Import Dataset

In [2]:
```
#import the necessary libraries
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
import datetime as dt
import time
%matplotlib inline
```

In [3]:
```
pd.set_option('display.float_format', lambda x: '%.2f' % x)
pd.set_option('display.max_columns', None)
data = pd.read_csv('OnlineRetail.csv')
data.head()
```

Out[3]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	12/1/2010 8:26	2.55	17850.00	United Kingdom
1	536365	71053	WHITE METAL LANTERN	6	12/1/2010 8:26	3.39	17850.00	United Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	12/1/2010 8:26	2.75	17850.00	United Kingdom
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	12/1/2010 8:26	3.39	17850.00	United Kingdom
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	12/1/2010 8:26	3.39	17850.00	United Kingdom

TO-DO: Data Preprocessing

In [5]:
```
# **TO-DO** Print the number of duplicate items
print("Number of duplicate rows:", data.duplicated().sum())
```

```
Number of duplicate rows: 5268
```

TO-DO: Remove Duplicate items from dataset

In [7]:
```
# **TO-DO** Remove duplicate items from the dataset
data = data.drop_duplicates()
```

TO-DO: Check for missing values

In [9]:

```
# **TO-DO** Display count of missing values
print(data.isnull().sum())
```

```
InvoiceNo           0
StockCode           0
Description      1454
Quantity            0
InvoiceDate         0
UnitPrice           0
CustomerID     135037
Country             0
dtype: int64
```

TO-DO: Create new Invoice List

In [11]:

```
# **TO-DO** Creates a list of unique invoice No. with Null Customer ID
invoice_list = data[data['CustomerID'].isnull()]['InvoiceNo'].unique().tolist()
```

In [12]:

```
print("InvoiceLise: ", invoice_list[:10])
print("Invoice Size:", len(invoice_list))
```

```
InvoiceLise:  ['536414', '536544', '536545', '536546', '536547', '536549', '536550', '536
552', '536553', '536554']
Invoice Size: 3710
```

TO-DO: Removing Inconsistent Records

In [14]:

```
# **TO-DO** Checking the number of records with Quantity Negative and Prices 0 or Vice v
condition1 = ((data['Quantity'] < 0) & (data['UnitPrice'] == 0)) | ((data['Quantity'] ==
print("The number of records with Quantity Negative and Prices 0 or Vice versa : ", cond

# **TO-DO** Checking if Negative quantities are cancelled items
cancelled_prefix = data[data['InvoiceNo'].astype(str).str.startswith('C')]['InvoiceNo'].
print("Cancelled Items have Invoice Starting with : ", cancelled_prefix)
# **TO-DO** Checking for Records with Negative Unit Price
negative_price_count = (data['UnitPrice'] < 0).sum()
print("The number of transactions with Negative Unit Price : ", negative_price_count)

# **TO-DO** Checking for Records with Unit Price 0
valid_zero_price = data[
    (data['UnitPrice'] == 0) &
    (data['Quantity'] > 0) &
    (~data['InvoiceNo'].astype(str).str.startswith('C')) &
    (data['CustomerID'].notnull())
]
print("The number of transactions with Unit Price 0 : ", len(valid_zero_price))
```

```
The number of records with Quantity Negative and Prices 0 or Vice versa :  1336
Cancelled Items have Invoice Starting with :  ['C']
The number of transactions with Negative Unit Price :  2
The number of transactions with Unit Price 0 :  40
```

In [15]:

```
# **TO-DO** Removing records with Null Customer ID
data = data[data['CustomerID'].notnull()]
```

In [16]:

```
# Copy the dataset and convert CustomerID to int
rfm_train = data.copy()
rfm_train.CustomerID = (rfm_train.CustomerID).astype(int)
```

In [17]:

```
# **TO-DO** Count the number of missing values
print("Count of Missing values:")
print(rfm_train.isnull().sum())
```

```
Count of Missing values:
InvoiceNo      0
StockCode      0
Description    0
Quantity       0
InvoiceDate    0
UnitPrice      0
CustomerID     0
Country        0
dtype: int64
```

Cancelled Items

In [19]:

```
## remove transactions with Cancelled Items.
placed = rfm_train[~rfm_train.InvoiceNo.str.contains('C',na=False)]
```

In [20]:

```
placed['TotalCost'] = rfm_train.Quantity * rfm_train.UnitPrice
```

```
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/140923902.py:1: SettingW
ithCopyWarning:
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_g
uide/indexing.html#returning-a-view-versus-a-copy
  placed['TotalCost'] = rfm_train.Quantity * rfm_train.UnitPrice
```

In [21]:

```
placed.head()
```

Out[21]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	Tota
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	12/1/2010 8:26	2.55	17850	United Kingdom	
1	536365	71053	WHITE METAL LANTERN	6	12/1/2010 8:26	3.39	17850	United Kingdom	
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	12/1/2010 8:26	2.75	17850	United Kingdom	
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	12/1/2010 8:26	3.39	17850	United Kingdom	
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	12/1/2010 8:26	3.39	17850	United Kingdom	

TO-DO: Exploratory Data Analysis

In [23]:

```
# **TO-DO** Find The Time Period of Transactions
print("Oldest date is:" + str(placed['InvoiceDate'].min()))
print("\nLatest date is:" + str(placed['InvoiceDate'].max()))
```

```
Oldest date is:1/10/2011 10:32

Latest date is:9/9/2011 9:52
```

TO-DO: Order Density in Different Countries

In [25]:

```
# **TO-DO** Display the proportion of order based on country as below
proportion = placed['Country'].value_counts(normalize=True).head(12) * 100
proportion = proportion.round(1).astype(str) + '%'
proportion = proportion.reset_index()
proportion.columns = ['Country', 'proportion']
proportion.set_index('Country', inplace=True)
proportion
```

Out[25]:

Country	proportion
United Kingdom	88.9%
Germany	2.3%
France	2.1%
EIRE	1.8%
Spain	0.6%
Netherlands	0.6%
Belgium	0.5%
Switzerland	0.5%
Portugal	0.4%
Australia	0.3%
Norway	0.3%
Italy	0.2%

