

Data Science: Data Cleansing And Visualization For Beginners Using Python

In this article, I am discussing an educational project work in the fascinating field of Data Science while trying to learn the ropes of Data Science. This write-up intends to share the project journey with the larger world and the outcome.

Data science is a discipline that is both artistic and scientific simultaneously. A typical project journey in Data Science involves extracting and gathering insightful knowledge from data that can either be structured or unstructured. The entire tour commences with data gathering and ends with exploring the data entirely for deriving business value. The cleansing of the data, selecting the right algorithm to use on the data, and finally devising a machine learning function is the objective in this journey. The machine learning function derived is the outcome of this art that would solve the business problems creatively.

I will be focussing exclusively on the Data cleansing, imputation, exploration, and visualization of the data. I presume the reader has a basic knowledge of Python or even any equivalent language such as Java or C or Cplusplus to follow the code snippets. The coding was done in Python and executed using Jupyter notebook. I will describe the steps we undertook in this project journey, forming this write-up's crux.

Import Libraries

We began by importing the libraries that are needed to preprocess, impute, and render the data. The Python libraries that we used are Numpy, random, re, Matplotlib, Seaborn, and Pandas. Numpy for everything mathematical, random for random numbers, re for regular expression, Pandas for importing and managing the datasets, Matplotlib.pyplot, and Seaborn for drawing figures. Import the libraries with a shortcut alias as below.

```
import numpy as np
import random
import re
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

Loading the data set

We were handed over e-commerce data to explore. The data set was loaded using Pandas. Some necessary information about the data set was obtained using the 'info' method.

```
ecom = pd.read_csv('Ecommerce_Purchases.csv')
ecom.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 14 columns):
 #   Column           Non-Null Count  Dtype  
--- 
 0   Address          10000 non-null   object 
 1   Lot              10000 non-null   object 
 2   AM or PM         10000 non-null   object 
 3   Browser Info    10000 non-null   object 
 4   Company          10000 non-null   object 
 5   Credit Card     10000 non-null   int64  
 6   CC Exp Date     10000 non-null   object 
 7   CC Security Code 10000 non-null   int64  
 8   CC Provider      10000 non-null   object 
 9   Email            10000 non-null   object 
 10  Job              10000 non-null   object 
 11  IP Address       10000 non-null   object 
 12  Language          10000 non-null   object 
 13  Purchase Price   10000 non-null   float64
dtypes: float64(1), int64(2), object(11)
memory usage: 1.1+ MB
```

The shape of the dataset was determined to be 10000 rows and 14 columns. The describe specifies the basic statistics of the dataset.

```
ecom.shape
```

```
(10000, 14)
```

```
ecom.describe()
```

	Credit Card	CC Security Code	Purchase Price
count	1.000000e+04	10000.000000	10000.000000
mean	2.341374e+15	907.217800	50.347302
std	2.256103e+15	1589.693035	29.015836
min	6.040186e+10	0.000000	0.000000
25%	3.056322e+13	280.000000	25.150000
50%	8.699942e+14	548.000000	50.505000
75%	4.492298e+15	816.000000	75.770000
max	6.012000e+15	9993.000000	99.990000

```
ecom.nunique()
```

```
Address          10000
Lot              9822
AM or PM         2
Browser Info     8287
Company          8653
Credit Card      10000
CC Exp Date      121
CC Security Code 1758
CC Provider       10
Email             9954
Job               623
IP Address        10000
Language           9
Purchase Price    6349
dtype: int64
```

The 'nunique' method gives the number of unique elements in the dataset.

Initial exploration of the data set

This step involved exploring the various facets of the loaded data. This step helps in understanding the data set columns and also the contents.

