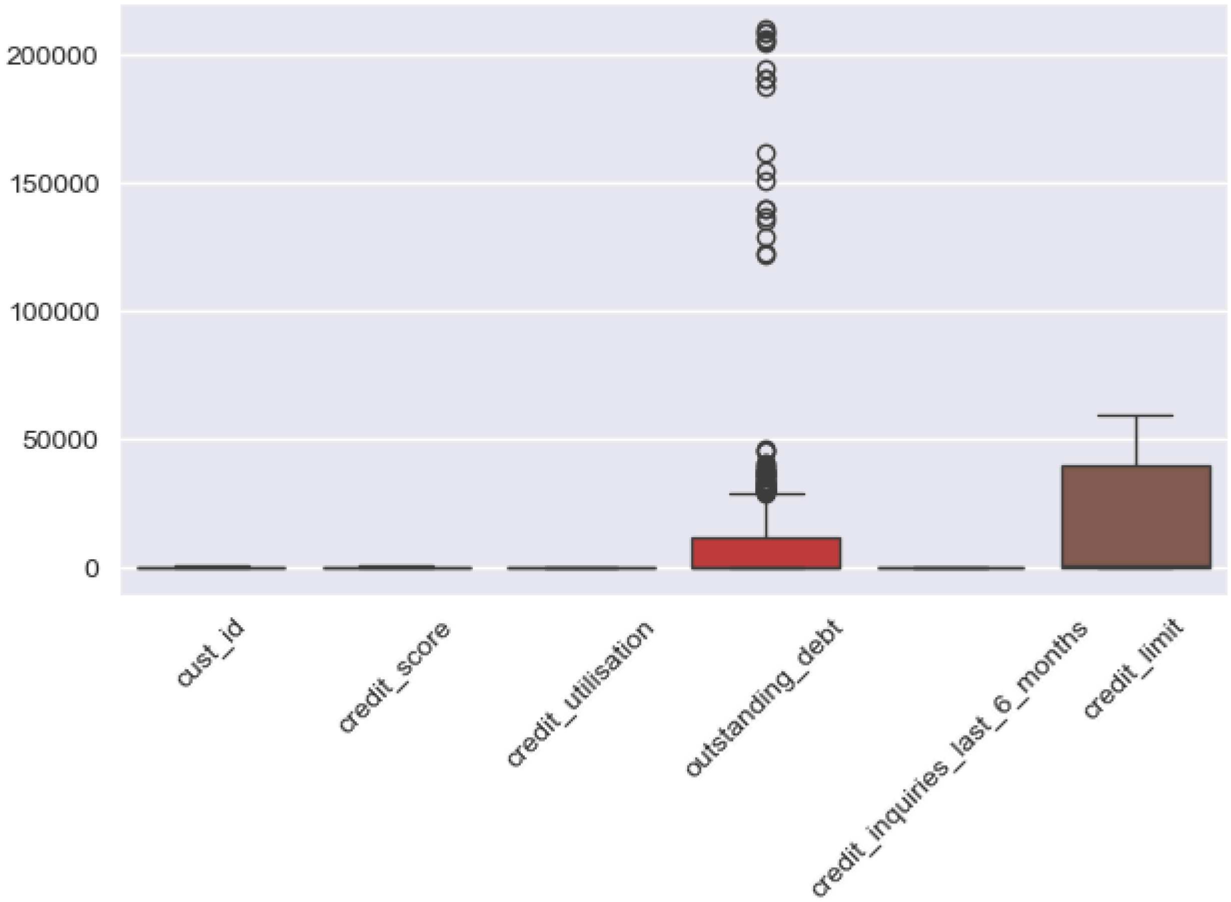
```
In [72]: df_credit_profile_clean_dup.describe()
```

Out[72]:

	cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit
count	1000.000000	1000.000000	1000.000000	1000.000000	1000.000000	1000.00000
mean	500.500000	589.182000	0.498950	9683.597000	1.955000	19733.75000
std	288.819436	152.284929	0.233139	25255.893671	1.414559	24717.43818
min	1.000000	300.000000	0.103761	33.000000	0.000000	500.00000
25%	250.750000	460.000000	0.293917	221.000000	1.000000	750.00000
50%	500.500000	601.500000	0.487422	550.000000	2.000000	1500.00000
75%	750.250000	738.000000	0.697829	11819.500000	3.000000	40000.00000
max	1000.000000	799.000000	0.899648	209901.000000	4.000000	60000.00000

The column outstanding_debt has issue because we may see the min, mean and std are very small than maximum debt, so that this has outliers value

```
In [73]: #Use boxplot to try to check firstly
         sns.boxplot(df_credit_profile_clean_dup)
         plt.xticks(rotation=45)
         plt.tight_layout()
         plt.show()
```



The chart above showed that the outstanding_debt apparently outliers value

We need to talk with project manager about the outliers and been confirmed that that limit debt can not be greater than credit limit ---> So that we will replace any outliers which higher than credit limit by credit limit number

```
In [74]: df_credit_profile_clean_dup[df_credit_profile_clean_dup['outstanding_debt']> df_credit_profile_clean_dup['credit_li
```

```
Out[74]: (20, 7)
```

```
In [75]: df_credit_profile_clean_dup[df_credit_profile_clean_dup['outstanding_debt']> df_credit_profile_clean_dup['credit_li
```

Out[75]:

	cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit	credit_range
1	2	587	0.107928	161644.0	2.0	1250.0	550-599
19	20	647	0.439132	205014.0	3.0	1500.0	600-649
25	26	758	0.250811	190838.0	2.0	60000.0	750-799
38	39	734	0.573023	122758.0	3.0	40000.0	700-749
93	94	737	0.739948	137058.0	2.0	40000.0	700-749
204	205	303	0.364360	187849.0	0.0	500.0	300-449
271	272	703	0.446886	154568.0	1.0	40000.0	700-749
301	302	722	0.608076	122402.0	4.0	40000.0	700-749
330	331	799	0.363420	208898.0	4.0	60000.0	750-799
350	351	320	0.285081	150860.0	0.0	500.0	300-449
446	447	754	0.178394	206191.0	2.0	60000.0	750-799
545	545	764	0.337769	135112.0	2.0	60000.0	750-799
639	637	420	0.323984	140063.0	4.0	500.0	300-449
649	647	498	0.658087	128818.0	3.0	750.0	450-499
702	699	775	0.385100	190717.0	2.0	60000.0	750-799
727	724	465	0.658173	140008.0	3.0	750.0	450-499
729	726	737	0.136048	205404.0	4.0	40000.0	700-749
734	731	626	0.762245	209901.0	2.0	1500.0	600-649
770	767	473	0.611750	195004.0	1.0	750.0	450-499
866	863	792	0.399555	208406.0	3.0	60000.0	750-799

Solution 1: Replace outliers value by apply lambda function

In [76]:

```
#Replace outliers from outstanding_debt by credit_limit
df_credit_profile_clean_dup['outstanding_debt'] = df_credit_profile_clean_dup.apply(lambda row: row['credit_limit']
                                                                                    if row['outstanding_debt'] > ro
```

```
/var/folders/q3/xgl4pwjd7lbg8skj81tsl0xr0000gn/T/ipykernel_17788/1042300203.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#returnin
g-a-view-versus-a-copy
  df_credit_profile_clean_dup['outstanding_debt'] = df_credit_profile_clean_dup.apply(lambda row: row['credit_limi
t']
```

Solution 2 : Replace outliers value by dataframe.at

In [77]:

```
for index, row in df_credit_profile_clean_dup.iterrows():
    if row['outstanding_debt'] > row['credit_limit']:
        df_credit_profile_clean_dup.at[index, 'outstanding_debt'] = row['credit_limit']
```

Solution 3 : Replace outliers value Using loc

In [78]:

```
df_credit_profile_clean_dup.loc[df_credit_profile_clean_dup['outstanding_debt']> df_credit_profile_clean_dup['credi
```

In [79]:

```
#Check if any value still outliers
df_credit_profile_clean_dup[df_credit_profile_clean_dup['outstanding_debt']> df_credit_profile_clean_dup['credit_li
```

Out[79]:

cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit	credit_range

In [80]:

```
df_credit_profile_clean_dup.loc[[330,350]]
```

Out[80]:

	cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit	credit_range
330	331	799	0.363420	60000.0	4.0	60000.0	750-799
350	351	320	0.285081	500.0	0.0	500.0	300-449

In [ ]:

```

```

Determine their correlation between Customer with theire Credit profile </center>?