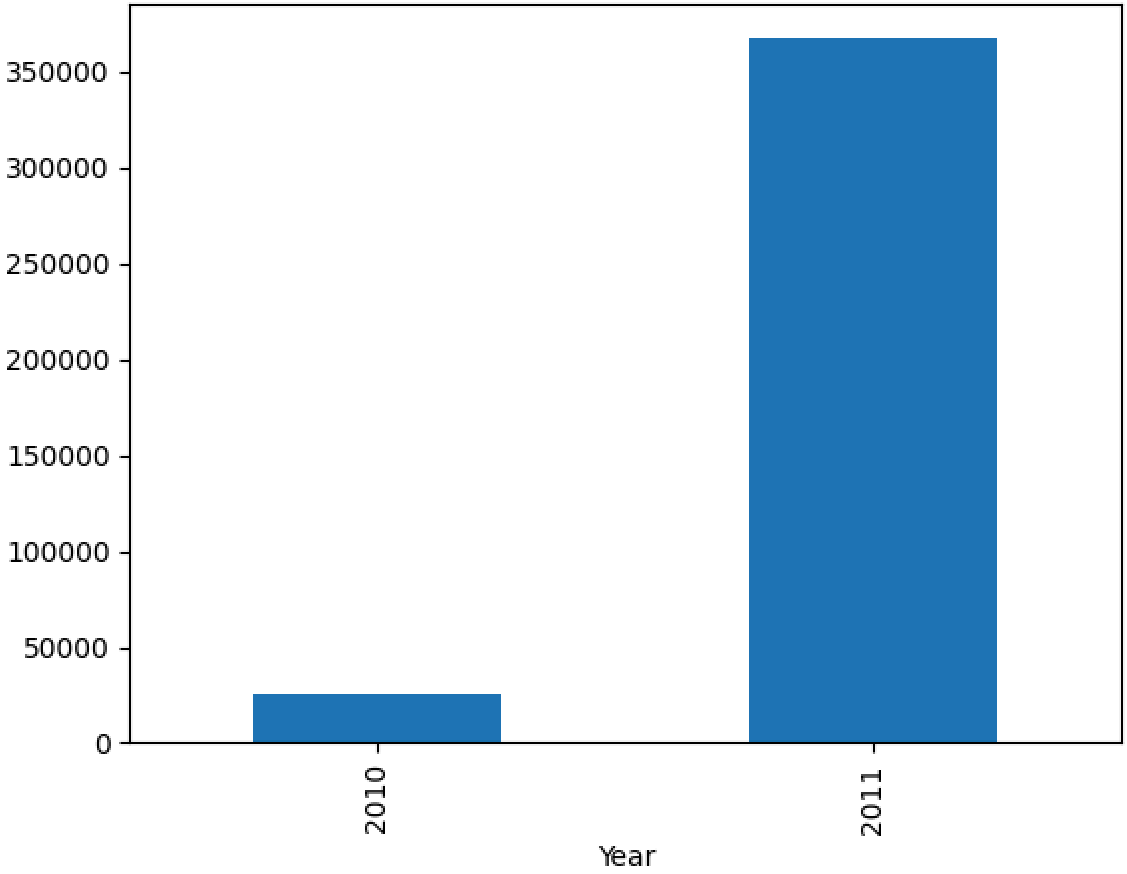
In [26]:

```
# **TO-DO** Produce the following Bar Graph Below comparing the number invoices by year
placed['InvoiceDate'] = pd.to_datetime(placed['InvoiceDate'], errors='coerce')

placed['Year'] = placed['InvoiceDate'].dt.year

placed['Year'].value_counts().sort_index().plot(kind='bar')
```

```
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/112687938.py:2: SettingW
ithCopyWarning:
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_g
uide/indexing.html#returning-a-view-versus-a-copy
  placed['InvoiceDate'] = pd.to_datetime(placed['InvoiceDate'], errors='coerce')
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/112687938.py:4: SettingW
ithCopyWarning:
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_g
uide/indexing.html#returning-a-view-versus-a-copy
  placed['Year'] = placed['InvoiceDate'].dt.year
```

Out[26]:

```
<Axes: xlabel='Year'>
```



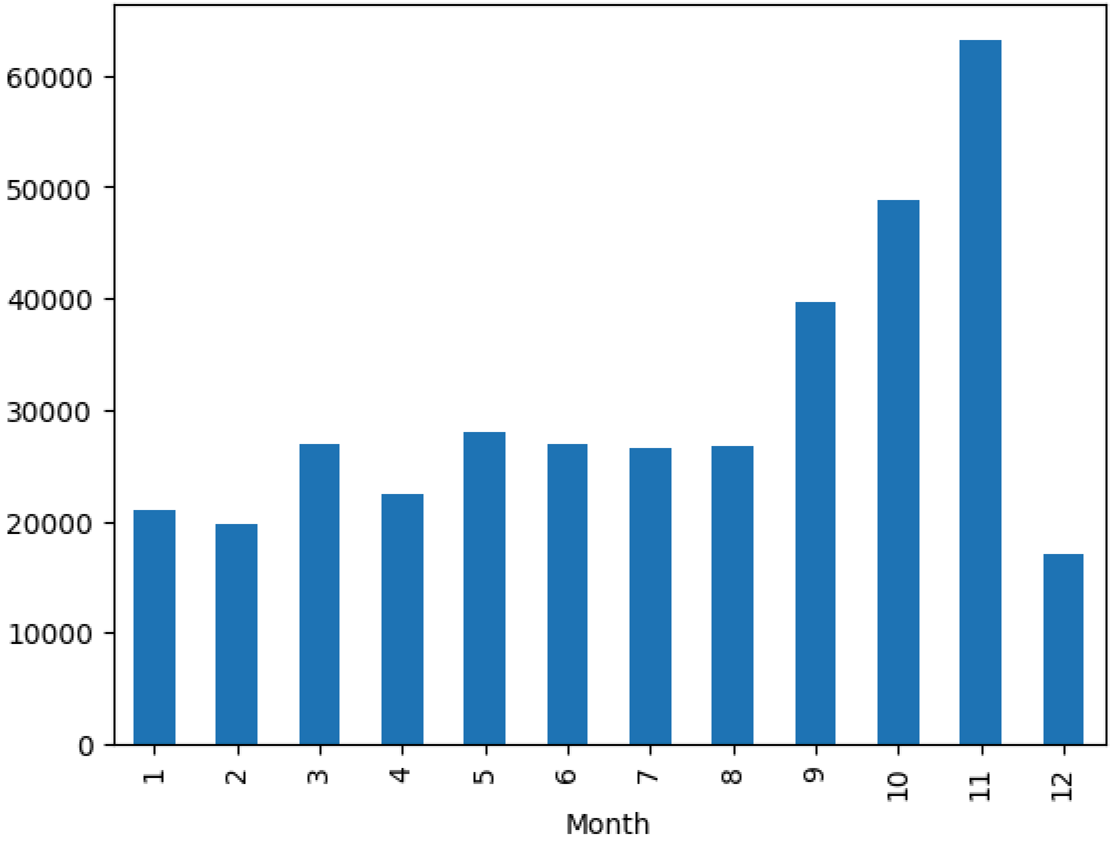
In [27]:

```python
# **TO-DO** Produce the following Bar Graph Below comparing the number invoices by month
placed_2011 = placed[placed['InvoiceDate'].dt.year == 2011]
placed_2011['Month'] = placed_2011['InvoiceDate'].dt.month
placed_2011['Month'].value_counts().sort_index().plot(kind='bar')
```

```
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/1578999889.py:3: Setting
WithCopyWarning:
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_g
uide/indexing.html#returning-a-view-versus-a-copy
  placed_2011['Month'] = placed_2011['InvoiceDate'].dt.month
```

Out[27]:

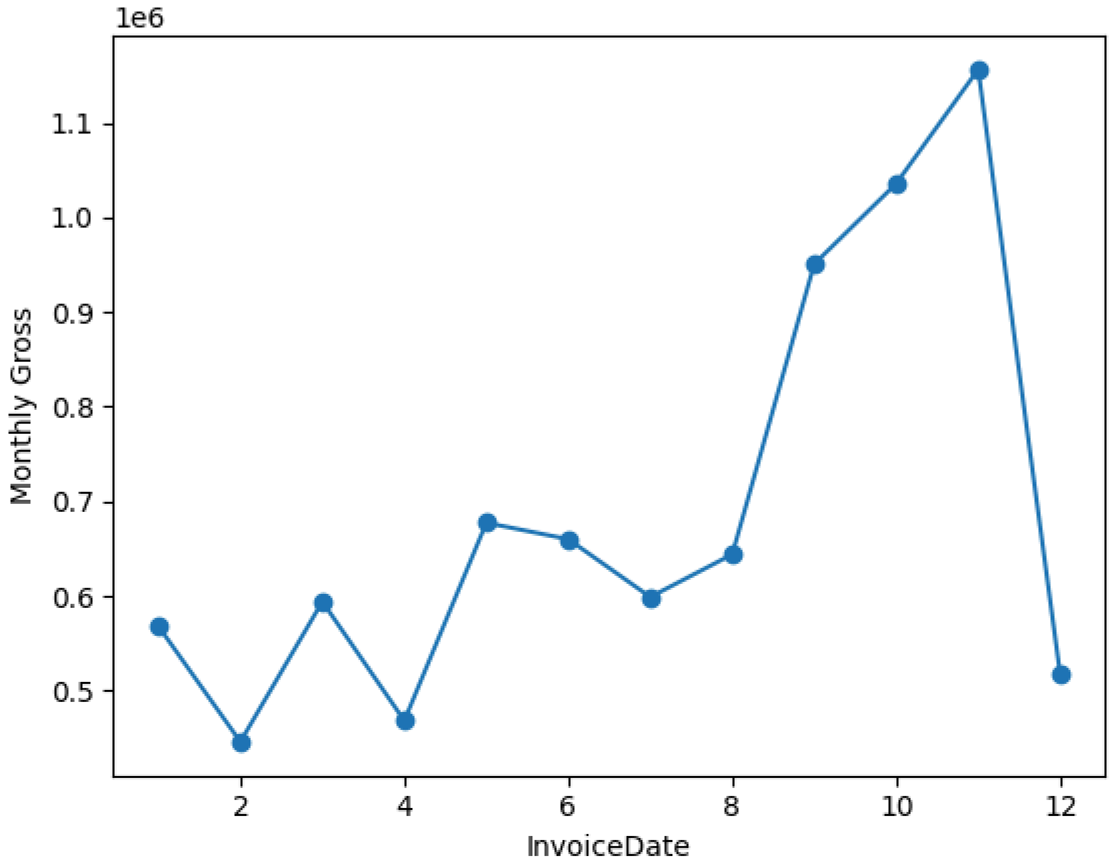
```
<Axes: xlabel='Month'>
```



Monthly Gross

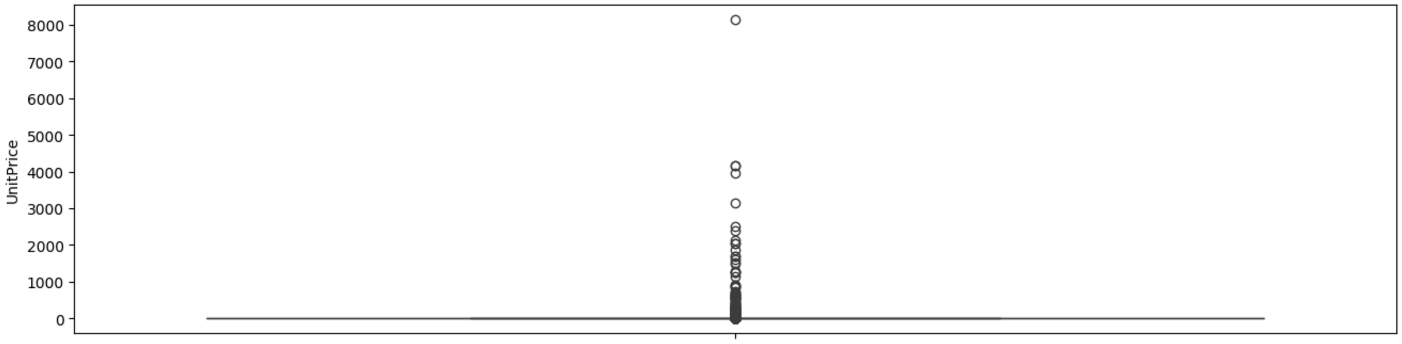
```
In [29]: # **TO-DO** Produce the following Bar Graph Below comparing the monthly gross rate in 20
placed_2011 = placed[placed['InvoiceDate'].dt.year == 2011]
monthly_gross = placed_2011.groupby(placed_2011['InvoiceDate'].dt.month)['TotalCost'].su
monthly_gross.plot(marker='o', linestyle='-')
plt.ylabel('Monthly Gross')
```

```
Out[29]: Text(0, 0.5, 'Monthly Gross')
```



```
In [30]: plt.figure(figsize=(16,4))
         sns.boxplot(y='UnitPrice',data = placed,orient=("Horizontal", "y"))
```

```
Out[30]: <Axes: ylabel='UnitPrice'>
```



Unit Price is more concentrated in lower values of prices.

Top Selling Products

```
In [33]: placed.head()
```

Out[33]:

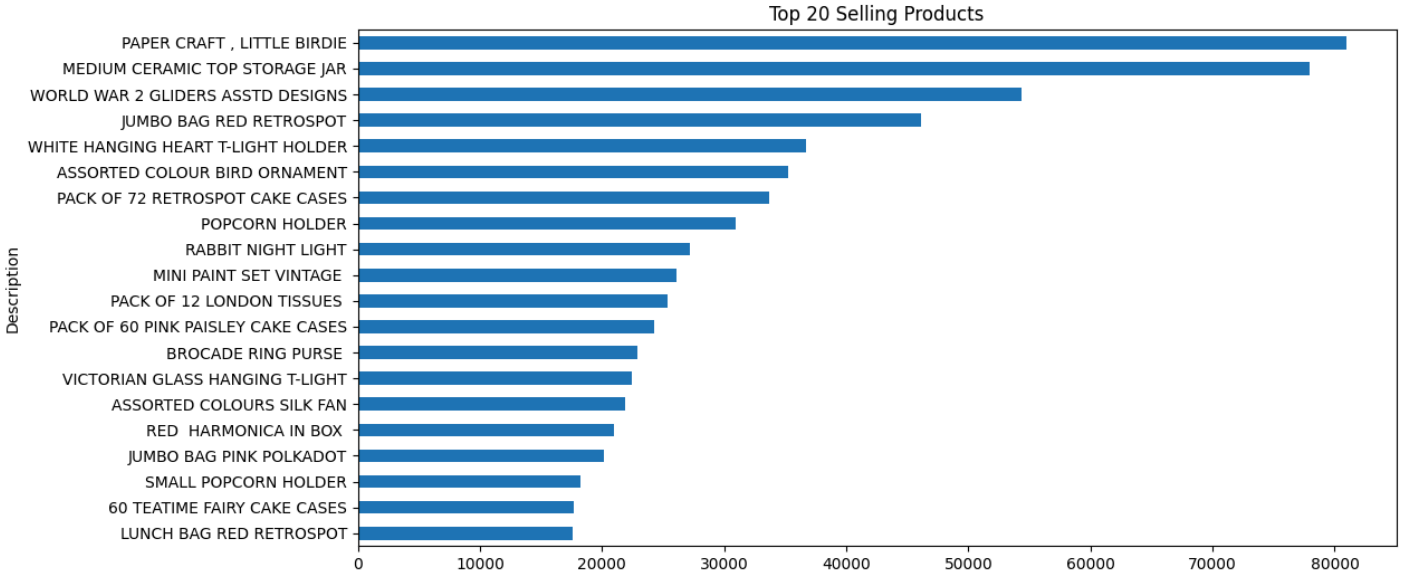
	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	Tota
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	2010-12-01 08:26:00	2.55	17850	United Kingdom	
1	536365	71053	WHITE METAL LANTERN	6	2010-12-01 08:26:00	3.39	17850	United Kingdom	
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	2010-12-01 08:26:00	2.75	17850	United Kingdom	
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	2010-12-01 08:26:00	3.39	17850	United Kingdom	
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	2010-12-01 08:26:00	3.39	17850	United Kingdom	