```
ecom[ 'Purchase Price' ].describe()
```

```
count      10000.000000
mean       50.347302
std        29.015836
min        0.000000
25%       25.150000
50%       50.505000
75%       75.770000
max        99.990000
Name: Purchase Price, dtype: float64
```

```
# People who have English 'en' as their Language of choice on the website
```

```
ecom[ecom[ 'Language' ]=='en'].count()
```

```
Address          1098
Lot              1098
AM or PM         1098
Browser Info    1098
Company          1098
Credit Card      1098
CC Exp Date     1098
CC Security Code 1098
CC Provider      1098
Email            1098
Job              1098
IP Address       1098
Language          1098
Purchase Price   1098
dtype: int64
```

```
#count number of transactions in AM and PM
ecom[ 'AM or PM' ].value_counts()
```

```
PM      5068
AM      4932
Name: AM or PM, dtype: int64
```

```
#top five jobs
ecom[ 'Job' ].value_counts().head(5)
```

```
Interior and spatial designer      31
Lawyer                            30
Social researcher                  28
Designer, jewellery                27
Research officer, political party  27
Name: Job, dtype: int64
```

```
#top five email providers
ecom[ 'Email' ].apply(lambda x: x.split('@')[1]).value_counts().head(5)
```

```
hotmail.com    1638
yahoo.com      1616
gmail.com      1605
smith.com       42
williams.com    37
Name: Email, dtype: int64
```

Interpreting and transforming the data set

In a real-world scenario, the data information that one starts with could be either raw or unsuitable for Machine Learning purposes. We will need to transform the incoming data suitably.

```
selected_columns = ecom[['AM or PM', 'Company', 'Credit Card',
    'CC Exp Date', 'CC Security Code', 'CC Provider', 'Email', 'Job',
    'IP Address', 'Language', 'Purchase Price']]

cleaned_ecom = selected_columns.copy()

#clean up address
address = ecom['Address'].str.extract(r",*\W*([A-Z]{2})\W+[0-9\-\-]*$",
    expand = False)
address = address.str.split(pat=r"\W|\-", expand = True)

#clean browser
browser = ecom['Browser Info'].str.split(pat=r" |\(|\)", expand = True)
browser_and_ver = browser[0].str.split(pat=r"/", expand = True)

cleaned_ecom['Browser'] = browser_and_ver[0]
cleaned_ecom['Browser Version'] = browser_and_ver[1]
cleaned_ecom['CC Exp Year'] = ecom['CC Exp Date'].str.split(pat=r"/",
    expand = True)[1].astype(int)
cleaned_ecom['CC Exp Month'] = ecom['CC Exp Date'].str.split(pat=r"/",
    expand = True)[0].astype(int)
cleaned_ecom['State'] = address[0]
cleaned_ecom['ZIP Code'] = address[1]
cleaned_ecom['ZIP Code'] = cleaned_ecom['ZIP Code'].astype(int)
cleaned_ecom['CC Provider'] = cleaned_ecom['CC Provider'].str.split(pat = '\d',
    expand = True)[0]
cleaned_ecom.nunique() #There are 10000 different credit cards registered and 10000 different IP addresses
#but interestingly not 10000 different email addresses. Hence email address is not used to maintain user account

AM or PM          2
Company         8653
Credit Card     10000
CC Exp Date     121
CC Security Code 1758
CC Provider      8
Email           9954
Job              623
IP Address      10000
Language          9
Purchase Price   6349
Browser            2
Browser Version   181
CC Exp Year       11
CC Exp Month      12
State             62
ZIP Code        9543
dtype: int64
```

We wanted to drop any duplicate rows in the data set using the 'duplicate' method. However, as you would note below, the data set we received did not contain any duplicates.