In [81]:

```
df_customers.head()
```

Out[81]:

	cust_id	name	gender	age	location	occupation	annual_income	marital_status	age_group
0	1	Manya Acharya	Female	51.0	City	Business Owner	358211.0	Married	49-65
1	2	Anjali Pandey	Female	47.0	City	Consultant	65172.0	Single	26-48
2	3	Aaryan Chauhan	Male	21.0	City	Freelancer	22378.0	Married	18-25
3	4	Rudra Bali	Male	24.0	Rural	Freelancer	33563.0	Married	18-25
4	5	Advait Malik	Male	48.0	City	Consultant	39406.0	Married	26-48

In [82]:

```
df_credit_profile_clean_dup.head()
```

Out[82]:

	cust_id	credit_score	credit_utilisation	outstanding_debt	credit_inquiries_last_6_months	credit_limit	credit_range
0	1	749	0.585171	40000.0	0.0	40000.0	700-749
1	2	587	0.107928	1250.0	2.0	1250.0	550-599
2	3	544	0.854807	1000.0	4.0	1000.0	500-549
3	4	504	0.336938	1000.0	2.0	1000.0	500-549
4	5	708	0.586151	40000.0	2.0	40000.0	700-749

In [83]:

```
#Merge two table
df_customer_credit_merged = pd.merge(df_customers, df_credit_profile_clean_dup, on='cust_id', how='inner')
df_customer_credit_merged.head()
```

Out[83]:

	cust_id	name	gender	age	location	occupation	annual_income	marital_status	age_group	credit_score	credit_utilisatio
0	1	Manya Acharya	Female	51.0	City	Business Owner	358211.0	Married	49-65	749	0.58517
1	2	Anjali Pandey	Female	47.0	City	Consultant	65172.0	Single	26-48	587	0.10792
2	3	Aaryan Chauhan	Male	21.0	City	Freelancer	22378.0	Married	18-25	544	0.85480
3	4	Rudra Bali	Male	24.0	Rural	Freelancer	33563.0	Married	18-25	504	0.33693
4	5	Advait Malik	Male	48.0	City	Consultant	39406.0	Married	26-48	708	0.58615

In [84]:

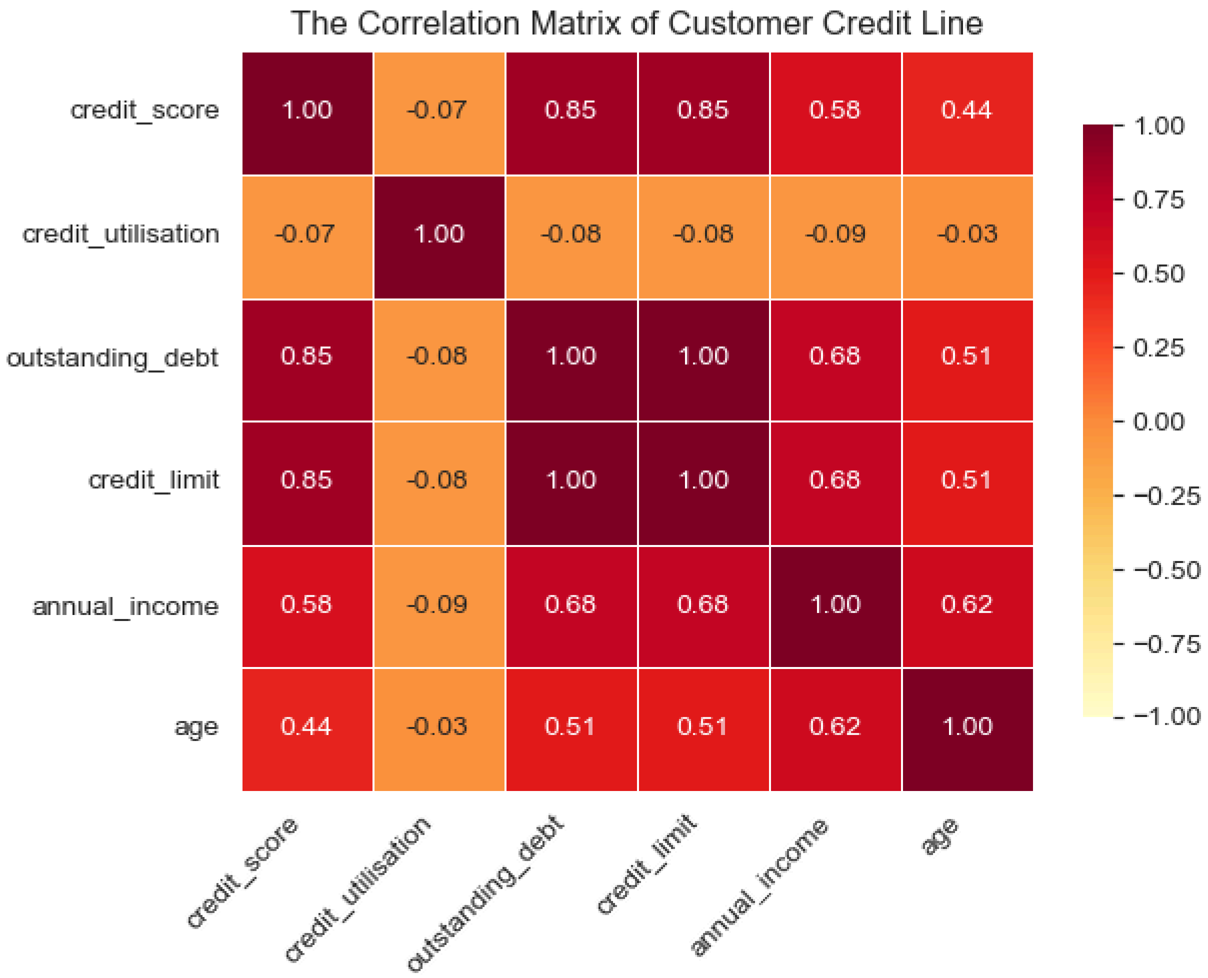
```
correlation_matrix = df_customer_credit_merged[['credit_score','credit_utilisation','outstanding_debt','credit_limi
correlation_matrix
```

Out[84]:

	credit_score	credit_utilisation	outstanding_debt	credit_limit	annual_income	age
credit_score	1.000000	-0.070445	0.847952	0.847952	0.575751	0.444917
credit_utilisation	-0.070445	1.000000	-0.080493	-0.080493	-0.086368	-0.027713
outstanding_debt	0.847952	-0.080493	1.000000	1.000000	0.684775	0.510993
credit_limit	0.847952	-0.080493	1.000000	1.000000	0.684775	0.510993
annual_income	0.575751	-0.086368	0.684775	0.684775	1.000000	0.619037
age	0.444917	-0.027713	0.510993	0.510993	0.619037	1.000000

In [85]:

```
sns.heatmap(
    correlation_matrix, annot=True, fmt=".2f", cmap='YlOrRd',
    linewidths=0.5, vmin=-1, vmax=1, cbar_kws={'shrink': .8}
)
plt.xticks(rotation=45, ha='right')
plt.yticks(rotation=0)
plt.title('The Correlation Matrix of Customer Credit Line')
plt.show()
# cmap : YlOrRd, YlGnBu, hot, coolwarm, magma and inferno
```



```
In [ ]:
```