In [34]:

```
# **TO-DO** Produce the following Graph displaying the top 20 selling products
top_products = placed.groupby('Description')['Quantity'].sum().sort_values(ascending=Fal

top_products.iloc[::-1].plot(kind='barh', figsize=(12, 6), title='Top 20 Selling Product
plt.ylabel('Description')
```

Out[34]:

```
Text(0, 0.5, 'Description')
```



TO-DO: Receny, Frequency, Montary (RFM) ANALYSIS

TO-DO: Recency

In [37]:

```
# **TO-DO** Print Lastest date in the Order History
cutoff = pd.to_datetime('2011-09-09 09:52')

placed = placed[placed['InvoiceDate'] <= cutoff]

print(placed['InvoiceDate'].max().strftime('%-m/%-d/%Y %-H:%M'))
```

```
9/9/2011 9:52
```

In [38]:

```
current_date = dt.date(2011,12,10)
```

In [39]:

```
rfm_train['InvoiceDate'] = pd.to_datetime(rfm_train['InvoiceDate'], errors='coerce')
rfm_train['Purchase_Date'] = rfm_train.InvoiceDate.dt.date
print(rfm_train['Purchase_Date'])
```

```
0         2010-12-01
1         2010-12-01
2         2010-12-01
3         2010-12-01
4         2010-12-01
             ...
541904    2011-12-09
541905    2011-12-09
541906    2011-12-09
541907    2011-12-09
541908    2011-12-09
Name: Purchase_Date, Length: 401604, dtype: object
```

TO-DO Create Seperate Column for Recency

In [41]:

```
recency = rfm_train.groupby('CustomerID')['Purchase_Date'].max().reset_index()
```

In [42]:

```
# **TO-DO** Calculate Recency based on purchase date and current date
recency['Recency'] = (current_date - recency['Purchase_Date']).apply(lambda x: x.days)
recency['Current_Date'] = current_date
recency = recency[['CustomerID', 'Purchase_Date', 'Current_Date', 'Recency']]

# Display Recency
recency.head()
```

Out[42]:

	CustomerID	Purchase_Date	Current_Date	Recency
0	12346	2011-01-18	2011-12-10	326
1	12347	2011-12-07	2011-12-10	3
2	12348	2011-09-25	2011-12-10	76
3	12349	2011-11-21	2011-12-10	19
4	12350	2011-02-02	2011-12-10	311

In [43]:

```
# **TO-DO** Drop Date Columns which are not useful anymore.
recency = recency.drop(columns=['Purchase_Date', 'Current_Date'])

recency.head()
```

Out[43]:

	CustomerID	Recency
0	12346	326
1	12347	3
2	12348	76
3	12349	19
4	12350	311

TO-DO Create Seperate Column for Frequency

In [45]:

```
# **TO-DO** Calculate Frequency based on Customer ID
frequency = rfm_train.groupby('CustomerID')['InvoiceNo'].nunique().reset_index()

frequency.head()
```

Out[45]:

	CustomerID	InvoiceNo
0	12346	2
1	12347	7
2	12348	4
3	12349	1
4	12350	1

TO-DO Create seperate Column for Monetary

In [47]:

```
# **TO-DO** Calculate Total Cost (Quantity * Price)
rfm_train['TotalCost'] = rfm_train['Quantity'] * rfm_train['UnitPrice']

rfm_train.head()
```

Out[47]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	Purc
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	2010-12-01 08:26:00	2.55	17850	United Kingdom	
1	536365	71053	WHITE METAL LANTERN	6	2010-12-01 08:26:00	3.39	17850	United Kingdom	
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	2010-12-01 08:26:00	2.75	17850	United Kingdom	
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	2010-12-01 08:26:00	3.39	17850	United Kingdom	
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	2010-12-01 08:26:00	3.39	17850	United Kingdom	

In [48]:

```
# **TO-DO** Calculate Monetary based on total cost per Customer
monetary = rfm_train.groupby('CustomerID')['TotalCost'].sum().reset_index()
monetary.columns = ['CustomerID', 'Monetary']

monetary.head()
```

Out[48]:

	CustomerID	Monetary
0	12346	0.00
1	12347	4310.00
2	12348	1797.24
3	12349	1757.55
4	12350	334.40

TO-DO: Combine Recency, Frequency and Monetary

In [50]:

```
# **TO-DO** Combine Recency, Frequency and Monetary into a single table
rfm_table = recency.merge(frequency, on='CustomerID').merge(monetary, on='CustomerID')
rfm_table.set_index('CustomerID', inplace=True)

rfm_table.head()
```

Out[50]:

	Recency	InvoiceNo	Monetary
CustomerID			
12346	326	2	0.00
12347	3	7	4310.00
12348	76	4	1797.24
12349	19	1	1757.55
12350	311	1	334.40

TO-DO: QQ Plot

In [52]:

```
from scipy import stats
from scipy.stats import skew, norm, probplot, boxcox

def QQ_plot(data, measure):
    fig = plt.figure(figsize=(20,7))

    #Get the fitted parameters used by the function
    (mu, sigma) = norm.fit(data)

    #Kernel Density plot
    fig1 = fig.add_subplot(121)
    sns.distplot(data, fit=norm)
    fig1.set_title(measure + ' Distribution ( mu = {:.2f} and sigma = {:.2f} )'.format(m
    fig1.set_xlabel(measure)
    fig1.set_ylabel('Frequency')

    #QQ plot
    fig2 = fig.add_subplot(122)
    res = probplot(data, plot=fig2)
    fig2.set_title(measure + ' Probability Plot (skewness: {:.6f} and kurtosis: {:.6f} )

    plt.tight_layout()
    plt.show()
```

A Quantile-Quantile (QQ) plot is a graphical tool to assess if a dataset follows a specified distribution, typically the normal distribution. It does this by plotting the quantiles of the dataset against the quantiles of the theoretical distribution. If the points roughly follow a straight line, the data is approximately normally distributed. Key Components of a QQ Plot