```
cleaned_ecom = cleaned_ecom.drop_duplicates() #drop duplicates if any
cleaned_ecom
```

	AM or PM	Company	Credit Card	CC Exp Date	CC Security Code	CC Provider	Email	Job	IP Address	Language	Purchase Price	Bra
0	PM	Martinez-Herman	6011929061123406	02/20	900	JCB	pdunlap@yahoo.com	Scientist, product/process development	149.146.147.205	el	98.14	N
1	PM	Fletcher, Richards and Whitaker	3337758169645356	11/18	561	Mastercard	anthony41@reed.com	Drilling engineer	15.160.41.51	fr	70.73	N
2	PM	Simpson, Williams and Pham	675957666125	08/19	699	JCB	amymiller@morales-harrison.com	Customer service manager	132.207.160.22	de	0.95	N
3	PM	Williams, Marshall and Buchanan	6011578504430710	02/24	384	Discover	brent16@olson-robinson.info	Drilling engineer	30.250.74.19	es	78.04	N
4	AM	Brown, Watson and Andrews	6011456623207998	10/25	678	Diners Club / Carte Blanche	christopherwright@gmail.com	Fine artist	24.140.33.94	es	77.82	N
...
9995	PM	Randall-Sloan	342945015358701	03/22	838	JCB	iscott@wade-garner.com	Printmaker	29.73.197.114	it	82.21	N
9996	AM	Hale, Collins and Wilson	210033169205009	07/25	207	JCB	mary85@hotmail.com	Energy engineer	121.133.168.51	pt	25.63	N
9997	AM	Anderson Ltd	6011539787356311	05/21	1	VISA	tyler16@gmail.com	Veterinary surgeon	156.210.0.254	el	83.98	N
9998	PM	Cook Inc	180003348082930	11/17	987	American Express	elizabethmoore@reid.net	Local government officer	55.78.26.143	es	38.84	N
9999	AM	Greene Inc	4139972901927273	02/19	302	JCB	rachelford@vaughn.com	Embryologist, clinical	176.119.198.199	el	67.59	N

10000 rows x 17 columns

```
cleaned_ecom.describe()
```

	Credit Card	CC Security Code	Purchase Price	CC Exp Year	CC Exp Month	ZIP Code
count	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000
mean	2.341374e+15	907.217800	50.347302	21.173100	6.42570	49808.190700
std	2.256103e+15	1589.693035	29.015836	2.918114	3.46648	28965.375251
min	6.040186e+10	0.000000	0.000000	16.000000	1.00000	29.000000
25%	3.056322e+13	280.000000	25.150000	19.000000	3.00000	24745.000000
50%	8.699942e+14	548.000000	50.505000	21.000000	6.00000	49695.000000
75%	4.492298e+15	816.000000	75.770000	24.000000	9.00000	75011.250000
max	6.012000e+15	9993.000000	99.990000	26.000000	12.00000	99994.000000

Impute the data

While looking for invalid values in the data set, we determined that the data set was clean. The question placed on us in the project was to introduce errors at the rate of 10% overall if the data set supplied was clean. So given this ask, we decided

to introduce errors into a data set column forcibly. We consciously choose to submit the errors in the

'Purchase Price' column as this has the maximum impact on the dataset outcome. Thus, about 10% of the 'Purchase Price' data randomly set with 'numpy–NaN.'

We could have used the Imputer class from the scikit-learn library to fill in missing values with the data (mean, median, most frequent). However, to keep experimenting with hand made code; instead, I wrote a re-usable data frame impute class named 'DataFrameWithImputor' that has the following capabilities.

Be instantiated with a data frame as a parameter in the constructor.

Introduce errors to any numeric column of a data frame at a specified error rate.

Introduce errors across the dataframe in any cell of the dataframe at a specified error rate.

Impute error values in a column of the data set.

Find empty strings in rows of the data set.

Get the 'nan' count in the data set.

Possess an ability to describe the entire data set in the imputed object.

Have an ability to express any column of the dataset in the impute object.

Perform forward fill on the entire data set.

Perform backward fill on the entire data set.

Shown below is the impute class.

```

class DataFrameWithImputer():
    def __init__(self,df):
        self.df=df

    def get_data_frame(self):
        return self.df

    #Randomly find indexes for x% of the column to populate with NaN values
    def introduce_errors(self, attribute, percent):
        column = self.df[attribute]
        error_data = int(column.size * percent)
        i = [random.choice(range(column.shape[0])) for _ in range(error_data)]
        column[i] = np.NaN
        self.df[attribute] = column
        return len(set(i)) # length of error indexes