Analyze Transactions

```
In [86]: import pandas as pd
         import numpy as np
         import matplotlib.pyplot as plt
         import seaborn as sns
         from bokeh.layouts import row
         from distributed.utils import palette
         from pyasn1_modules.rfc2985 import gender
         from sqlalchemy import custom_op

         path_avg_transaction = '''/Users/ricky/Downloads/DATA ANALYST BOOSTCAMP/Booscamp DATA/Mathematic/Industry Project/B
         path_credit_profile = '''/Users/ricky/Downloads/DATA ANALYST BOOSTCAMP/Booscamp DATA/Mathematic/Industry Project/Ba
         path_customers = '/Users/ricky/Downloads/DATA ANALYST BOOSTCAMP/Booscamp DATA/Mathematic/Industry Project/Bank/data
         path_transactions = '''/Users/ricky/Downloads/DATA ANALYST BOOSTCAMP/Booscamp DATA/Mathematic/Industry Project/Bank
         df_transactions = pd.read_csv(path_transactions)
         df_avg_transactions = pd.read_csv(path_avg_transaction)
         df_credit_profile = pd.read_csv(path_credit_profile)
         df_customers = pd.read_csv(path_customers)
```

In [87]:

```
df_transactions.shape
```

Out[87]:

```
(500000, 7)
```

In [88]:

```
df_transactions.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 500000 entries, 0 to 499999
Data columns (total 7 columns):
 #   Column            Non-Null Count   Dtype 
---  ------            --------------   ----- 
 0   tran_id           500000 non-null  int64 
 1   cust_id           500000 non-null  int64 
 2   tran_date         500000 non-null  object
 3   tran_amount       500000 non-null  int64 
 4   platform          495059 non-null  object
 5   product_category  500000 non-null  object
 6   payment_type      500000 non-null  object
dtypes: int64(3), object(4)
memory usage: 26.7+ MB
```

In [89]:

```
df_transactions.describe()
```

Out[89]:

	tran_id	cust_id	tran_amount
count	500000.000000	500000.000000	500000.00000
mean	250000.500000	501.400428	3225.20733
std	144337.711634	288.641924	13098.74276
min	1.000000	1.000000	0.00000
25%	125000.750000	252.000000	64.00000
50%	250000.500000	502.000000	141.00000
75%	375000.250000	752.000000	397.00000
max	500000.000000	1000.000000	69999.00000

check null value

In [90]:

```
df_transactions.isnull().sum()
```

Out[90]:

```
tran_id                0
cust_id                0
tran_date              0
tran_amount            0
platform            4941
product_category       0
payment_type           0
dtype: int64
```

In [91]:

```
df_transactions[df_transactions['platform'].isnull()].shape
```

Out[91]:

```
(4941, 7)
```

In [92]:

```
df_transactions['platform'].unique()
```

Out[92]:

```
array(['Flipkart', 'Alibaba', 'Shopify', 'Amazon', 'Ebay', 'Meesho',
       'Cred', nan], dtype=object)
```

In [93]:

```
platform_count = df_transactions['platform'].value_counts().reset_index().sort_values('count', ascending=False)
platform_count
```

Out[93]:

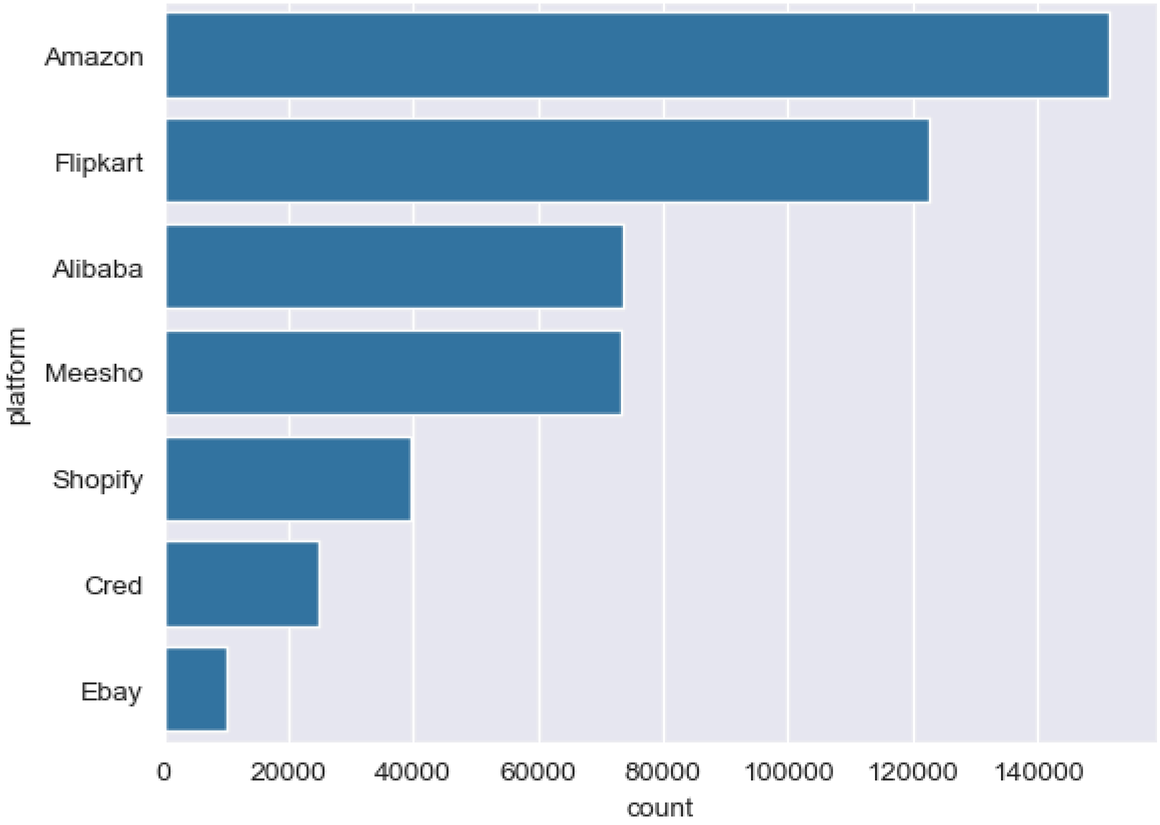
	platform	count
0	Amazon	151443
1	Flipkart	122660
2	Alibaba	73584
3	Meesho	73271
4	Shopify	39416
5	Cred	24741
6	Ebay	9944

In [94]:

```
sns.barplot(platform_count, y = 'platform', x = 'count')
```

Out[94]:

```
<Axes: xlabel='count', ylabel='platform'>
```



We may see the most platform user using is Amazon, so that for 4941 N/A value, we're going to replace by Amazon

```
In [95]: df_transactions['platform']=df_transactions['platform'].fillna('Amazon')
```

```
In [96]: df_transactions.isnull().sum()
```

Out[96]:

```
tran_id             0
cust_id             0
tran_date           0
tran_amount         0
platform            0
product_category    0
payment_type        0
dtype: int64
```

Check outliers

The project manager had confirmed the transaction amount could not be zero

In [97]:

```
df_transactions.describe()
```

Out[97]:

	tran_id	cust_id	tran_amount
count	500000.000000	500000.000000	500000.00000
mean	250000.500000	501.400428	3225.20733
std	144337.711634	288.641924	13098.74276
min	1.000000	1.000000	0.00000
25%	125000.750000	252.000000	64.00000
50%	250000.500000	502.000000	141.00000
75%	375000.250000	752.000000	397.00000
max	500000.000000	1000.000000	69999.00000

In [98]:

```
df_trans_zero = df_transactions[df_transactions['tran_amount']==0]
df_trans_zero
```