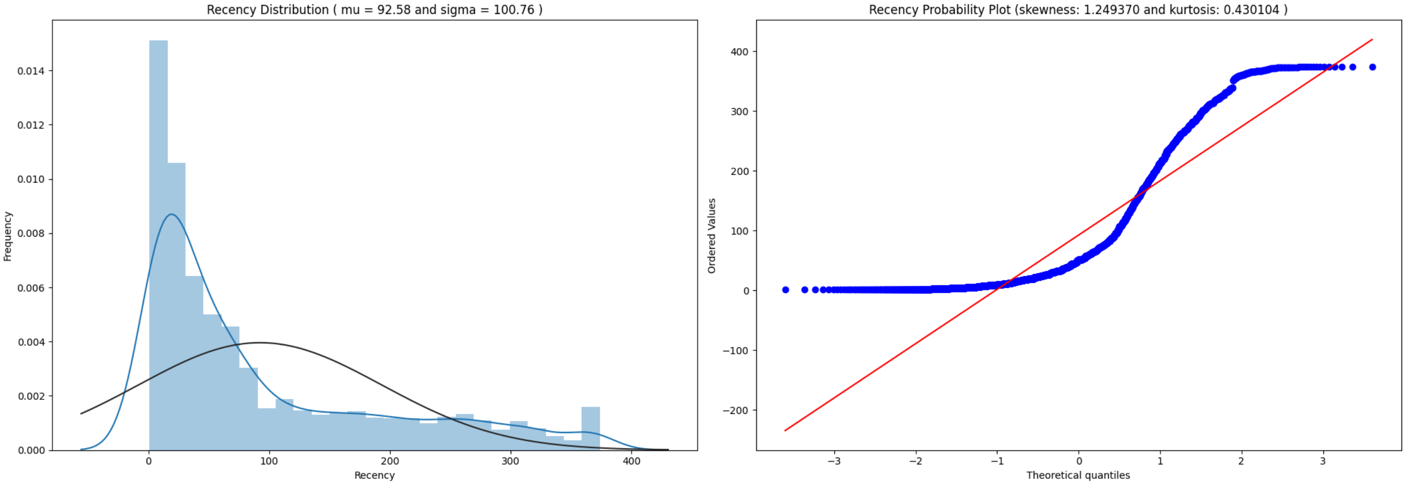
How to Interpret a QQ Plot

```
Straight Line: If the points form a roughly straight line, the data
follows the theoretical distribution.
S-shaped Curve: If the points form an S-shape, the data may have heavier
tails than the theoretical distribution.
Convex/Concave Curve: Indicates a skewness in the data.
```

In [54]:

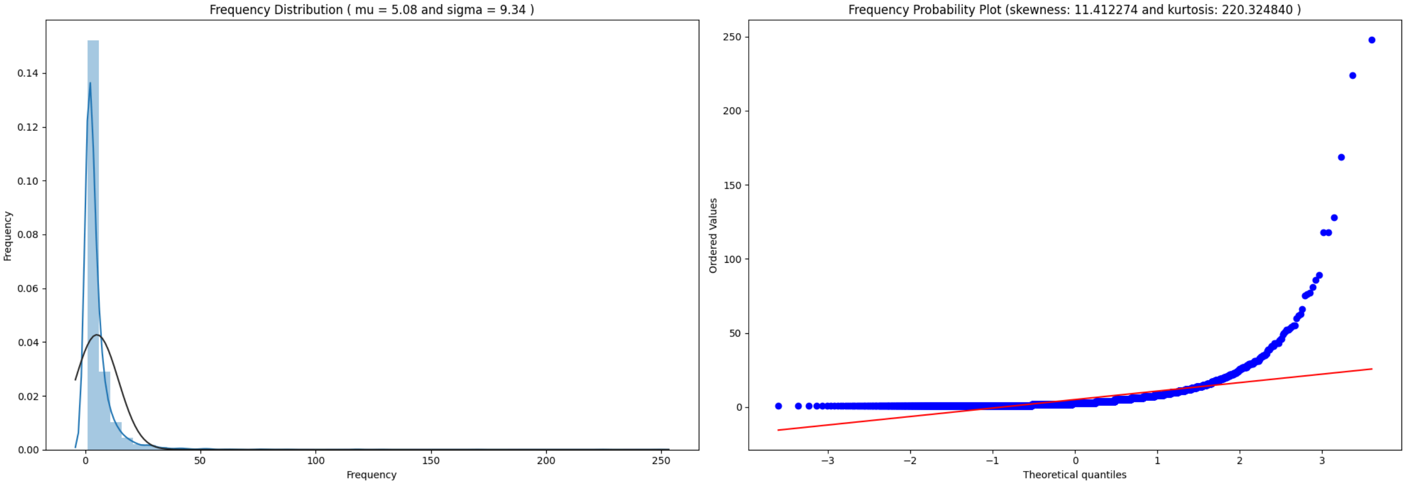
```
# **TO-DO** Generate the below Recency graphs using the QQ_plot function
QQ_plot(rfm_table['Recency'], 'Recency')
```

```
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/1895157362.py:12: UserWa
rning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data, fit=norm)
```



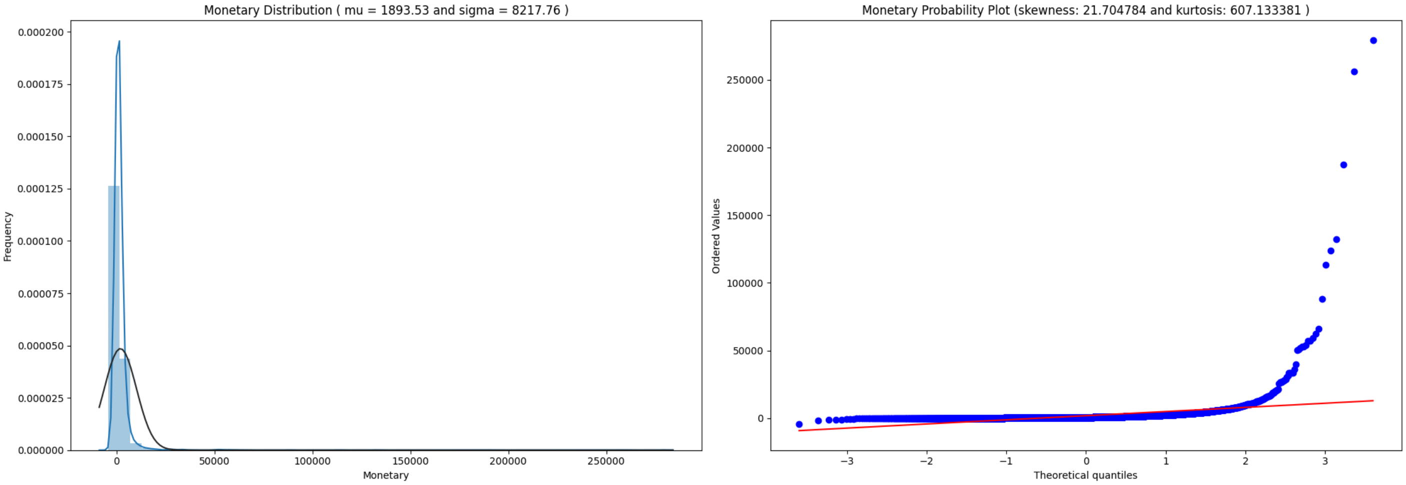
In [55]:
```
# **TO-DO** Generate the below Frequency graphs using the QQ_plot function
frequency.columns = ['CustomerID', 'Frequency']
rfm_table = recency.merge(frequency, on='CustomerID').merge(monetary, on='CustomerID')
QQ_plot(rfm_table['Frequency'], 'Frequency')
```

```
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/1895157362.py:12: UserWa
rning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data, fit=norm)
```



```
In [56]: # **TO-DO** Generate the below Monetary graphs using the QQ_plot function
         QQ_plot(rfm_table['Monetary'], 'Monetary')
```

```
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/1895157362.py:12: UserWa
rning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data, fit=norm)
```