    #Randomly find indexes for x% of the cells to populate with NaN values
    def introduce_errors_in_dataframe(self, percent):
        rows = len(self.df.index)
        error_data = int(rows * percent)
        columns = len(self.df.columns)
        for i in range(error_data):
            col = i % columns
            row = i % rows
            self.df.iloc[row,col] = np.NaN
        return self.df.isnull().sum().sum()

    def impute(self,column,value):
        #Impute NaN values in the column with a random value

        null_values = self.df[self.df[column].isnull()].index

        for i in range(len(null_values)):
            self.df[column][null_values] = value

        col_description = pd.DataFrame(self.df[column].describe())
        col_description.loc['Frequent'] = self.df[column].value_counts().idxmax()
        return col_description

```

```

def get_nan_count(self):
    return self.df.isnull().sum()

def find_empty_string(self):
    return np.where(self.df.applymap(lambda x: x == '')) # return rows with empty string

def nan_values_in_column(self):
    return np.where(pd.isnull(self.df)) #return indexes for null values in a row

def describe(self):
    return self.df.describe

def describe_col(self, col):
    desc = pd.DataFrame(self.df[col].describe())

    desc.loc['Frequent'] = self.df[col].value_counts().idxmax()
    return desc

def fillforward(self):
    self.df = self.df.fillna(method='ffill',axis = 0)

def fillbackward(self):
    self.df = self.df.fillna(method='bfill',axis = 0)

```

The un-imputed data set was checked for any Nan or missing strings for one final time before introducing errors.

```

unimputed = DataFrameWithImputer(cleaned_ecom)
if len(unimputed.find_empty_string()) > 2:
    print('Empty strings in the data frame')

if len(unimputed.nan_values_in_column()) > 2:
    print('NaN in the data frame')

```

A helper function '*doimpute*' was defined to introduce errors in a column of the data set and impute the data set column afterwards. This function would take a condition parameter to perform imputation.

```

def do_imputation(df,column,error_rate,condition = None):
    imp = DataFrameWithImputer(df.copy())
    imp.introduce_errors(column,error_rate)

    if condition != None:
        imp.impute(column,condition)
    else:
        #Impute through backfill and forwardfill
        imp.fillbackward()
        imp.fillforward()

    return imp

```

To introduce error, random cells in the 'Purchase Price' column is set to 'NaN.' Once set, there are several ways to fill up missing values or 'NaN':

1. We can remove the missing value rows itself from the data set. However, in this case, the error percentage is low at just 10%, so this method was not needed.
2. Fill in the null cell in the data set column with a constant value.
3. Filling the invalid section with mean and median values
4. Fill the nulls with a random value.
5. Filling null using data frame backfill and forward fill

The above mentioned are some common strategies applied to impute the data set. However, there are no limits to designing a radically different approach to the data set imputation itself.

```

#####
# Mean imputation
#####

mean_imputed = do_imputation(cleaned_ecom,'Purchase Price',.1, cleaned_ecom['Purchase Price'].mean())

#####
# Median imputation
#####
#Impute NaN values in the column with the median

median_imputed = do_imputation(cleaned_ecom,'Purchase Price',.1, cleaned_ecom['Purchase Price'].median())

#####
# Random imputation
#####

random_imputed = do_imputation(cleaned_ecom,'Purchase Price',.1,random.choice(range(1,99)))

#####
# Impute with constant
#####

const_imputed = do_imputation(cleaned_ecom,'Purchase Price',.1, 50)

#Forward and backward fill to impute data
#
fill_imputed = do_imputation(cleaned_ecom,'Purchase Price',.1)

```

Each of the imputed outcomes was studied separately – the fill (backfill and forward fill) and constant value imputations outcome shown below.

```
fill_imputed.describe_col('Purchase Price')
```

Purchase Price	
count	10000.000000
mean	50.327816
std	29.071102
min	0.000000
25%	25.060000
50%	50.570000
75%	75.860000
max	99.990000
Frequent	76.530000

```
const_imputed.describe_col('Purchase Price')
```

Purchase Price	
count	10000.000000
mean	50.302625
std	27.581357
min	0.000000
25%	27.750000
50%	50.000000
75%	72.990000
max	99.990000
Frequent	50.000000

The median and random value imputations are in the code below.