Out[98]:

	tran_id	cust_id	tran_date	tran_amount	platform	product_category	payment_type
120	121	440	2023-01-01	0	Amazon	Electronics	Credit Card
141	142	839	2023-01-01	0	Amazon	Electronics	Credit Card
517	518	147	2023-01-01	0	Amazon	Electronics	Credit Card
533	534	891	2023-01-01	0	Amazon	Electronics	Credit Card
586	587	108	2023-01-01	0	Amazon	Electronics	Credit Card
...	...	...	...	...	...	...	...
499326	499327	695	2023-09-05	0	Amazon	Electronics	Credit Card
499494	499495	295	2023-09-05	0	Amazon	Electronics	Credit Card
499708	499709	141	2023-09-05	0	Amazon	Electronics	Credit Card
499928	499929	4	2023-09-05	0	Amazon	Electronics	Credit Card
499972	499973	224	2023-09-05	0	Amazon	Electronics	Credit Card

4734 rows × 7 columns

In [99]:

```
df_trans_zero[['platform','product_category','payment_type']].value_counts()
```

Out[99]:

```
platform  product_category  payment_type
Amazon    Electronics       Credit Card     4734
Name: count, dtype: int64
```

In [100…

```
# ==> The table of count value above showed us all zero amount is come from platform Amazon, product_category Elect
# Get the table with 3 type of zero tran amount
df_trans_other =df_transactions[(df_transactions['product_category']=='Electronics')&(df_transactions['platform']==
df_trans_other
```

Out[100…

	tran_id	cust_id	tran_date	tran_amount	platform	product_category	payment_type
109	110	887	2023-01-01	635	Amazon	Electronics	Credit Card
120	121	440	2023-01-01	0	Amazon	Electronics	Credit Card
141	142	839	2023-01-01	0	Amazon	Electronics	Credit Card
173	174	676	2023-01-01	60439	Amazon	Electronics	Credit Card
190	191	763	2023-01-01	697	Amazon	Electronics	Credit Card
...	...	...	...	...	...	...	...
499812	499813	688	2023-09-05	425	Amazon	Electronics	Credit Card
499860	499861	373	2023-09-05	480	Amazon	Electronics	Credit Card
499885	499886	520	2023-09-05	643	Amazon	Electronics	Credit Card
499928	499929	4	2023-09-05	0	Amazon	Electronics	Credit Card
499972	499973	224	2023-09-05	0	Amazon	Electronics	Credit Card

15637 rows × 7 columns

In [101…

```
df_trans_other_non_zero=df_trans_other[df_trans_other['tran_amount']>0]
df_trans_other_non_zero
```

Out[101…

	tran_id	cust_id	tran_date	tran_amount	platform	product_category	payment_type
109	110	887	2023-01-01	635	Amazon	Electronics	Credit Card
173	174	676	2023-01-01	60439	Amazon	Electronics	Credit Card
190	191	763	2023-01-01	697	Amazon	Electronics	Credit Card
263	264	528	2023-01-01	421	Amazon	Electronics	Credit Card
311	312	936	2023-01-01	537	Amazon	Electronics	Credit Card
...	...	...	...	...	...	...	...
499766	499767	723	2023-09-05	909	Amazon	Electronics	Credit Card
499793	499794	586	2023-09-05	304	Amazon	Electronics	Credit Card
499812	499813	688	2023-09-05	425	Amazon	Electronics	Credit Card
499860	499861	373	2023-09-05	480	Amazon	Electronics	Credit Card
499885	499886	520	2023-09-05	643	Amazon	Electronics	Credit Card

10903 rows × 7 columns

In [102…

```
tran_median = df_trans_other_non_zero['tran_amount'].median()
tran_median
```

Out[102…

```
554.0
```

In [103…

```
df_transactions['tran_amount']=df_transactions['tran_amount'].replace(0,tran_median)
```

In [104…

```
df_transactions[df_transactions['tran_amount']==0]
```

Out[104…

tran_id	cust_id	tran_date	tran_amount	platform	product_category	payment_type

In [105…

```
df_transactions.describe()
```

Out[105…

	tran_id	cust_id	tran_amount
count	500000.000000	500000.000000	500000.000000
mean	250000.500000	501.400428	3230.452602
std	144337.711634	288.641924	13097.561071
min	1.000000	1.000000	2.000000
25%	125000.750000	252.000000	66.000000
50%	250000.500000	502.000000	146.000000
75%	375000.250000	752.000000	413.000000
max	500000.000000	1000.000000	69999.000000