Customer Segmentation Using Quantiles

```
In [58]: # **TO-DO** Calcualte the quantils for recency, frenuency, and monetary
         quantil = rfm_table[['Recency', 'Frequency', 'Monetary']].quantile(q=[0.25, 0.5, 0.75])

         print(quantil)
```

```
      Recency  Frequency  Monetary
0.25    17.00       1.00    291.80
0.50    51.00       3.00    644.07
0.75   144.00       5.00   1608.34
```

Quantiles in General:

```
0.25 Quantile (25th Percentile): This is the value below which 25% of
the data falls. It’s also known as the
first quartile.
0.50 Quantile (50th Percentile): This is the median, the middle value of
the data. Half of the data lies below
this value.
0.75 Quantile (75th Percentile): This is the value below which 75% of
the data falls. It’s also known as the
third quartile.
```

```
In [60]: # Convert quantil into dict to access each value
         quantil = quantil.to_dict()
         print(quantil)
```

```
{'Recency': {0.25: 17.0, 0.5: 51.0, 0.75: 144.0}, 'Frequency': {0.25: 1.0, 0.5: 3.0, 0.7
5: 5.0}, 'Monetary': {0.25: 291.795, 0.5: 644.0699999999999, 0.75: 1608.335}}
```

```
RecencyPoints Function: Assigns points to customers based on how
recently they made their last purchase, giving
higher scores (4) to more recent purchases.
Freq_MonetaryPoints Function: Assigns points to customers based on their
purchase frequency and monetary value,
giving higher scores to more frequent and higher spending customers.
Application: These functions are applied to the DataFrame to segment
customers into quartiles for each RFM
metric, facilitating further analysis and customer segmentation.
```

By applying these functions, businesses can better understand customer behavior and tailor marketing strategies accordingly, targeting different customer segments based on their RFM scores.

In [62]:

```python
# **TO-DO** Define the recency points function
# 0-25% = 4 / 25%-50% = 3 / 50%-75% = 2 / 75%-100% = 1
def RecencyPoints(y,rfm,q):
    if y <= q['Recency'][0.25]:
        return 4
    elif y <= q['Recency'][0.5]:
        return 3
    elif y <= q['Recency'][0.75]:
        return 2
    else:
        return 1

# **TO-DO** Define the recency points function
# 0-25% = 4 / 25%-50% = 3 / 50%-75% = 2 / 75%-100% = 1
def Freq_MonetaryPoints(y,rfm,q):
    if y <= q[rfm][0.25]:
        return 1
    elif y <= q[rfm][0.5]:
        return 2
    elif y <= q[rfm][0.75]:
        return 3
    else:
        return 4
```

In [63]:

```python
# Copy RFM Table
rfm_segment = rfm_table.copy()

# **TO-DO** Apply RecencyPoint and MonetaryPoints function to Calculate Recency_Quartile
rfm_segment['Recency_Quartile'] = rfm_segment['Recency'].apply(lambda y: RecencyPoints(y
rfm_segment['Frequency_Quartile'] = rfm_segment['Frequency'].apply(lambda y: Freq_Moneta
rfm_segment['Monetary_Quartile'] = rfm_segment['Monetary'].apply(lambda y: Freq_Monetary
rfm_segment.set_index('CustomerID', inplace=True)

rfm_segment.head()
```

Out[63]:

	Recency	Frequency	Monetary	Recency_Quartile	Frequency_Quartile	Monetary_Quarti
CustomerID						
12346	326	2	0.00	1	2	
12347	3	7	4310.00	4	4	
12348	76	4	1797.24	2	3	
12349	19	1	1757.55	3	1	
12350	311	1	334.40	1	1	

RFM Classification

In [65]:

```
rfm_segment['RFMPoints'] = rfm_segment.Recency_Quartile.map(str)+rfm_segment.Frequency_Q
print(rfm_segment['RFMPoints'])
```

```
CustomerID
12346    121
12347    444
12348    234
12349    314
12350    112
        ...
18280    111
18281    111
18282    421
18283    444
18287    324
Name: RFMPoints, Length: 4372, dtype: object
```

In [66]:

```
customer_dict = {'Best Customers':'444','Loyal Customers':'344','Big Spender':'334','Alm
dict_segment = dict(zip( customer_dict.values(),customer_dict.keys()))
```

In [67]:

```
# Segment Customers based on RFM Points
rfm_segment['Segment'] = rfm_segment.RFMPoints.map(lambda x:dict_segment.get(x))
rfm_segment.Segment.fillna('others',inplace = True)

rfm_segment.sample(10)
```

```
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/3954248131.py:3: FutureW
arning: A value is trying to be set on a copy of a DataFrame or Series through chained as
signment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because the i
ntermediate object on which we are setting values always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col:
value}, inplace=True)' or df[col] = df[col].method(value) instead, to perform the operati
on inplace on the original object.


  rfm_segment.Segment.fillna('others',inplace = True)
```

Out[67]:

	Recency	Frequency	Monetary	Recency_Quartile	Frequency_Quartile	Monetary_Quarti
CustomerID						
13044	292	1	560.47	1	1	
14722	148	1	180.42	1	1	
18112	13	2	352.69	4	2	
14716	44	2	307.51	3	2	
17382	66	1	65.40	2	1	
12888	215	4	313.77	1	3	
12826	3	8	1468.12	4	4	
17053	129	2	496.38	2	2	
13634	34	5	1547.36	3	3	
18130	9	4	1045.74	4	3	

In [68]:

```
# **TO-DO** Display Best Customers whose recency, frequency as well as monetary attribut
best_customers = rfm_segment[rfm_segment['RFMPoints'] == '444']
best_customers = best_customers[[
    'Recency', 'Frequency', 'Monetary',
    'Recency_Quartile', 'Frequency_Quartile', 'Monetary_Quartile',
    'RFMPoints', 'Segment'
]]
best_customers.head(10)
```

Out[68]:

CustomerID	Recency	Frequency	Monetary	Recency_Quartile	Frequency_Quartile	Monetary_Quarti
12347	3	7	4310.00	4	4	
12359	8	6	6182.98	4	4	
12362	4	13	5154.58	4	4	
12381	5	6	1803.96	4	4	
12388	16	6	2780.66	4	4	
12395	16	15	2998.28	4	4	
12417	4	12	3578.80	4	4	
12423	1	9	1849.11	4	4	
12433	1	7	13375.87	4	4	
12437	2	19	4896.66	4	4	

In [69]:

```
# **TO-DO** Display Big Spenders
big_spenders = rfm_segment[rfm_segment['RFMPoints'] == '334']

big_spenders = big_spenders[[
    'Recency', 'Frequency', 'Monetary',
    'Recency_Quartile', 'Frequency_Quartile', 'Monetary_Quartile',
    'RFMPoints', 'Segment'
]]

big_spenders.head()
```

Out[69]:

CustomerID	Recency	Frequency	Monetary	Recency_Quartile	Frequency_Quartile	Monetary_Quarti
12380	22	5	2720.56	3	3	
12407	50	5	1708.12	3	3	
12432	43	5	5059.32	3	3	
12444	22	5	5005.46	3	3	
12449	23	4	4067.29	3	3	