```
median_imputed.describe_col('Purchase Price')
```

Purchase Price	
count	10000.000000
mean	50.450384
std	27.641255
min	0.000000
25%	27.797500
50%	50.505000
75%	73.205000
max	99.990000
Frequent	50.505000

```
random_imputed.describe_col('Purchase Price')
```

Purchase Price	
count	10000.000000
mean	50.542415
std	27.575375
min	0.000000
25%	27.927500
50%	53.000000
75%	72.862500
max	99.990000
Frequent	53.000000

Then the mean imputed outcome is visually compared with an un-imputed or clean data column as below.

```
mean_imputed.describe_col('Purchase Price')
```

Purchase Price	
count	10000.000000
mean	50.445186
std	27.662944
min	0.000000
25%	27.930000
50%	50.347302
75%	73.162500
max	99.990000
Frequent	50.347302

```
unimputed.describe_col('Purchase Price')
```

Purchase Price	
count	10000.000000
mean	50.347302
std	29.015836
min	0.000000
25%	25.150000
50%	50.505000
75%	75.770000
max	99.990000
Frequent	49.730000

From the above techniques, mean imputation was found closer to the un-imputed clean data, thus preferred. Other choices such as fill(forward and backward) also seemed to produce data set column qualitatively very close to clean data from the study above. However, the mean imputation was preferred as it gives a consistent result and a more widespread impute technique.

```
df = mean_imputed.get_data_frame()
```

The data frame adopted for further visualization was the mean imputed data set.

Exploring and Analysing the data

A cleaned up and structured data is suitable for analyzing and finding exemplars using visualization.

Top five Professions that have highest Purchase Amount

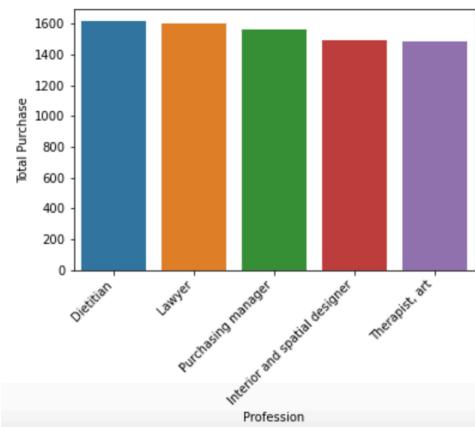
1. Find the relationship between Job designation and Purchase amount

```
job = df.groupby(by=['Job'], as_index=False)[ 'Purchase Price' ].sum()#group by Job and sort by total purchase amount  
res1= job.sort_values(by='Purchase Price', ascending=False).iloc[:5,:] #get top 5 profession and corresponding purchase  
res1 #On first sight it looks like dietitian is the designation that is spending the most amount
```

Job	Purchase Price
158	Dietitian 1613.111906
325	Lawyer 1603.850000
473	Purchasing manager 1564.237302
312	Interior and spatial designer 1494.529208
589	Therapist, art 1484.737302