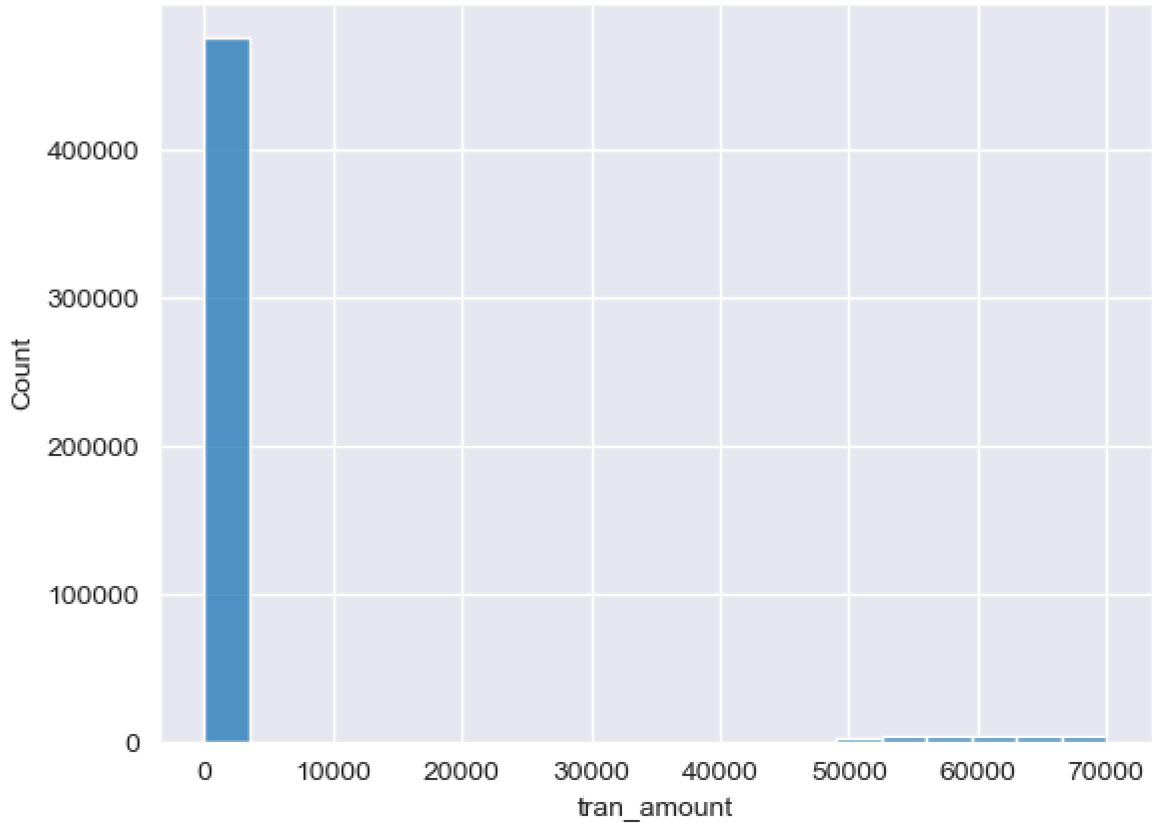
Check outliers tran_amount column

In [106…

```
sns.histplot(df_transactions['tran_amount'], bins=20)
```

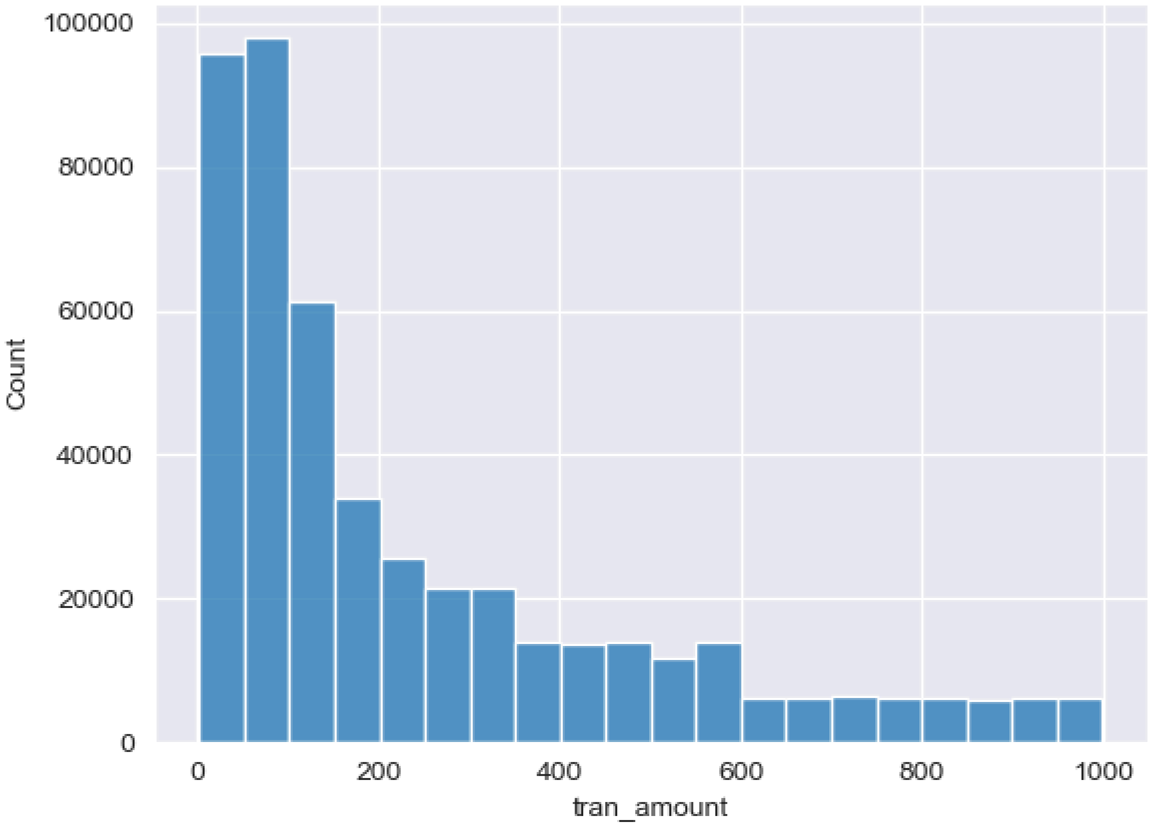
Out[106…

```
<Axes: xlabel='tran_amount', ylabel='Count'>
```



Try to check if tran amout < 10000 and get the idea of skewed right.

```
In [107…  sns.histplot(df_transactions[df_transactions['tran_amount']<10000].tran_amount, bins= 20)

Out[107…  <Axes: xlabel='tran_amount', ylabel='Count'>
```



Because of skewed right, we will determine the outliers by IQR

```
In [108…
Q1 = df_transactions['tran_amount'].quantile(0.25)
Q3 = df_transactions['tran_amount'].quantile(0.75)
IQR = Q3 - Q1
IQR
```

```
Out[108…
347.0
```

```
In [109…
higher_limit_IQR = Q3 + 2*IQR
higher_limit_IQR
```

```
Out[109…
1107.0
```

Check outliers

In [110…

```
df_transactions[df_transactions['tran_amount']>higher_limit_IQR].shape
```

Out[110…

```
(25000, 7)
```

In [111…

```
df_transactions[df_transactions['tran_amount']>higher_limit_IQR]
```

Out[111…

	tran_id	cust_id	tran_date	tran_amount	platform	product_category	payment_type
26	27	380	2023-01-01	61963	Shopify	Beauty & Personal Care	Credit Card
49	50	287	2023-01-01	57869	Amazon	Toys & Games	Gpay
94	95	770	2023-01-01	52881	Ebay	Kitchen Appliances	Credit Card
104	105	549	2023-01-01	58574	Flipkart	Fashion & Apparel	Gpay
113	114	790	2023-01-01	51669	Shopify	Kitchen Appliances	Credit Card
...	...	...	...	...	...	...	...
499742	499743	868	2023-09-05	55131	Meesho	Fashion & Apparel	Gpay
499888	499889	614	2023-09-05	59679	Meesho	Fashion & Apparel	Net Banking
499900	499901	811	2023-09-05	60184	Flipkart	Sports	Debit Card
499966	499967	662	2023-09-05	54678	Meesho	Sports	Gpay
499996	499997	569	2023-09-05	53022	Meesho	Fashion & Apparel	Net Banking

25000 rows × 7 columns

Get median of product category to clarify median tran_amount of each

In [112…

```
df_get_median_product = df_transactions.groupby('product_category')['tran_amount'].median()
df_get_median_product
```

Out[112...

```
product_category
Beauty & Personal Care     97.0
Books                      31.0
Electronics               554.0
Fashion & Apparel          68.0
Garden & Outdoor          132.0
Home Decor                319.0
Kitchen Appliances        186.0
Sports                    283.0
Toys & Games               53.0
Name: tran_amount, dtype: float64
```

Solution 1

In [113...

```
df_transactions['tran_amount'] = df_transactions.apply(lambda row: df_get_median_product[row['product_category']]
                                                       if row['tran_amount']>higher_limit_IQR
                                                       else row['tran_amount'] , axis=1)
```

In [114...

```
# Check if any outliers which higher than limit
df_transactions[df_transactions['tran_amount']>higher_limit_IQR]
```

Out[114...

	tran_id	cust_id	tran_date	tran_amount	platform	product_category	payment_type

In [115...

```
df_transactions.describe()
```

Out[115…

	tran_id	cust_id	tran_amount
count	500000.000000	500000.000000	500000.000000
mean	250000.500000	501.400428	241.534922
std	144337.711634	288.641924	242.364496
min	1.000000	1.000000	2.000000
25%	125000.750000	252.000000	66.000000
50%	250000.500000	502.000000	133.000000
75%	375000.250000	752.000000	349.000000
max	500000.000000	1000.000000	999.000000

In [116…

```
df_transactions.shape
```

Out[116…

```
(500000, 7)
```

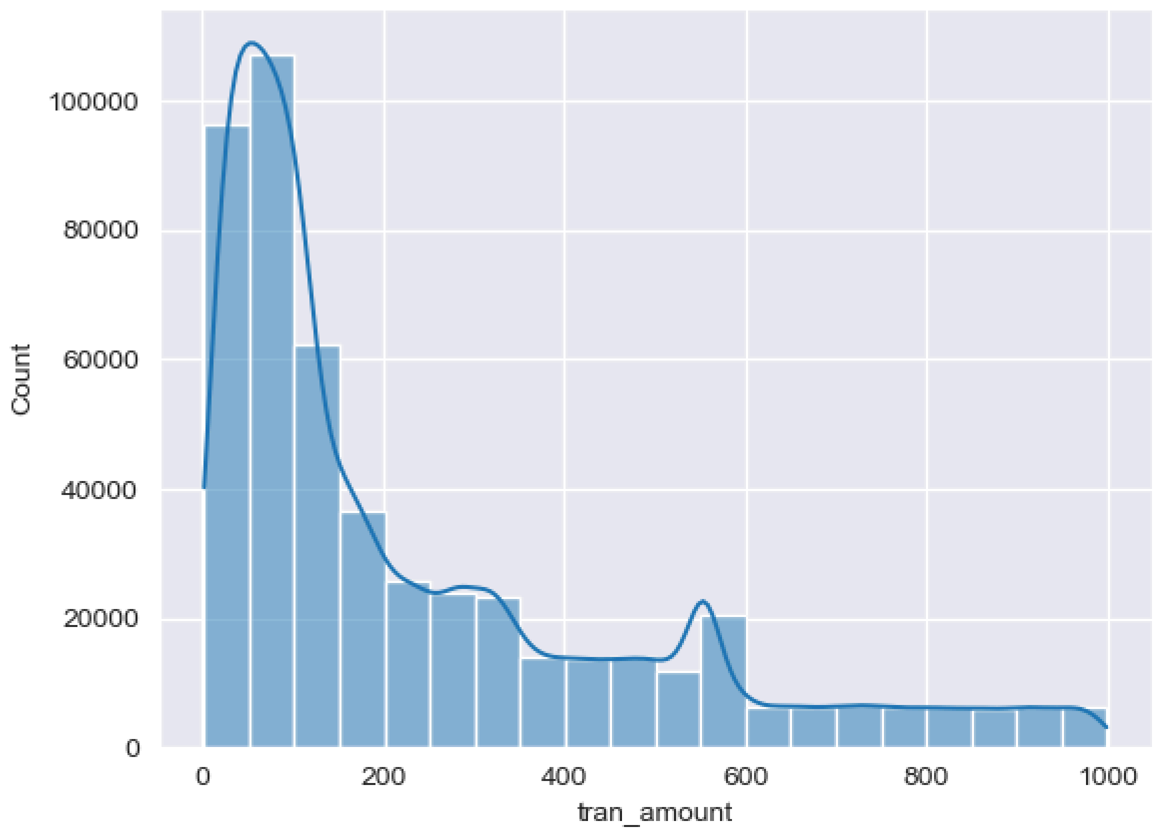
Visualization transaction for checking tran_amount