In [70]:

```
# **TO-DO** Display Almost Lost who's recency is very low
almost_lost = rfm_segment[rfm_segment['RFMPoints'] == '244']

almost_lost = almost_lost[[
    'Recency', 'Frequency', 'Monetary',
    'Recency_Quartile', 'Frequency_Quartile', 'Monetary_Quartile',
    'RFMPoints', 'Segment'
]]

almost_lost.head()
```

Out[70]:

	Recency	Frequency	Monetary	Recency_Quartile	Frequency_Quartile	Monetary_Quarti
CustomerID						
12409	79	7	11056.93	2	4	
12455	74	6	2466.86	2	4	
12457	59	12	1917.78	2	4	
12520	80	6	2582.51	2	4	
12637	68	10	5934.25	2	4	

In [71]:

```
# **TO-DO** DisplayLost customers that don't need attention whose recency, frequency as
lost_customers = rfm_segment[rfm_segment['RFMPoints'] == '144']

lost_customers = lost_customers[[
    'Recency', 'Frequency', 'Monetary',
    'Recency_Quartile', 'Frequency_Quartile', 'Monetary_Quartile',
    'RFMPoints', 'Segment'
]]

lost_customers.head()
```

Out[71]:

	Recency	Frequency	Monetary	Recency_Quartile	Frequency_Quartile	Monetary_Quarti
CustomerID						
12383	185	6	1839.31	1	4	
12980	156	12	7092.06	1	4	
13093	268	13	7741.47	1	4	
15235	218	12	2247.51	1	4	
15379	170	8	3631.89	1	4	

In [72]:

```
# **TO-DO** Display loyal customers whose purchase frequency is high
loyal_customers = rfm_segment[rfm_segment['RFMPoints'] == '344']
```

```python
loyal_customers = loyal_customers[[
    'Recency', 'Frequency', 'Monetary',
    'Recency_Quartile', 'Frequency_Quartile', 'Monetary_Quartile',
    'RFMPoints', 'Segment'
]]

loyal_customers.head()
```

Out[72]:

	Recency	Frequency	Monetary	Recency_Quartile	Frequency_Quartile	Monetary_Quart
CustomerID						
12408	33	9	2842.57	3	4	
12415	25	26	123725.45	3	4	
12428	26	12	7877.20	3	4	
12431	36	18	6348.89	3	4	
12472	31	13	6229.48	3	4	

In [73]:

```python
# **TO-DO** Display customers that you must retain are those whose monetary and frequenc
must_retain = rfm_segment[rfm_segment['RFMPoints'] == '244']

must_retain = must_retain[[
    'Recency', 'Frequency', 'Monetary',
    'Recency_Quartile', 'Frequency_Quartile', 'Monetary_Quartile',
    'RFMPoints', 'Segment'
]]

must_retain.head()
```

Out[73]:

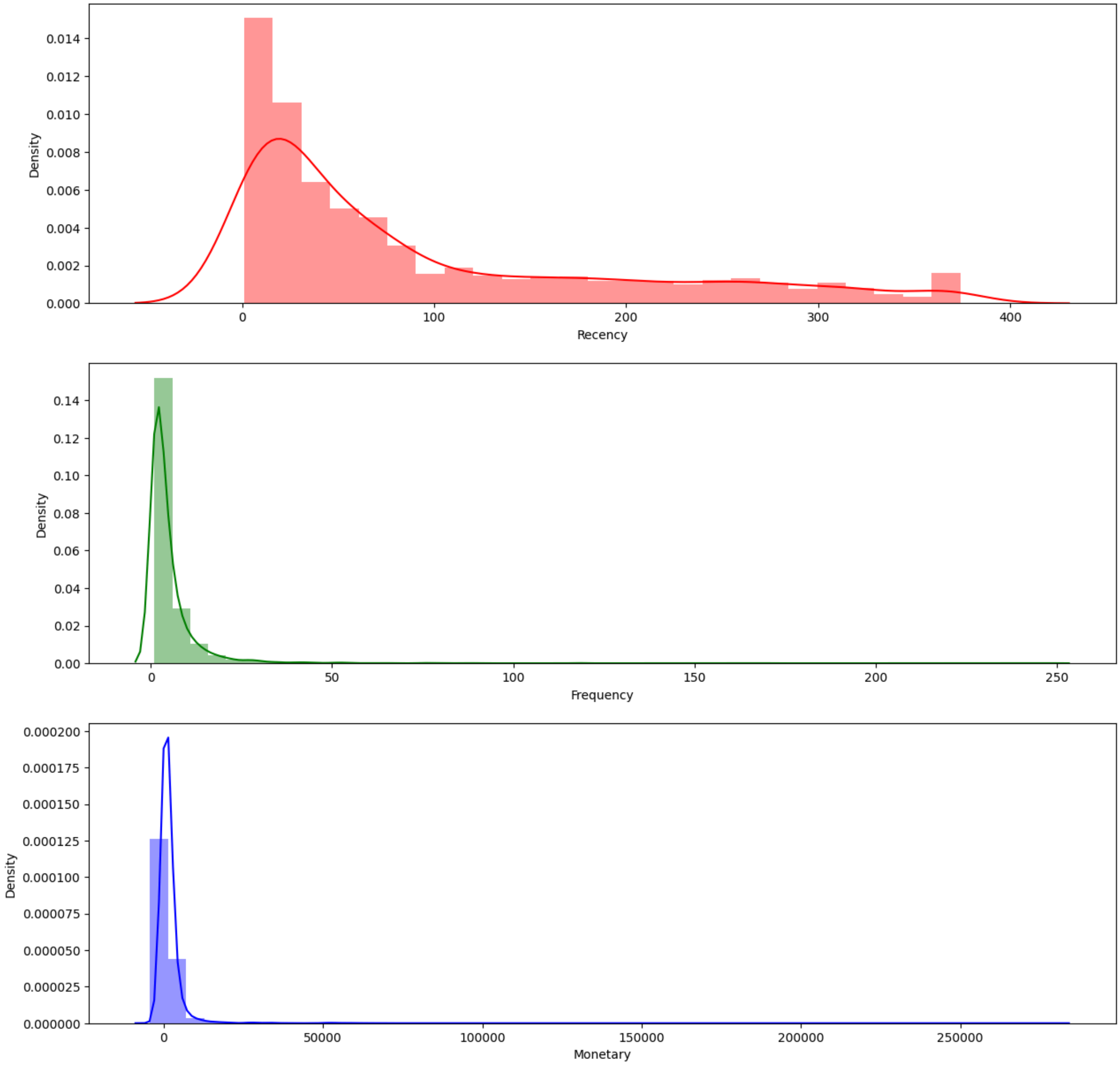
	Recency	Frequency	Monetary	Recency_Quartile	Frequency_Quartile	Monetary_Quarti
CustomerID						
12409	79	7	11056.93	2	4	
12455	74	6	2466.86	2	4	
12457	59	12	1917.78	2	4	
12520	80	6	2582.51	2	4	
12637	68	10	5934.25	2	4	