```
ax = sns.barplot(x = "Job", y = "Purchase Price", data = res1)  
ax.set(xlabel="Profession", ylabel = "Total Purchase")  
ax.set_xticklabels(ax.get_xticklabels(), rotation=45, horizontalalignment='right')
```

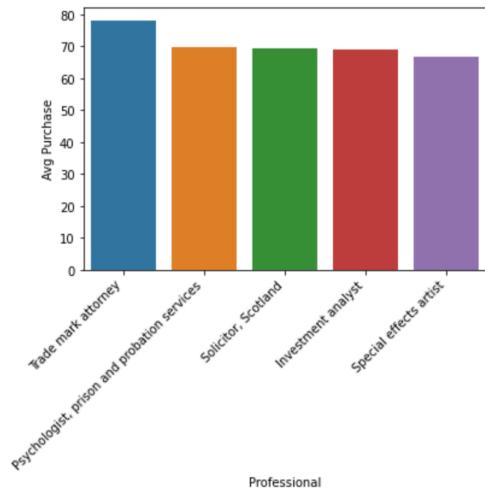
```
[Text(0, 0, 'Dietitian'),  
Text(0, 0, 'Lawyer'),  
Text(0, 0, 'Purchasing manager'),  
Text(0, 0, 'Interior and spatial designer'),  
Text(0, 0, 'Therapist, art')]
```



1.1. Find the relationship between Job designation and mean Purchase amount

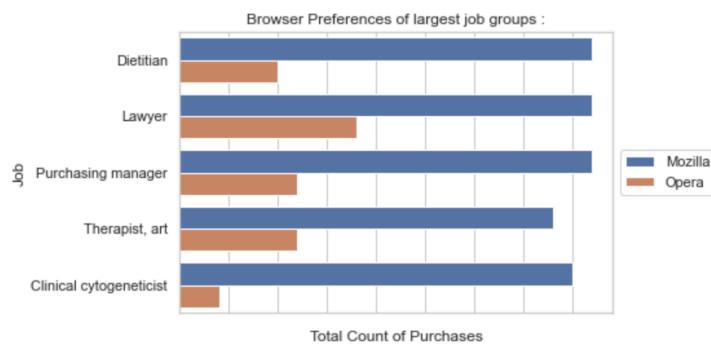
```
job = df.groupby(by=['Job'], as_index=False)[['Purchase Price']].mean()
res2= job.sort_values(by='Purchase Price', ascending=False).iloc[:5,:]
res2
#Calculating the mean Purchase price by Job Designation
#We can see that Trade Mark attorney is the job type that makes the biggest purchases on avg

ax = sns.barplot(x = "Job", y = "Purchase Price", data = res2)
ax.set_xlabel="Professional", ylabel = "Avg Purchase")
ax.set_xticklabels(ax.get_xticklabels(), rotation=45, horizontalalignment='right')
plt.show()
```



Bi-variate analysis of Profession, Purchase counts against browsers used

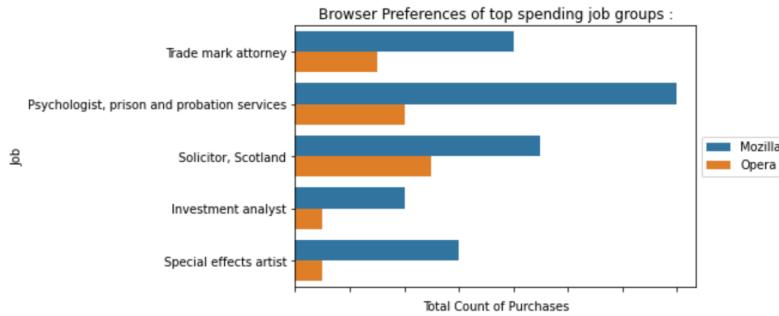
```
#Group by job and browser preferences
jobBrowser = df.groupby(by=['Job', 'Browser'], as_index=False, )[['Purchase Price']].count()
plt.title(f"Browser Preferences of largest job groups :")
ax = sns.barplot(x = "Purchase Price_y", y = "Job", hue="Browser",
                  orient = 'h', data = res1.merge(jobBrowser, on = 'Job', how = 'inner')) #merge with top 5 jobs
ax.set_ylabel="Job", xlabel = "Total Count of Purchases"
ax.set_xticklabels(ax.get_xticklabels(), rotation=45, horizontalalignment='right')
plt.legend(loc='center left', bbox_to_anchor=(1.0, 0.5))
plt.show()
```



```

plt.title(f"Browser Preferences of top spending job groups :")
ax = sns.barplot(x = "Purchase Price", y = "Job", hue="Browser" , orient = 'h',
                  data = res2.merge(jobBrowser,on = 'Job' ,how = 'inner'))
ax.set(ylabel="Job", xlabel = "Total Count of Purchases")
ax.set_xticklabels(ax.get_xticklabels(), rotation=45, horizontalalignment='right')
plt.legend(loc='center left', bbox_to_anchor=(1.0, 0.5))
plt.show()

```



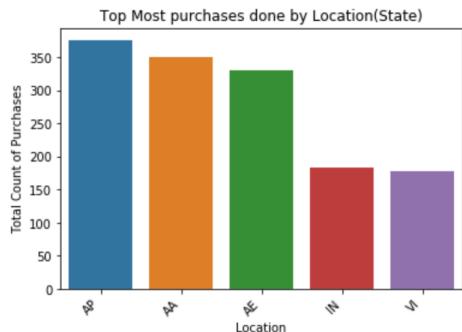
States that have maximum purchases

```
#### 3. Top five states (locations) that purchases
```

```

res=df.groupby(by='State', as_index=False).count()[['State','Purchase Price']]
res = res.sort_values(by='Purchase Price', ascending=False).head()
plt.title('Top Most purchases done by Location(State)')
ax = sns.barplot(x = "State", y = "Purchase Price", data = res)
ax.set(xlabel="Location", ylabel = "Total Count of Purchases")
ax.set_xticklabels(ax.get_xticklabels(), rotation=45, horizontalalignment='right')
plt.show()

```

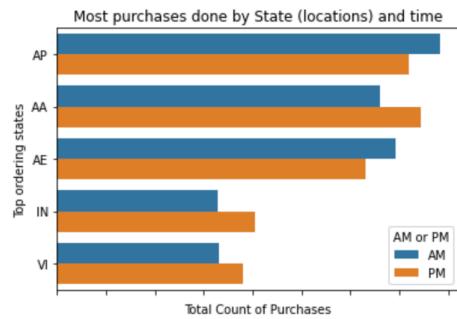


```

#Purchases done by State (locations) and correspinding time
res=df.groupby(by='State', as_index=False)[ 'Purchase Price'].count()
res = res.sort_values(by='Purchase Price', ascending=False).iloc[:5,:]
res4=df.groupby(by=['State','AM or PM'], as_index=False)[ 'Purchase Price'].count()
res4= res4.sort_values(by='Purchase Price', ascending=False)

plt.title('Most purchases done by State (locations) and time')
ax = sns.barplot(x = "Purchase Price_y", y = "State",hue="AM or PM" , orient = 'h', \
                  data = res.merge(res4, on = 'State', how = 'inner'))
ax.set(ylabel="Top ordering states", xlabel = "Total Count of Purchases")
ax.set_xticklabels(ax.get_xticklabels(), rotation=45, horizontalalignment='right')
plt.show()

```



Credit cards providers at different times (AM/PM) for purchases

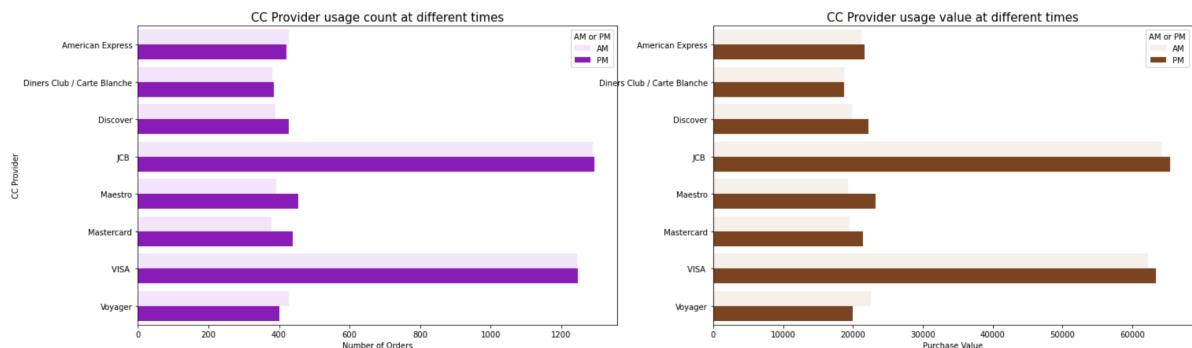
4. Credit Card providers involved in transactions at different times for purchases

```

fig, axarr = plt.subplots(1, 2, figsize=(24, 7))
CC_data_hue_cnt = df.groupby(by=['CC Provider','AM or PM'], as_index=False)[ 'Purchase Price'].count()
ax = sns.barplot(y = 'CC Provider', x = 'Purchase Price' ,hue='AM or PM', orient = 'h', data = CC_data_hue_cnt,\n                 color = 'darkviolet', ax=axarr[0])
ax.set(xlabel="Number of Orders", ylabel='CC Provider')
axarr[0].set_title("CC Provider usage count at different times", fontsize=15)

CC_data_hue_sum = df.groupby(by=['CC Provider','AM or PM'], as_index=False)[ 'Purchase Price'].sum()
ax = sns.barplot(y = 'CC Provider', x = 'Purchase Price' ,hue='AM or PM', orient = 'h', data = CC_data_hue_sum,\n                 color = 'saddlebrown', ax=axarr[1])
ax.set(xlabel="Purchase Value", ylabel=None)
axarr[1].set_title("CC Provider usage value at different times", fontsize=15)
plt.show()

```



Top five locations for purchases

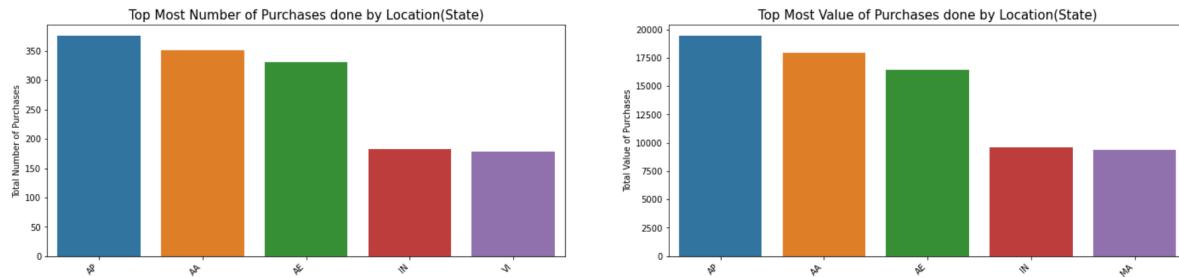
We plotted a sub-plot as below.

5. What are top 5 Location(State) for purchases?

```
fig, axarr = plt.subplots(1, 2, figsize=(24, 5))
#print('The TOP 5 Locations(state) with number of purchase...')
res=df.groupby(by='State', as_index=False).count()[['State','Purchase Price']]
res = res.sort_values(by='Purchase Price', ascending=False).head()
ax = sns.barplot(x = "State", y = "Purchase Price", data = res, ax=axarr[0])
axarr[0].set_title("Top Most Number of Purchases done by Location(State)", fontsize=15)
ax.set(xlabel=None, ylabel = "Total Number of Purchases")
ax.set_xticklabels(ax.get_xticklabels(), rotation=45, horizontalalignment='right')

#print('The TOP 5 Locations(state) with max amount of purchase...')
res=df.groupby(by='State', as_index=False).sum()[['State','Purchase Price']]
res = res.sort_values(by='Purchase Price', ascending=False).head()
ax = sns.barplot(x = "State", y = "Purchase Price", data = res, ax=axarr[1])
axarr[1].set_title("Top Most Value of Purchases done by Location(State)", fontsize=15)
ax.set(xlabel=None, ylabel = "Total Value of Purchases")
ax.set_xticklabels(ax.get_xticklabels(), rotation=45, horizontalalignment='right')

plt.show()
```



We can similarly repeat this subplot to view the top 5 credit cards, the top 5 email providers, and the top 5 languages involved in purchases. There are many other visualizations techniques beyond what I have described in this article, with each one capable of giving unique insights into the dataset.

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The Team

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Closing Words

We had fun and many learnings while doing some of these fundamental steps required to work through a large data set, clean, impute, and visualize the data for further work. We finished the project here, and of course, the real journey does not end here as it will progress into modeling, training, and testing phases. For us, this is only the beginning of a long trip. Every data science project that has a better and cleaner data will generate awe-inspiring results! :