In [117…

```
sns.histplot(df_transactions['tran_amount'], kde=True, bins=20)
```

Out[117…

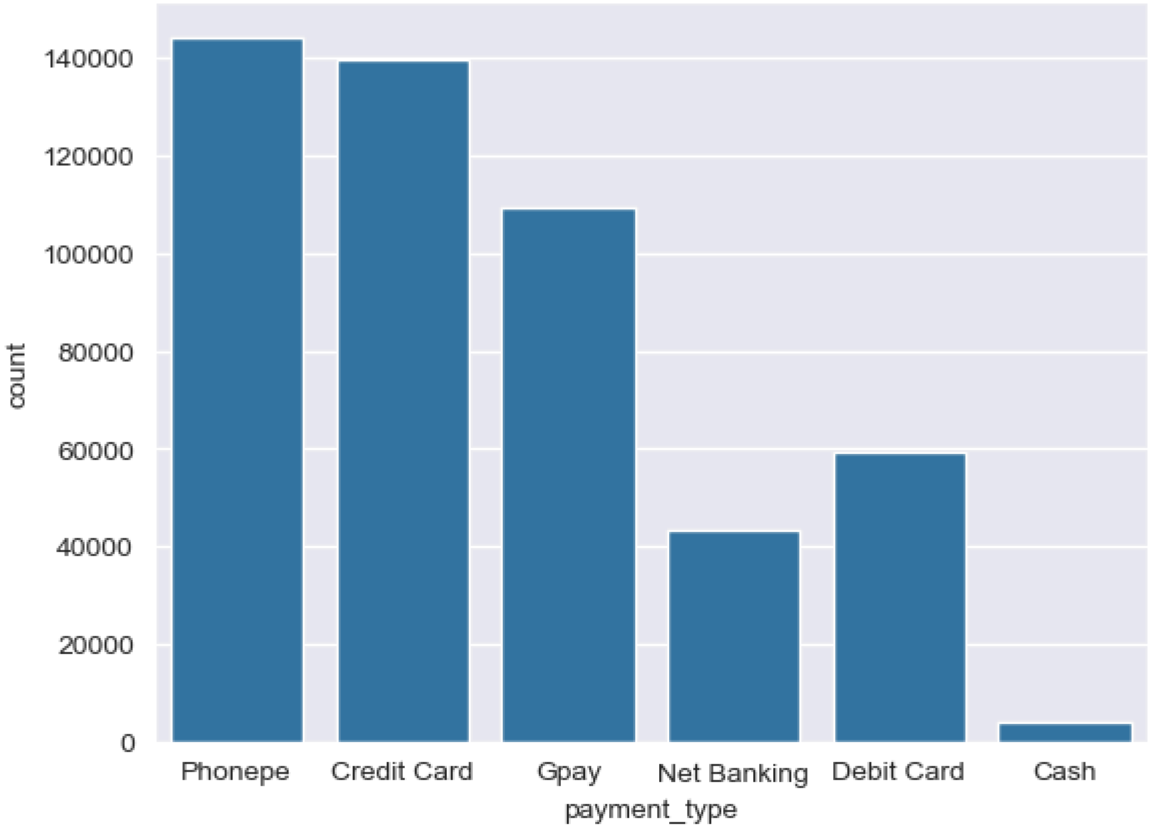
```
<Axes: xlabel='tran_amount', ylabel='Count'>
```



Visualization Transactions

```
In [118…  sns.countplot(x = df_transactions['payment_type'])
```

```
Out[118…  <Axes: xlabel='payment_type', ylabel='count'>
```



Determine the distribution of age with payment type

In [143…

```
df_customers.head()
```

Out[143…

	cust_id	name	gender	age	location	occupation	annual_income	marital_status	age_group
0	1	Manya Acharya	Female	51.0	City	Business Owner	358211.0	Married	49-65
1	2	Anjali Pandey	Female	47.0	City	Consultant	65172.0	Single	26-48
2	3	Aaryan Chauhan	Male	21.0	City	Freelancer	22378.0	Married	18-25
3	4	Rudra Bali	Male	24.0	Rural	Freelancer	33563.0	Married	18-25
4	5	Advait Malik	Male	48.0	City	Consultant	39406.0	Married	26-48

In [145…

```
df_transactions.head()
```

Out[145…

	tran_id	cust_id	tran_date	tran_amount	platform	product_category	payment_type
0	1	705	2023-01-01	63.0	Flipkart	Electronics	Phonepe
1	2	385	2023-01-01	99.0	Alibaba	Fashion & Apparel	Credit Card
2	3	924	2023-01-01	471.0	Shopify	Sports	Phonepe
3	4	797	2023-01-01	33.0	Shopify	Fashion & Apparel	Gpay
4	5	482	2023-01-01	68.0	Amazon	Fashion & Apparel	Net Banking

In [144…

```
df_customer_transaction_merge = pd.merge(df_customers, df_transactions, on='cust_id', how='inner')
df_customer_transaction_merge.head()
```

Out[144…

	cust_id	name	gender	age	location	occupation	annual_income	marital_status	age_group	tran_id	tran_date	tran_amou
0	1	Manya Acharya	Female	51.0	City	Business Owner	358211.0	Married	49-65	1283	2023-01-01	30
1	1	Manya Acharya	Female	51.0	City	Business Owner	358211.0	Married	49-65	1382	2023-01-01	96
2	1	Manya Acharya	Female	51.0	City	Business Owner	358211.0	Married	49-65	1521	2023-01-01	86
3	1	Manya Acharya	Female	51.0	City	Business Owner	358211.0	Married	49-65	1576	2023-01-01	149
4	1	Manya Acharya	Female	51.0	City	Business Owner	358211.0	Married	49-65	1757	2023-01-01	37

In [146…

```
df_customer_transaction_merge.describe()
```

Out[146…

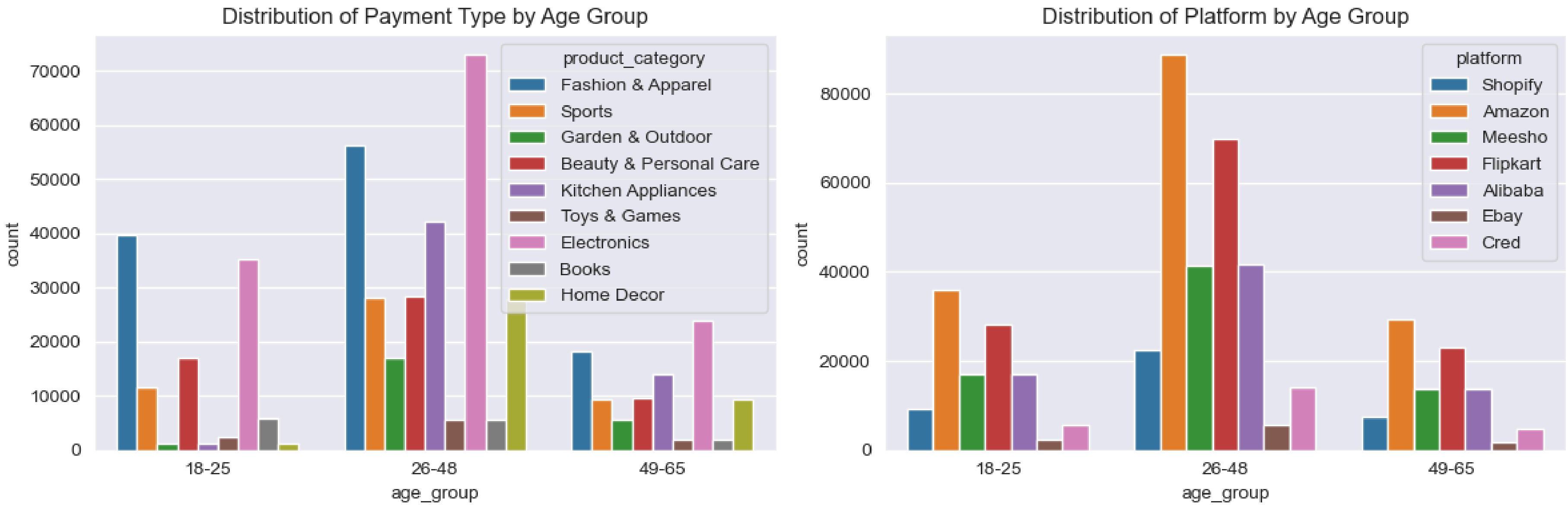
	cust_id	age	annual_income	tran_id	tran_amount
count	500000.000000	500000.000000	475010.000000	500000.000000	500000.000000
mean	501.400428	35.560216	139690.179607	250000.500000	241.534922
std	288.641924	12.267277	112454.252360	144337.711634	242.364496
min	1.000000	18.000000	2.000000	1.000000	2.000000
25%	252.000000	26.000000	47665.000000	125000.750000	66.000000
50%	502.000000	32.000000	112754.000000	250000.500000	133.000000
75%	752.000000	45.000000	194922.000000	375000.250000	349.000000
max	1000.000000	64.000000	449346.000000	500000.000000	999.000000

Visualize tran amount with age group

In [153…

```
# Set up the number of rows and columns for subplots (1x2 grid in this case)
n_rows = 1
n_cols = 2
```

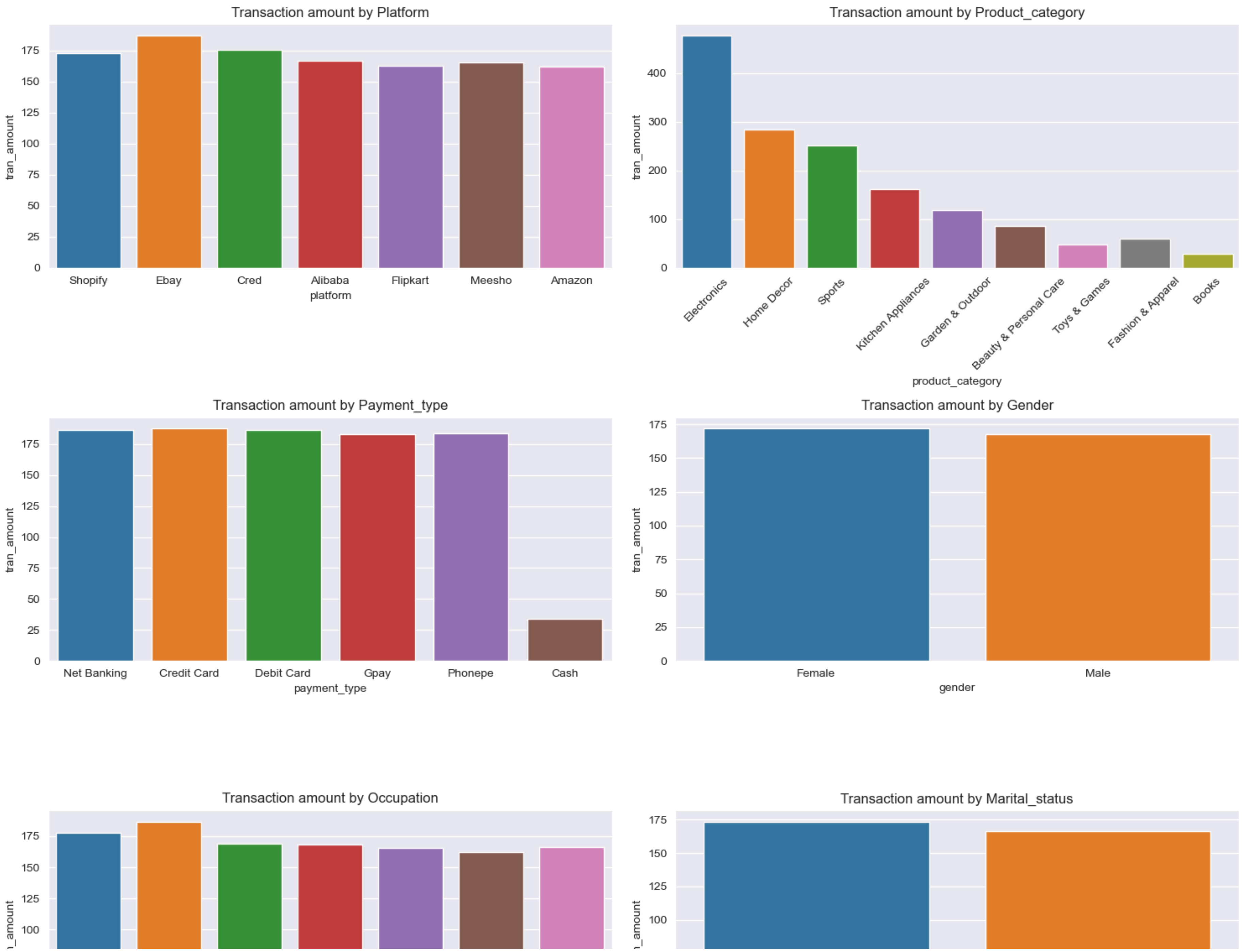
```
fig, axes = plt.subplots(n_rows, n_cols, figsize=(12, 4))

# Plot the first list in the first subplot
sns.countplot(
    data=df_customer_transaction_merge,
    x='age_group',
    # y='tran_amount',
    hue='product_category',  # Add hue for age group comparison
    palette='tab10',
    ax=axes[0]
)
axes[0].set_title('Distribution of Payment Type by Age Group')
# axes[0].tick_params(axis='x', rotation=45)

# Plot the second list in the second subplot
sns.countplot(
    data=df_customer_transaction_merge,
    x='age_group',
    # y='tran_amount',
    hue='platform',  # Add hue for age group comparison
    palette='tab10',
    ax=axes[1]

)
axes[1].set_title('Distribution of Platform by Age Group')
# axes[1].tick_params(axis='x', rotation=45)

# Adjust layout for better spacing
plt.tight_layout()
plt.show()
```



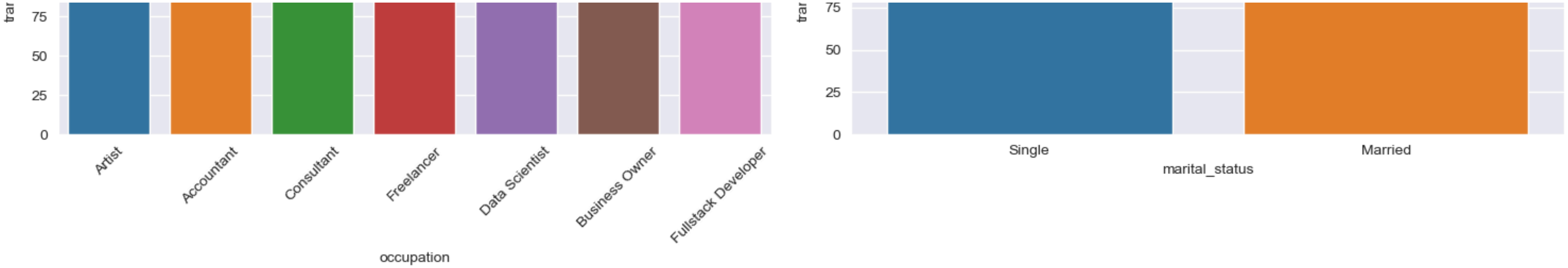
```
In [450…  df_customer_transaction_merge.columns
```

```
Out[450…  Index(['cust_id', 'name', 'gender', 'age', 'location', 'occupation',
                 'annual_income', 'marital_status', 'age_group', 'tran_id', 'tran_date',
                 'tran_amount', 'platform', 'product_category', 'payment_type'],
                dtype='object')
```

```
In [503…  factor_2 = ['platform', 'product_category', 'payment_type','gender','occupation','marital_status']
          n_rows = 3
          n_cols = 2
          fig2, axes = plt.subplots(n_rows, n_cols, figsize=(15, 14))
          axes = axes.flatten()
          df_get_all_chart = df_customer_transaction_merge.groupby(factor_2)['tran_amount'].mean().reset_index().sort_values(
          # Plot the first list in the first subplot
          for idx, factor in enumerate(factor_2):
              sns.barplot(
                  data=df_get_all_chart,
                  x=factor,
                  y='tran_amount',
                  hue=factor,
                  # palette='tab10',
                  errorbar=None,
                  ax=axes[idx],
                  legend=False
              )
              axes[idx].set_title(f"Transaction amount by {factor.capitalize()}")
              if factor == 'product_category':
                  axes[idx].tick_params(axis='x', rotation=45)
              if factor == 'occupation':
                  axes[idx].tick_params(axis='x', rotation=45)
              # axes[idx].tick_params(axis='x', rotation=45)
          plt.tight_layout()
          plt.show()
```



Transaction amount by Platform
tran_amount
0
25
50
75
100
125
150
175
Shopify
Ebay
Cred
Alibaba
Flipkart
Meesho
Amazon
platform
Transaction amount by Product_category
tran_amount
0
100
200
300
400
Electronics
Home Decor
Sports
Kitchen Appliances
Garden & Outdoor
Beauty & Personal Care
Toys & Games
Fashion & Apparel
Books
product_category
Transaction amount by Payment_type
tran_amount
0
25
50
75
100
125
150
175
Net Banking
Credit Card
Debit Card
Gpay
Phonepe
Cash
payment_type
Transaction amount by Gender
tran_amount
0
25
50
75
100
125
150
175
Female
Male
gender
Transaction amount by Occupation
n_amount
100
125
150
175
Transaction amount by Marital_status
n_amount
100
125
150
175



In [ ]:

Analyze more about the connection of age group with annual income, credit limit, credit score

In [500…

```
df_customer_credit_merged.head()
```

Out[500…

	cust_id	name	gender	age	location	occupation	annual_income	marital_status	age_group	credit_score	credit_utilisatio
0	1	Manya Acharya	Female	51.0	City	Business Owner	358211.0	Married	49-65	749	0.58517
1	2	Anjali Pandey	Female	47.0	City	Consultant	65172.0	Single	26-48	587	0.10792
2	3	Aaryan Chauhan	Male	21.0	City	Freelancer	22378.0	Married	18-25	544	0.85480
3	4	Rudra Bali	Male	24.0	Rural	Freelancer	33563.0	Married	18-25	504	0.33693
4	5	Advait Malik	Male	48.0	City	Consultant	39406.0	Married	26-48	708	0.58615

In [505…

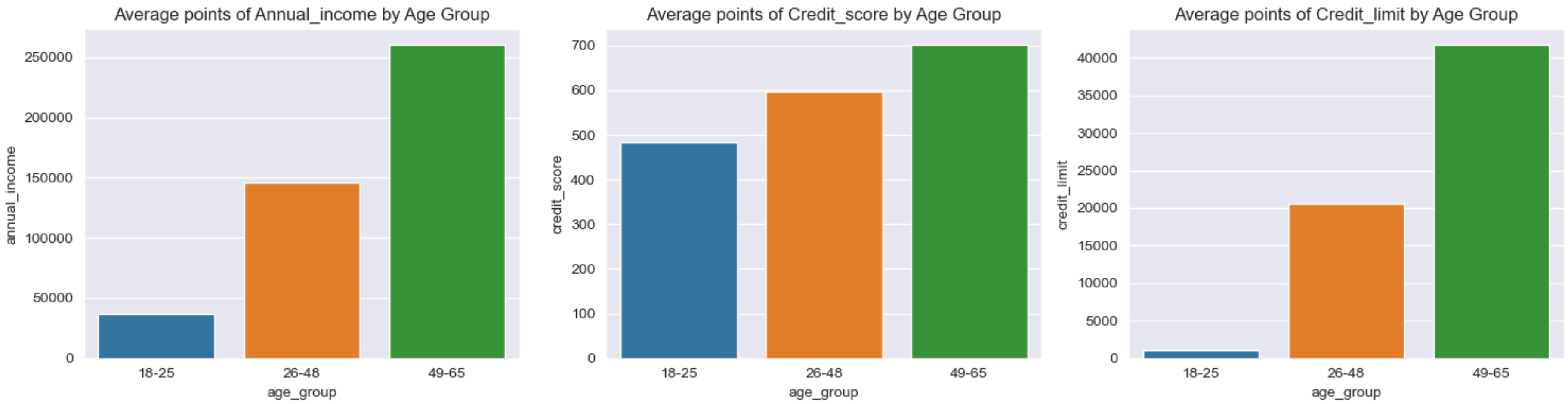
```
df_get_all_chart2 = df_customer_credit_merged.groupby('age_group',observed=False)[['annual_income','credit_score','
df_get_all_chart2
```

Out[505…

	annual_income	credit_score	credit_limit
age_group			
18-25	37111.398268	483.354978	1139.610390
26-48	145869.623457	597.569665	20560.846561
49-65	260165.925134	701.524064	41699.197861

In [507…

```
factor_need = ['annual_income','credit_score','credit_limit']
n_rows = 1
n_cols = 3
fig2, axes = plt.subplots(n_rows, n_cols, figsize=(15, 4))
axes = axes.flatten()
df_get_all_chart2 = df_customer_credit_merged.groupby('age_group',observed=False)[['annual_income','credit_score','
# Plot the first list in the first subplot
for idx, factor in enumerate(factor_need):
    sns.barplot(
        data=df_get_all_chart2,
        x='age_group',
        y=factor,
        hue='age_group',
        palette='tab10',
        errorbar=None,
        ax=axes[idx],
        legend=False
    )
    axes[idx].set_title(f"Average points of {factor.capitalize()} by Age Group")
    # if factor == 'product_category':
    #     axes[idx].tick_params(axis='x', rotation=45)
    # axes[idx].tick_params(axis='x', rotation=45)
plt.tight_layout()
plt.show()
```



```
In [ ]:
```

Look at the chart above, we may see the group from 18-25 has pretty small points of annual income, Credit score and Credit limit. About other age group, they already had the utilise of others credit company bank, so that it's quite hard to convince them to switch to different bank. And it's pretty hard for the age group from 49-65 also because this period age are lightly dont want to change.

Conclusion , we may have plans to target to 18-25 age group instead because they may not have any credit card by above reasons. That's really a blue ocean because the population of this age group is pretty huge. We may get a various of members from this group if we have a good offer.

```
In [ ]:
```