RFM Distribution Visualization

In [75]:

```python
fig,axes = plt.subplots(3,1,figsize=(15,15))
sns.distplot(rfm_table.Recency,color='Red',axlabel='Recency',ax=axes[0])
sns.distplot(rfm_table.Frequency,color='Green',axlabel='Frequency',ax=axes[1])
sns.distplot(rfm_table.Monetary,color='Blue',axlabel='Monetary',ax=axes[2])
plt.show()
```

```
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/318202995.py:2: UserWarn
ing:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(rfm_table.Recency,color='Red',axlabel='Recency',ax=axes[0])
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/318202995.py:3: UserWarn
ing:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(rfm_table.Frequency,color='Green',axlabel='Frequency',ax=axes[1])
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/318202995.py:4: UserWarn
ing:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(rfm_table.Monetary,color='Blue',axlabel='Monetary',ax=axes[2])
```



In [76]:

```
rfm_table.describe()
```

Out[76]:

	CustomerID	Recency	Frequency	Monetary
count	4372.00	4372.00	4372.00	4372.00
mean	15299.68	92.58	5.08	1893.53
std	1722.39	100.77	9.34	8218.70
min	12346.00	1.00	1.00	-4287.63
25%	13812.75	17.00	1.00	291.80
50%	15300.50	51.00	3.00	644.07
75%	16778.25	144.00	5.00	1608.34
max	18287.00	374.00	248.00	279489.02

In [77]:

```
scaled_rfm = rfm_table.copy()
scaled_rfm.Monetary = rfm_table.Monetary + abs(rfm_table.Monetary.min())+1
scaled_rfm.Recency = rfm_table.Recency + abs(rfm_table.Recency.min())+1
scaled_rfm.describe()
```

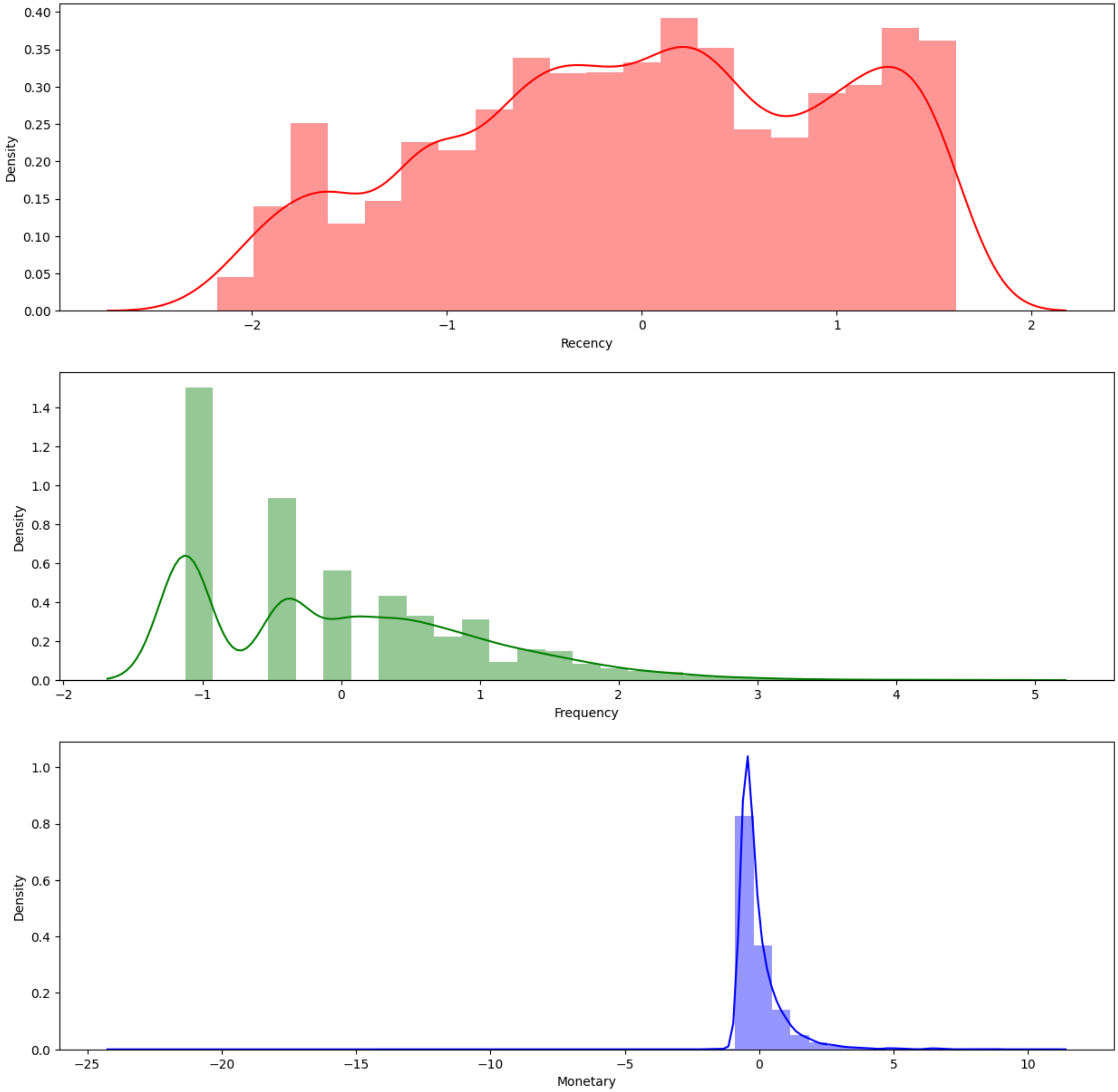
Out[77]:

	CustomerID	Recency	Frequency	Monetary
count	4372.00	4372.00	4372.00	4372.00
mean	15299.68	94.58	5.08	6182.16
std	1722.39	100.77	9.34	8218.70
min	12346.00	3.00	1.00	1.00
25%	13812.75	19.00	1.00	4580.43
50%	15300.50	53.00	3.00	4932.70
75%	16778.25	146.00	5.00	5896.97
max	18287.00	376.00	248.00	283777.65

In [78]:

```
import numpy as np

from sklearn.preprocessing import StandardScaler

log_df = np.log(scaled_rfm)
scal = StandardScaler()
normal_ = scal.fit_transform(log_df)
normal_ = pd.DataFrame(data=normal_,index = rfm_table.index,columns=rfm_table.columns)

fig, axes = plt.subplots(3, 1, figsize=(15, 15))
sns.distplot(normal_.Recency , color="Red", ax=axes[0], axlabel='Recency')
sns.distplot(normal_.Frequency , color="Green", ax=axes[1], axlabel='Frequency')
sns.distplot(normal_.Monetary , color="Blue", ax=axes[2], axlabel='Monetary')
plt.show()
```

```
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/1296018613.py:11: UserWa
rning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(normal_.Recency , color="Red", ax=axes[0], axlabel='Recency')
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/1296018613.py:12: UserWa
rning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(normal_.Frequency , color="Green", ax=axes[1], axlabel='Frequency')
/var/folders/xb/2tg9ddl94wl284px7ngj8hn40000gn/T/ipykernel_20245/1296018613.py:13: UserWa
rning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(normal_.Monetary , color="Blue", ax=axes[2], axlabel='Monetary')
```


Density
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
−2
−1
0
1
2
Recency
Density
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
−2
−1
0
1
2
3
4
5
Frequency
Density
1.0
0.8
0.6
0.4
0.2
0.0
−25
−20
−15
−10
−5
0
5
10
Monetary

In [ ]: