Lending club case study by - Ashwin Kumar H

Purpose - The purpose of this document is to perfrom an explonatory data analysis on the lending club case.

The document aims to perform below,

1. Data understanding.
2. Data cleaning and manipulation.
3. Data analysis.
4. Presentation and recommendations.

```
# from google.colab import drive
# drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mour
```

Import required libraries

bold text

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

%matplotlib inline

import warnings
warnings.filterwarnings('ignore')

from datetime import date
```

Perfrom global settings

```
pd.options.display.float_format = '{:.2f}'.format
pd.options.display.max_colwidth = 500
```

```
font = {'family': 'serif',
        'color':  'darkred',
        'weight': 'normal',
        'size': 16,
        }
```

Functions

```
# Functions to trim the strings on either side.
def trimData(x):
  return x.strip()


# Function to get basic dataset details like shape, rows, columns
def getBasicDataSetDetails(df):
  print("The shape of the dataset is ", df.shape)
  print("The number of rows dataset is ", df.shape[0])
  print("The number of columns in the dataset is ", df.shape[1])



# Function to provide a summary of how many int64, float, object and datetime columns exists
def getColumnDataTypes(df):
  dtypes = df.dtypes.to_frame().reset_index()
  dtypes.columns = ["Column","Data Types"]
  return dtypes


# Function to get column names by datatype.
def getEachColumnsDataType(df,col_dtype):
  columnsList = [var for var in df.columns if df[var].dtype == col_dtype]
  print('columns of type', col_dtype , 'are', columnsList, end='')


# Function to plot histogram, probplot and boxplot for numerical analysis
def plotNumericalDiagnostics(df,var_col, no_of_bins):

  print(f"Total NA enties {df[var_col].isnull().mean()} \n")
  print(df[var_col].describe().to_frame().T,'\n')
  plt.figure(figsize=(18,6))

  plt.subplot(1,3,1)
  sns.histplot(df[var_col], bins=no_of_bins)
  plt.title(f'Histogram for varibale {var_col}')

  plt.subplot(1, 3, 2)
  sns.boxplot(y=df[var_col])
  plt.title(f'Boxplot for variable {var_col}')

  plt.subplot(1, 3, 3)
```

```
    stats.probplot(df[var_col], dist="norm", plot=plt)
    plt.title(f'Probplot for varibale {var_col}')

    plt.show()



# Function to get columns with nulls above a percentage
def getColumnsWithHighNulls(df,nullPercentage):
    x = df.isnull().mean().sort_values(ascending= False).apply(lambda x: x >= nullPercentage)
    return x[x == True].index


# Function to drop all numerical columns who just have NAN or zero in them
def dropNumericColumnsWithSumAsZero(df,dt_type):
    columnsList = [var for var in df.columns if df[var].dtype == dt_type and df[var].fillna(0).
    df.drop(columns=columnsList, inplace=True)


# Function to replace a character with other
def replaceCharcter(df, var_char, originalChar, replaceChar):
    df[var_char] = df[var_char].apply(lambda x: x.replace(originalChar,replaceChar))



# Function to displaya seborn countplot with hue
def drawCountPlotWithHue(df,var_x,var_hue,plt_title):
    sns.set(style="whitegrid")
    plt.figure(figsize=(8,5))
    total = float(len(df))
    ax = sns.countplot(x=var_x, hue=var_hue, data=df)
    plt.title(plt_title, fontsize=20)
    for p in ax.patches:
        percentage = '{:.1f}%'.format(100 * p.get_height()/total)
        x = p.get_x() + p.get_width()
        y = p.get_height()
        ax.annotate(percentage, (x, y),ha='center')
    plt.show()


# Function to displaya seborn countplot with hue
def drawCountplotWithHue(df,var_x,var_hue):
    plt.figure(figsize=(18,10), dpi=70)
    sns.countplot(data=df, x=var_x,  hue=var_hue)
    plt.xticks(rotation = 90)
    plt.show()


# Function to displaya seborn countplot without hue
def drawCountPlotWithoutHue(df,var_x):
    plt.figure(figsize=(18,10), dpi=70)
    sns.countplot(data = df, x =var_x)
    plt.xticks(rotation = 90)
```

```
  plt.show()


# Function to convert object types to datetime types
def convertToDateTime(df,c_var):
  year = date.today().year
  year = '-' + str(year)
  df[c_var] = pd.to_datetime(df[c_var] + year)


# Function to categorize if loan is given in excess,less or equal
def categorizeloan(x):
  res = "unknown;"
  if (x==0):
    res = "equal"
  elif (x > 0):
    res = "excess"
  else:
    res = "less"
  return res;
```

Data understanding

Read the file and create the dataset

```
dfLendingclub = pd.read_csv("drive/MyDrive/loan.csv")
```

Get basic data of the dataset

```
getBasicDataSetDetails(dfLendingclub)
dfLendingclub.columns = dfLendingclub.columns.map(trimData)
```

```
    The shape of the dataset is  (39717, 111)
    The number of rows dataset is  39717
    The number of columns in the dataset is  111
```

Get top 2 rows

```
dfLendingclub.head(2)
```

	id	member_id	loan_amnt	funded_amnt	funded_amnt_inv	term	int_rate	insta
0	1077501	1296599	5000	5000	4975.00	36 months	10.65%	

No of floats, object, int type columns exists

2 rows × 111 columns

```
getColumnDataTypes(dfLendingclub).groupby(['Data Types'])["Column"].count()
```

```
Data Types
int64      13
float64    74
object     24
Name: Column, dtype: int64
```

Get all integer column names

```
getEachColumnsDataType(dfLendingclub,'int64')
```

```
columns of type int64 are ['id', 'member_id', 'loan_amnt', 'funded_amnt', 'delinq_2yrs',
```

Get all float column names

```
getEachColumnsDataType(dfLendingclub,'float64')
```

```
columns of type float64 are ['funded_amnt_inv', 'installment', 'annual_inc', 'dti', 'mth
```

Get all string column names

```
getEachColumnsDataType(dfLendingclub,'object')
```

```
columns of type object are ['term', 'int_rate', 'grade', 'sub_grade', 'emp_title', 'emp_
```

Data cleaning

Remove unwanted columns

```
columnlist = ['id','url','desc','member_id','pymnt_plan','application_type','out_prncp', 'out
```

```
dfLendingclub.drop(columns=columnlist, inplace=True)
```

Remove columns that have atleast 60 percent null data

```
dfLendingclub.drop(columns=getColumnsWithHighNulls(dfLendingclub,0.6), inplace=True)
```

Remove numerical columns that have just NAN or zeroes

```
dropNumericColumnsWithSumAsZero(dfLendingclub,'int64')
dropNumericColumnsWithSumAsZero(dfLendingclub,'float64')
```

Remove % in int_rate column

```
replaceCharcter(dfLendingclub,"int_rate",'%','')
```

Remove months in term column

```
dfLendingclub["term"] = dfLendingclub["term"].map(trimData)
replaceCharcter(dfLendingclub,"term",'months','')
dfLendingclub["term"] = dfLendingclub["term"].astype(int)
```

Check null data again

```
dfLendingclub.isnull().mean().sort_values(ascending=False).head(3)
```

```
emp_title              0.06
emp_length             0.03
pub_rec_bankruptcies   0.02
dtype: float64
```

Map loan status to binary

```
dfLendingclub = dfLendingclub[dfLendingclub["loan_status"] != "Current"]
dfLendingclub['loan_status'] = dfLendingclub.loan_status.map({'Fully Paid':1, 'Charged Off':0
```

Remove duplicate rows

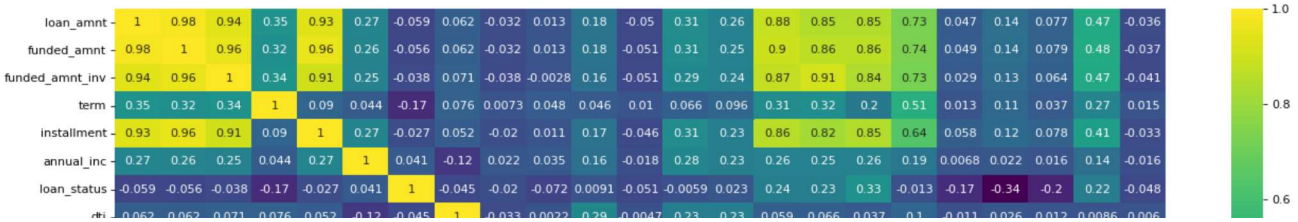
```
# check to see if any duplicate rows
len(dfLendingclub[dfLendingclub.duplicated() == True])
```

```
0
```

Data manipulation and analysis

Analyse Data correlations

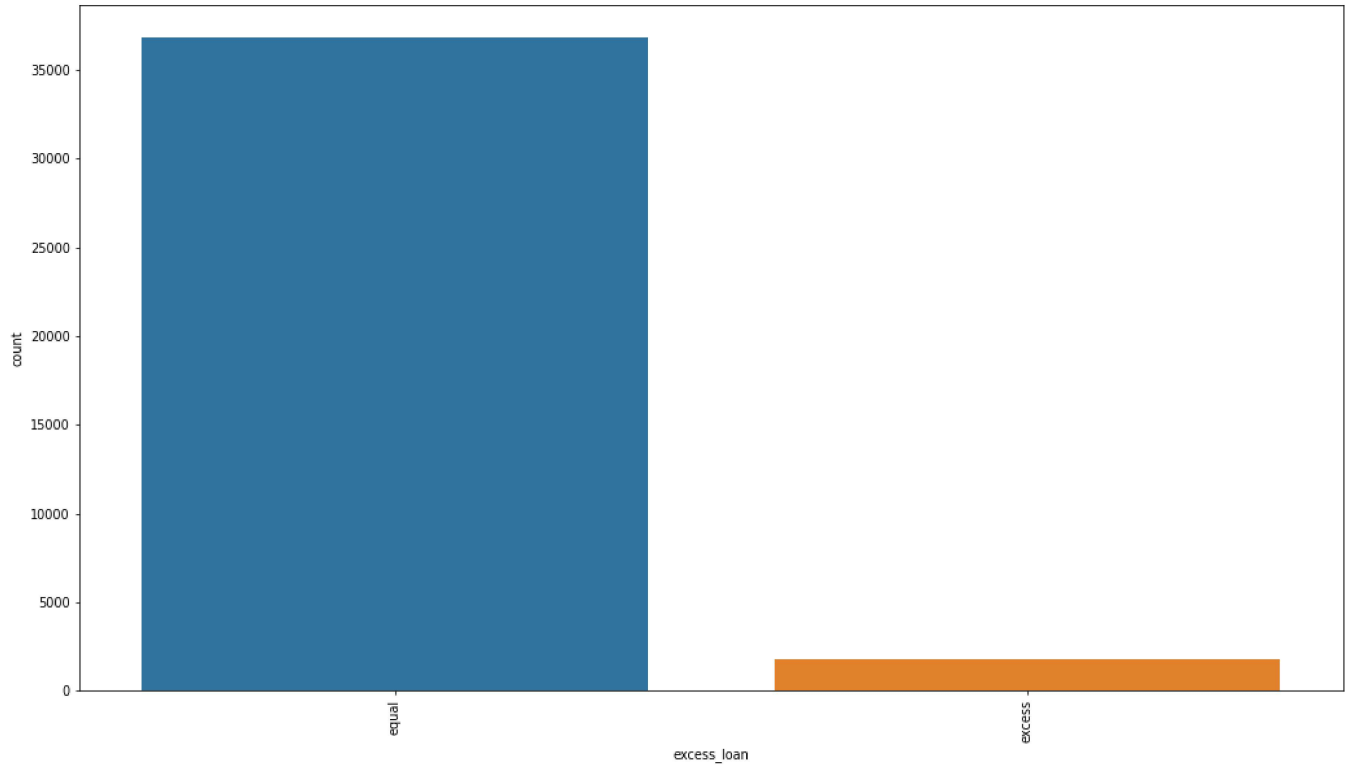
```
# We can see that there is very positive corelation between loan amount and installment
plt.figure(figsize=(20,10), dpi=80)
sns.heatmap(dfLendingclub.corr(),annot=True, cmap='viridis')
plt.show()
```



Add column which shows loan amount - funded amount


```
dfLendingclub["excess_loan"] = dfLendingclub["loan_amnt"] - dfLendingclub["funded_amnt"]
dfLendingclub["excess_loan"] = dfLendingclub["excess_loan"].apply(lambda x: categorizeloan(x)
```

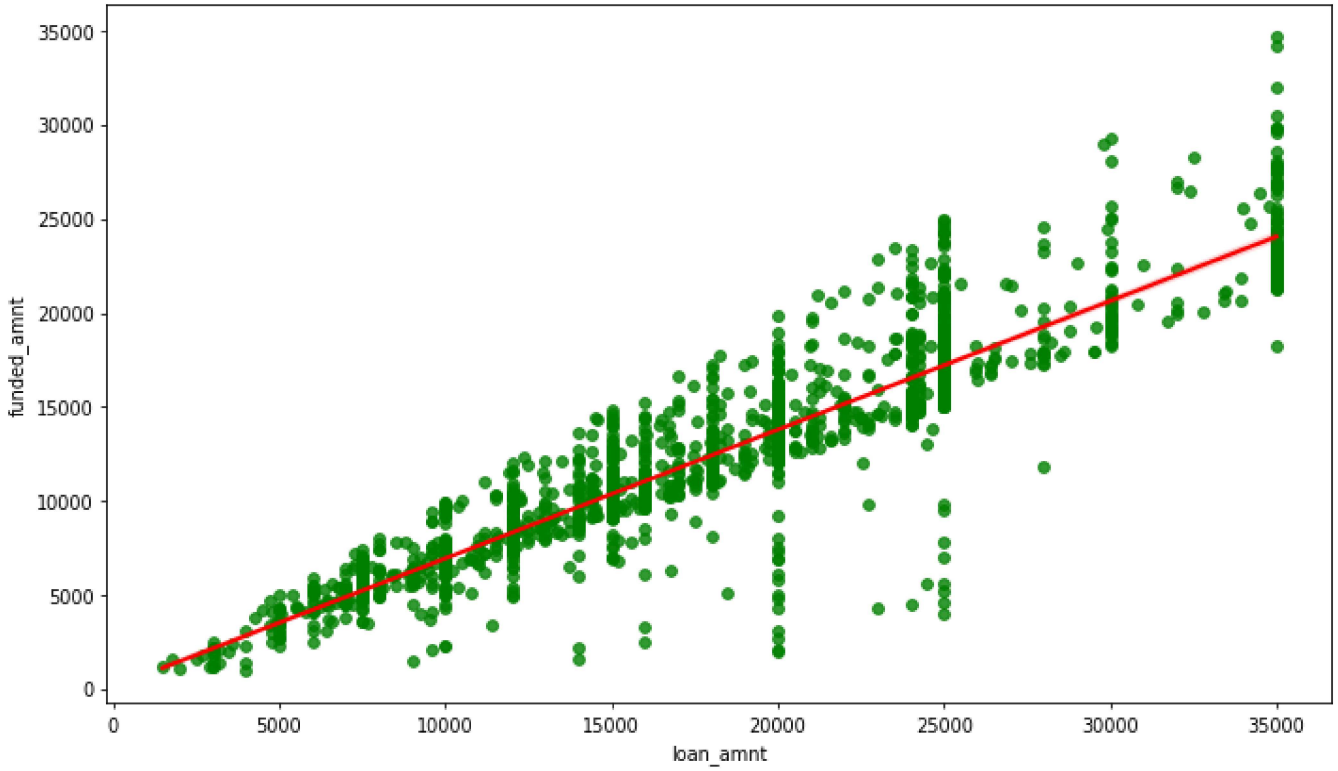

```
drawCountPlotWithoutHue(dfLendingclub,"excess_loan")
```



From above it is clear that majority of people where provided loans based on their incomes only few were provided in excess

Loan amount v/s funded amount

```
plt.figure(figsize=(12,7), dpi=70)
sns.regplot(x="loan_amnt", y="funded_amnt",
            data=dfLendingclub[dfLendingclub["excess_loan"] == "excess"], scatter_kws = {'col
plt.show()
```

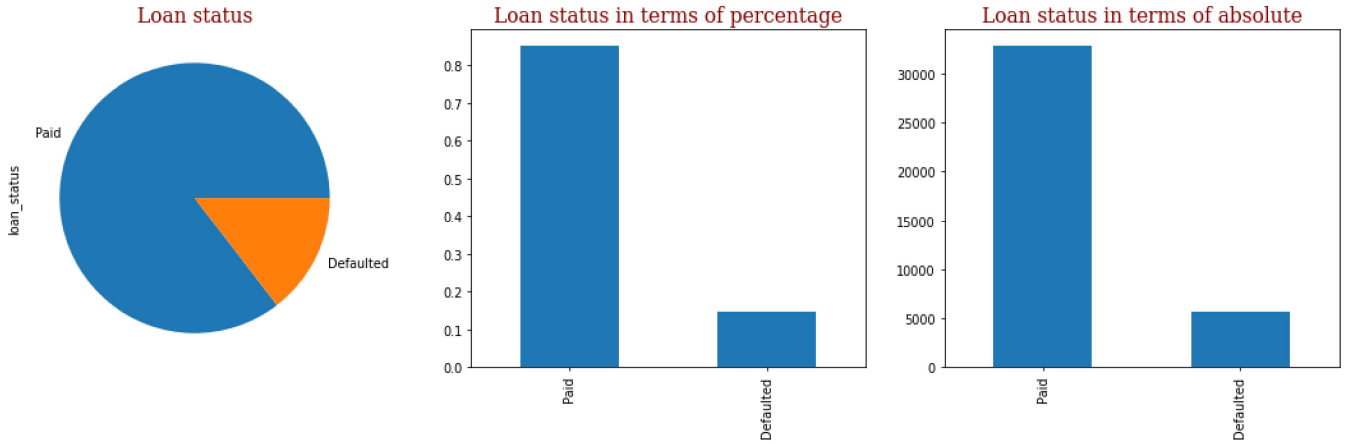


Excess loans provided

```
df_excess_loans_given = dfLendingclub[dfLendingclub["excess_loan"] == "excess"]
df_excess_loans_given.groupby(by=['grade'])['excess_loan'].count().plot(kind='bar')
plt.show()
```

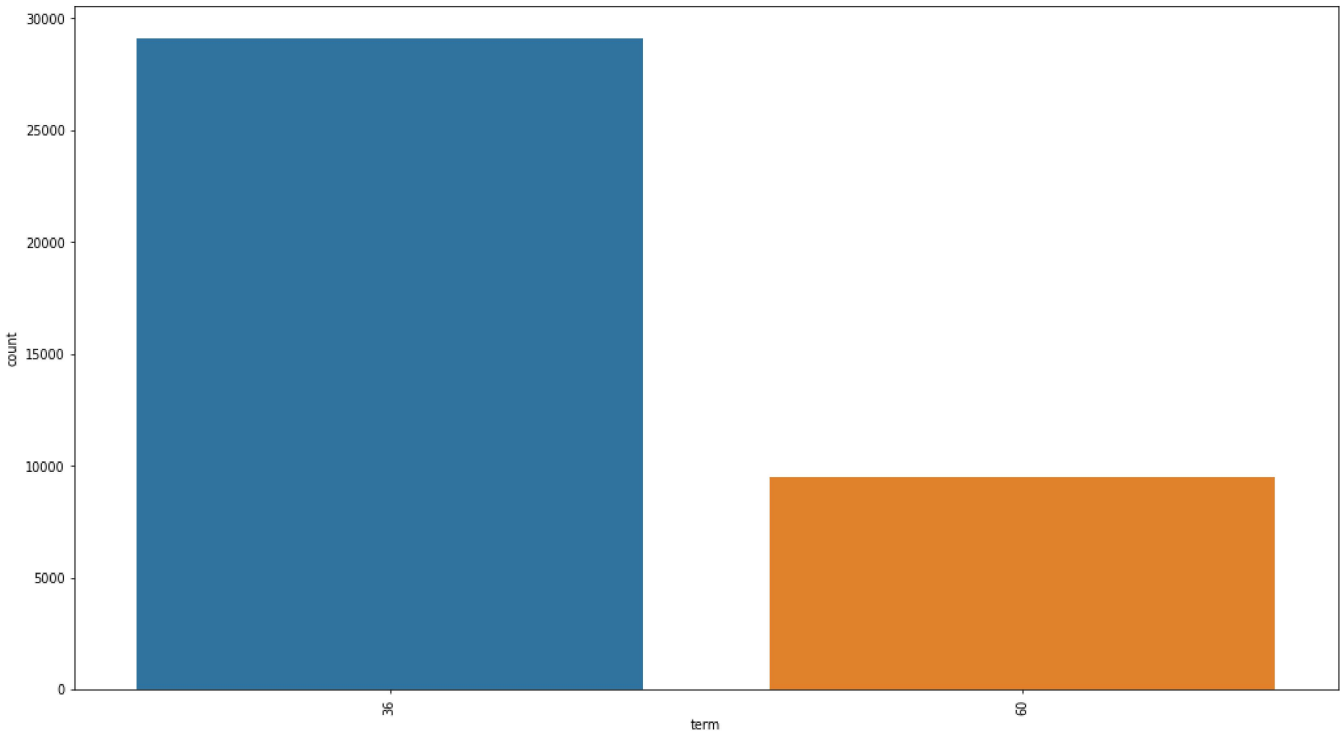
Loans repaid ratio

```
# Majority of the loans are repaid
plt.figure(figsize=(20, 5), dpi=70)

plt.subplot(1, 3, 1)
dfLendingclub["loan_status"].map({1:'Paid', 0:'Defaulted'}).value_counts('%').plot(kind='pie'
plt.title('Loan status', fontdict=font)

plt.subplot(1, 3, 2)
dfLendingclub["loan_status"].map({1:'Paid', 0:'Defaulted'}).value_counts('%').plot(kind='bar'
plt.title('Loan status in terms of percentage', fontdict=font)

plt.subplot(1, 3, 3)
dfLendingclub["loan_status"].map({1:'Paid', 0:'Defaulted'}).value_counts().plot(kind='bar')
plt.title('Loan status in terms of absolute', fontdict=font)

plt.subplots_adjust(left=0.15)
plt.show()
```



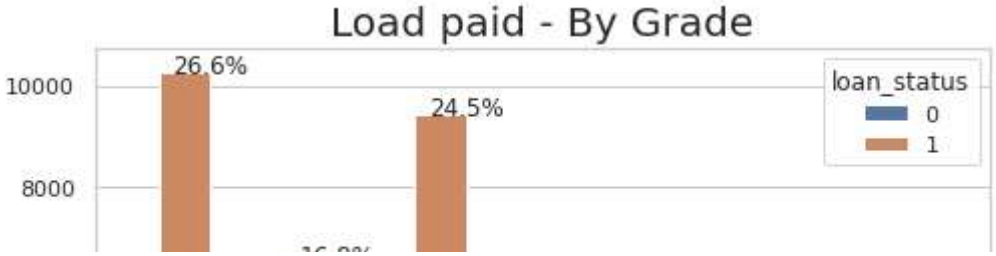
Short term loans are more preferred

```
# Loans are preferred for shorter durations
drawCountPlotWithoutHue(dfLendingclub,'term')
```



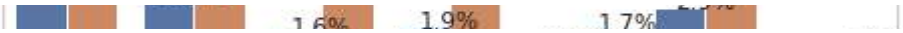
All grades have defaulters

```
#We can make out that even though the grade is lower for category F, G they have a high payin
drawCountPlotWithHue(dfLendingclub,'grade','loan_status','Load paid - By Grade')
```



Round of interest rates

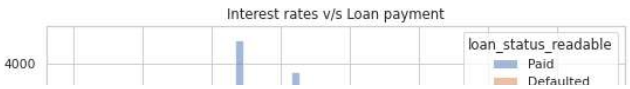
```
# Let us round of interest rates to integers and see if higher interest rates relate to defau

df_interestRates = dfLendingclub[["int_rate","loan_status","grade","annual_inc","purpose"]]
```




```
dfLendingclub["int_rate"] = dfLendingclub["int_rate"].astype(float).round(0).astype(int)
dfLendingclub["loan_status_readable"] = dfLendingclub["loan_status"].map({1:'Paid', 0:'Defaul
```

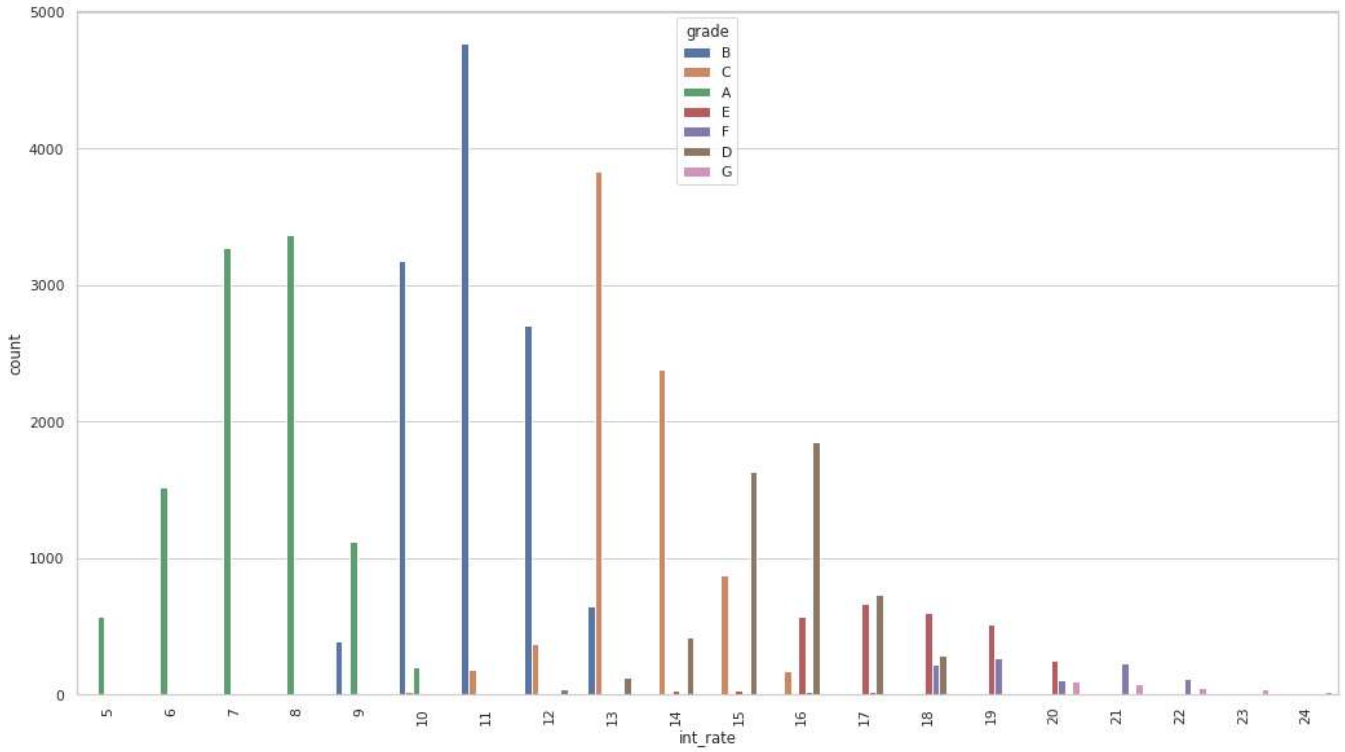
Interest rates less than 10% have least deafulters

```
# We can conclude that interest rates below 10 % have less defaulters
plt.figure(figsize=(20, 5), dpi=70)
plt.subplot(1, 2, 1)
sns.countplot(data=dfLendingclub,x="int_rate",hue="loan_status_readable")
plt.title('Interest rates v/s Loan payment')


plt.subplot(1, 2, 2)
sns.histplot(data=dfLendingclub,x="int_rate",hue="loan_status_readable")
plt.title('Interest rates v/s Loan payment')

plt.show()
```



Grades v/s interest rates

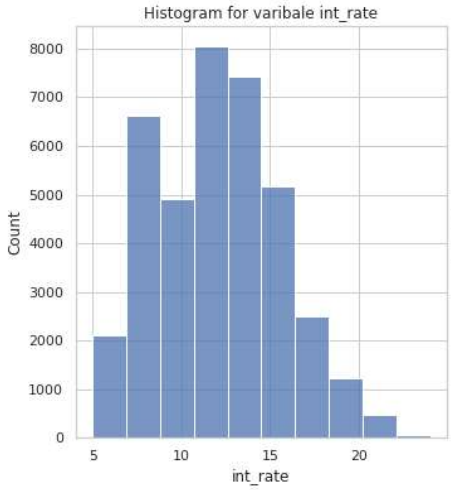

```
# interest rates are lower fro grade -A people
# plt.figure(figsize=(18,10), dpi=70)
# sns.countplot(data=df_interestRates,x="int_rate",hue="grade")
# plt.show()
drawCountplotWithHue(dfLendingclub,"int_rate","grade")
```

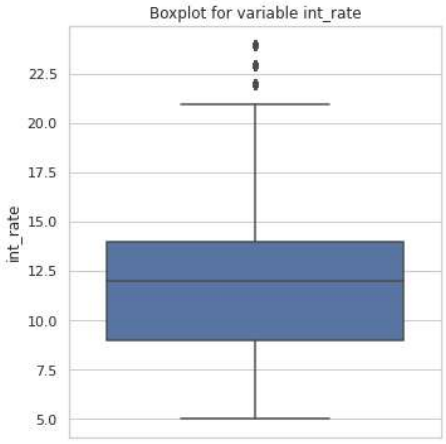


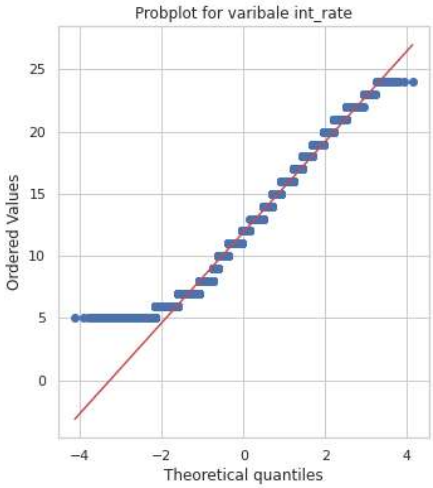
Interest rate distribution

```
# Very close to Gausian - Once the interest rates cross 18% they are hardly takers
plotNumericalDiagnostics(dfLendingclub,"int_rate",10)
```

```
Total NA enties 0.0

             count  mean  std  min  25%   50%   75%   max
int_rate 38577.00 11.92 3.68 5.00 9.00 12.00 14.00 24.00
```



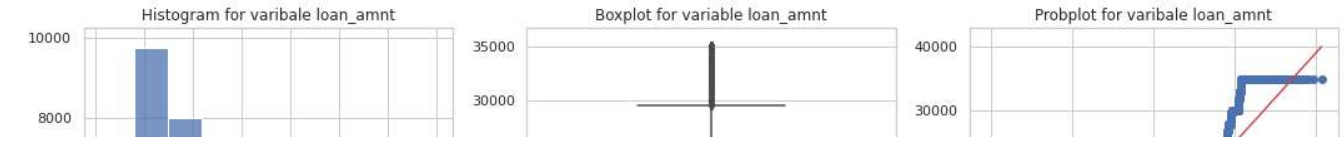




Higher loan amount is with very less population

```
# Skewed distribution towards right - As the amount of loan increases the number of people de
plotNumericalDiagnostics(dfLendingclub,"loan_amnt",10)
```

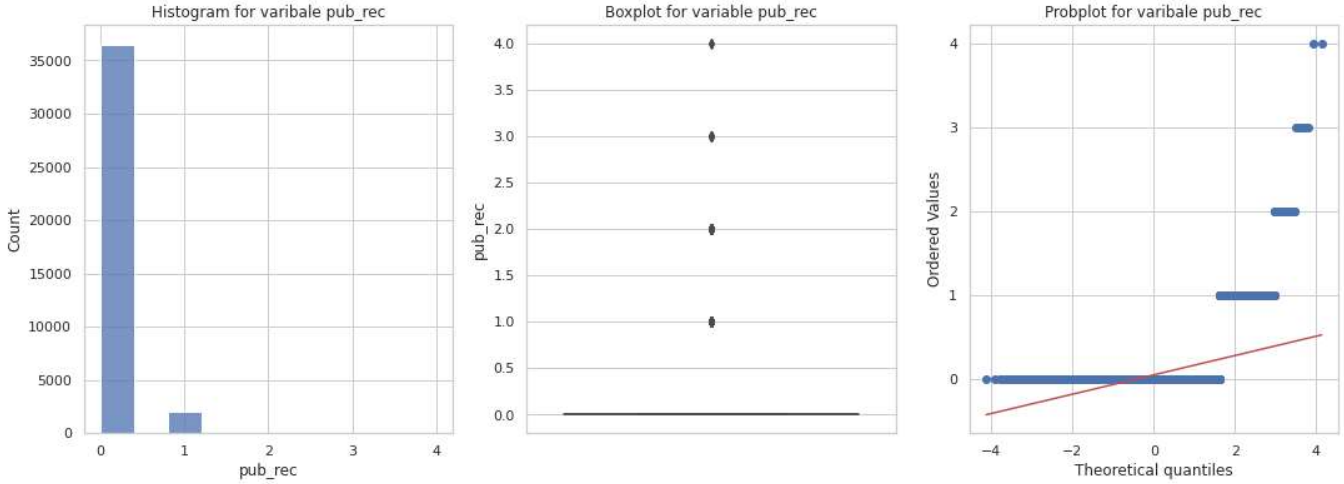
```
Total NA enties 0.0

              count     mean     std    min     25%     50%      75%      max
loan_amnt 38577.00 11047.03 7348.44 500.00 5300.00 9600.00 15000.00 35000.00
```



Pub_rec analysis

```
# Conclusion - Majority of the people do not have pub_rec which is why they are provided loan
plotNumericalDiagnostics(dfLendingclub,"pub_rec",10)
```

```
Total NA enties 0.0

           count  mean  std  min  25%  50%  75%  max
pub_rec 38577.00  0.06 0.24 0.00 0.00 0.00 0.00 4.00
```

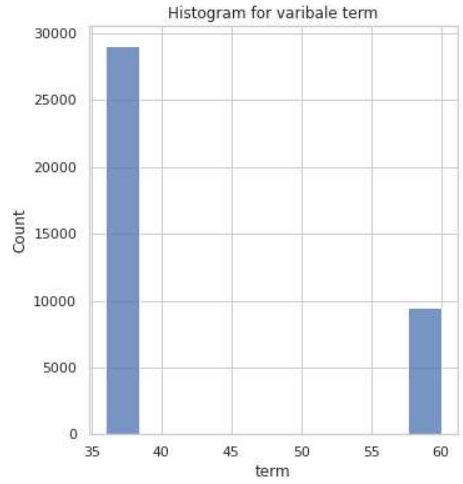


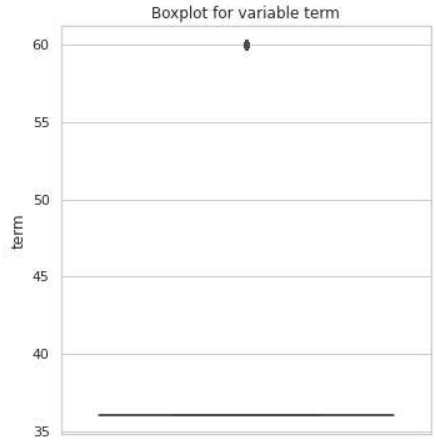
Term analysis

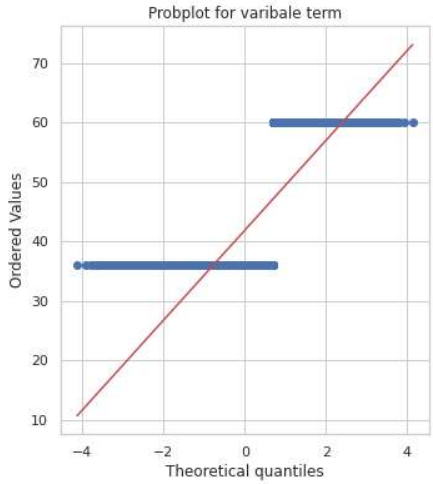
```
# Conclusion - People prefer shorter duration loans
plotNumericalDiagnostics(dfLendingclub,"term",10)
```

```
Total NA enties 0.0
```

```
        count  mean   std   min   25%   50%   75%   max
term 38577.00 41.90 10.33 36.00 36.00 36.00 36.00 60.00
```







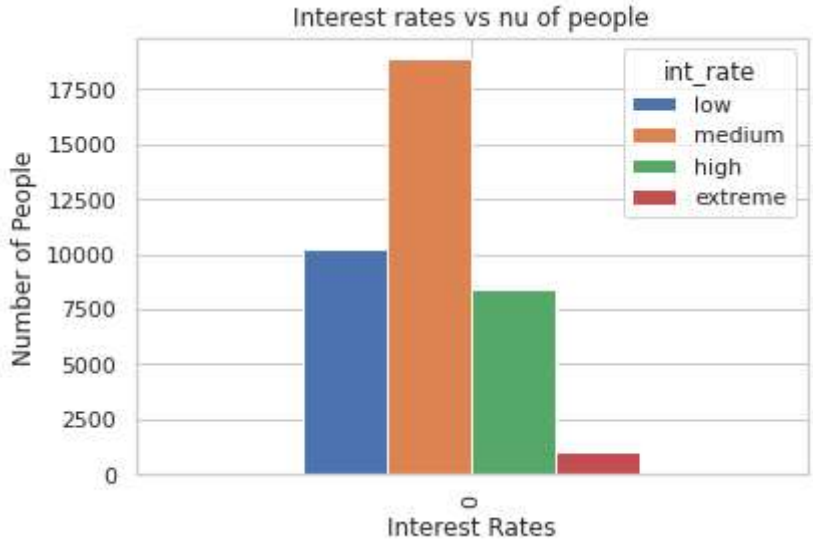
Defaulters vs loan amount distribution

```
# We can see that we have defaulters when the amount is as low as 5000 or even when high as 3
plt.figure(figsize=(18,10), dpi=70)
sns.scatterplot(data=dfLendingclub,x="annual_inc", y="loan_amnt", hue="loan_status")
plt.show()
```

Ratio of people against the interest rates

```
# Ratio of people against the interest rates
# Extreme and high interest rates - very less people
# Medium interest rates - Highest people
bins = pd.cut(dfLendingclub["int_rate"], bins=4, labels=("low", "medium", "high", "extreme"))
fig = dfLendingclub[["annual_inc"]].groupby(bins).agg(["count"]).transpose().reset_index().dr
fig.set_title('Interest rates vs nu of people')
fig.set_xlabel('Interest Rates')
fig.set_ylabel('Number of People')
```

```
Text(0, 0.5, 'Number of People')
```

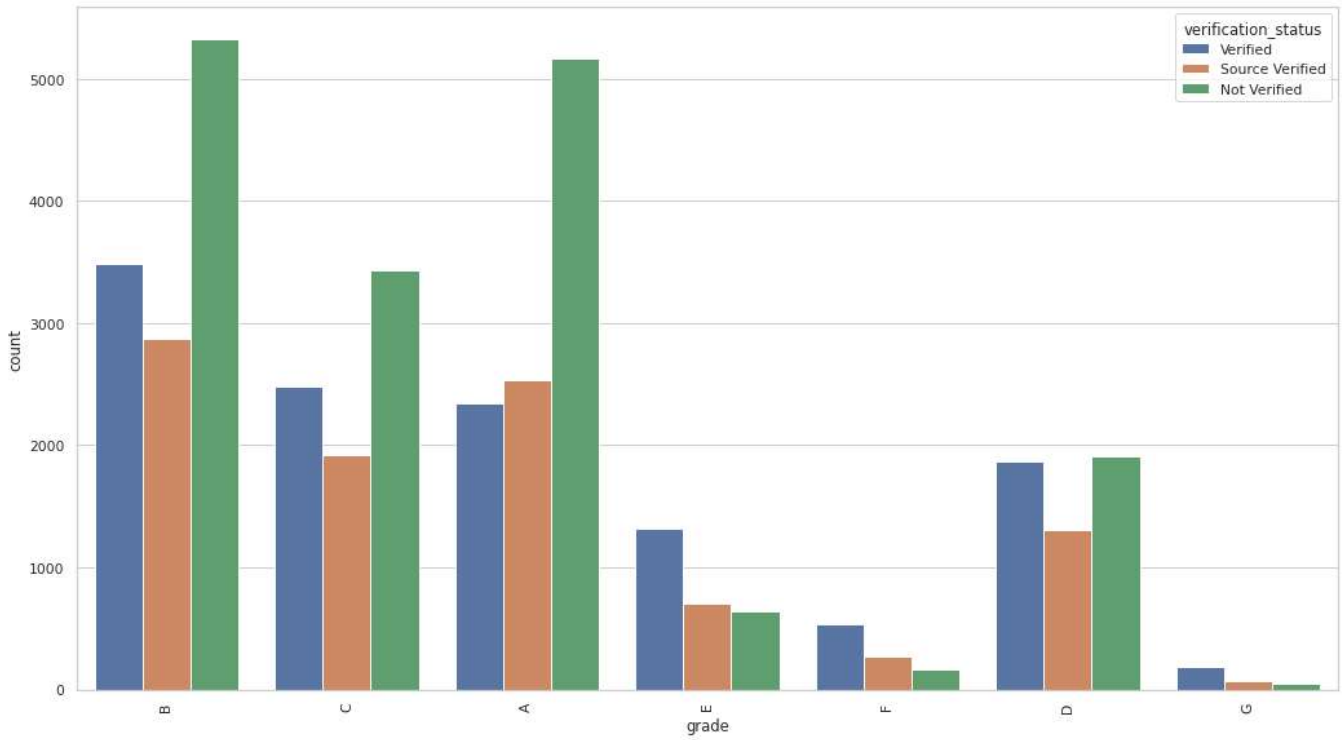


Add new column "int_rate_bins"

```
# Add nw column "int_rate_bins" into the mai dataframe
dfLendingclub["int_rate_bins"] = bins
```

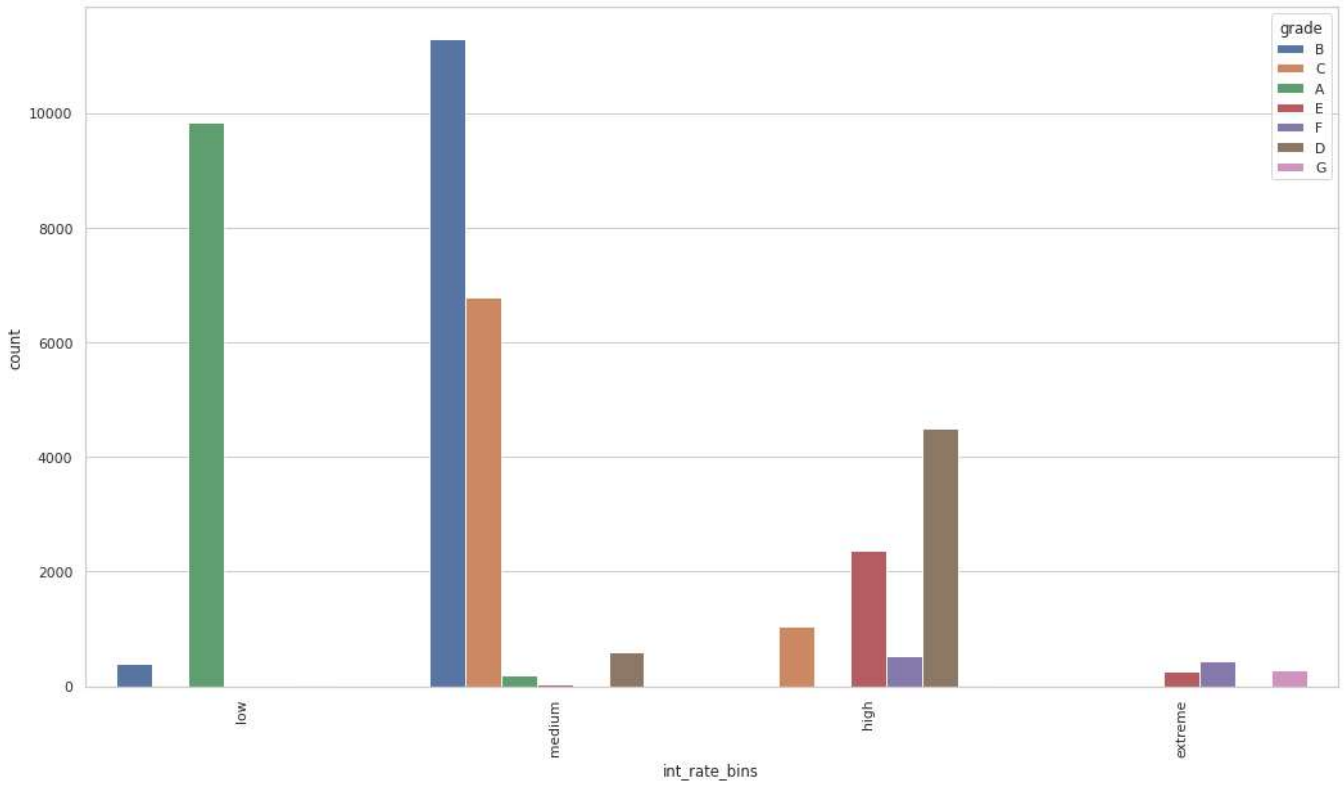
Verified column analysis

```
# Every grade has non verified members with highestbeing in B,A
drawCountplotWithHue(dfLendingclub,"grade","verification_status")
```



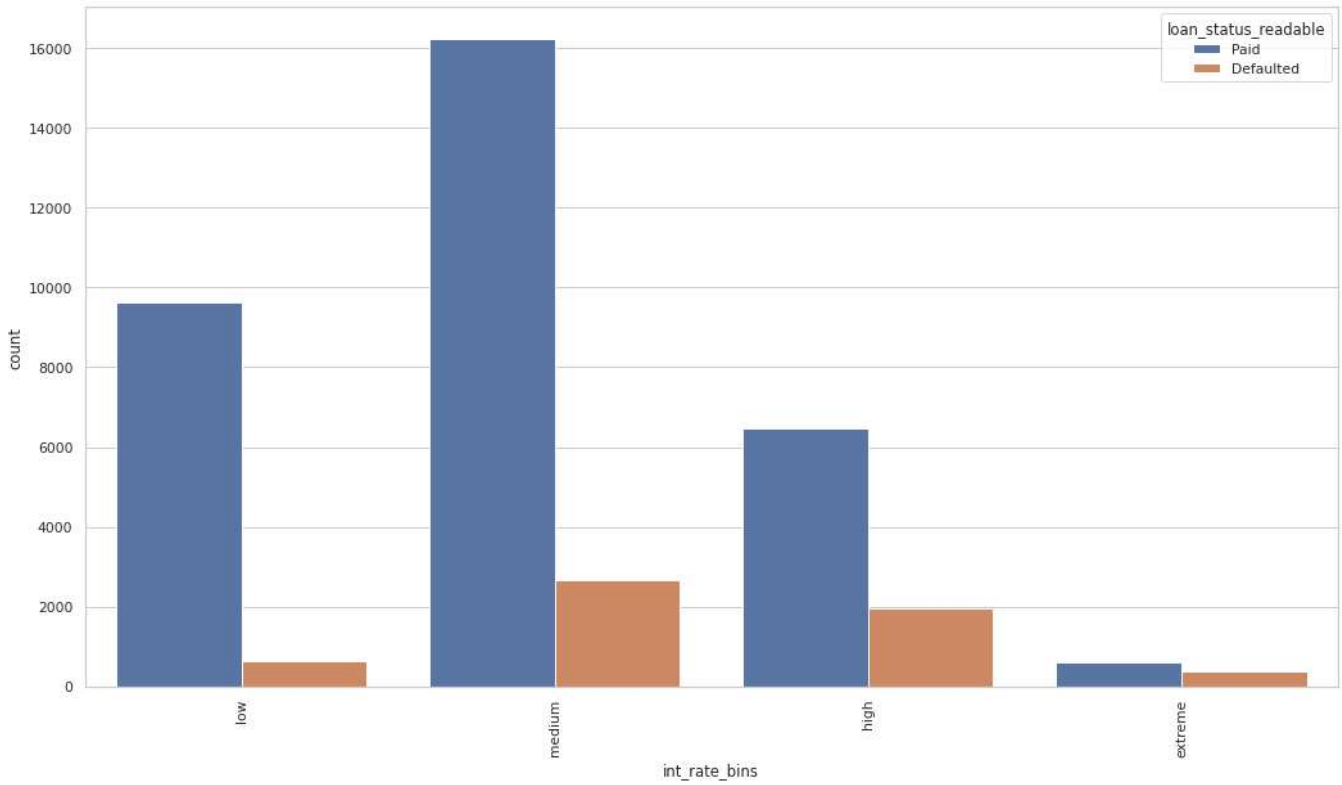
Grades v/s intrest rates analysis

```
# Low interest rates are for grades 'A'
# Medium interest rates are for grades 'B,C'
# High interest rates are for grades 'D,E'
# Extreme interest rates are for grades 'F,G'
drawCountplotWithHue(dfLendingclub,"int_rate_bins","grade")
```



Lower intrest rates are repaid better

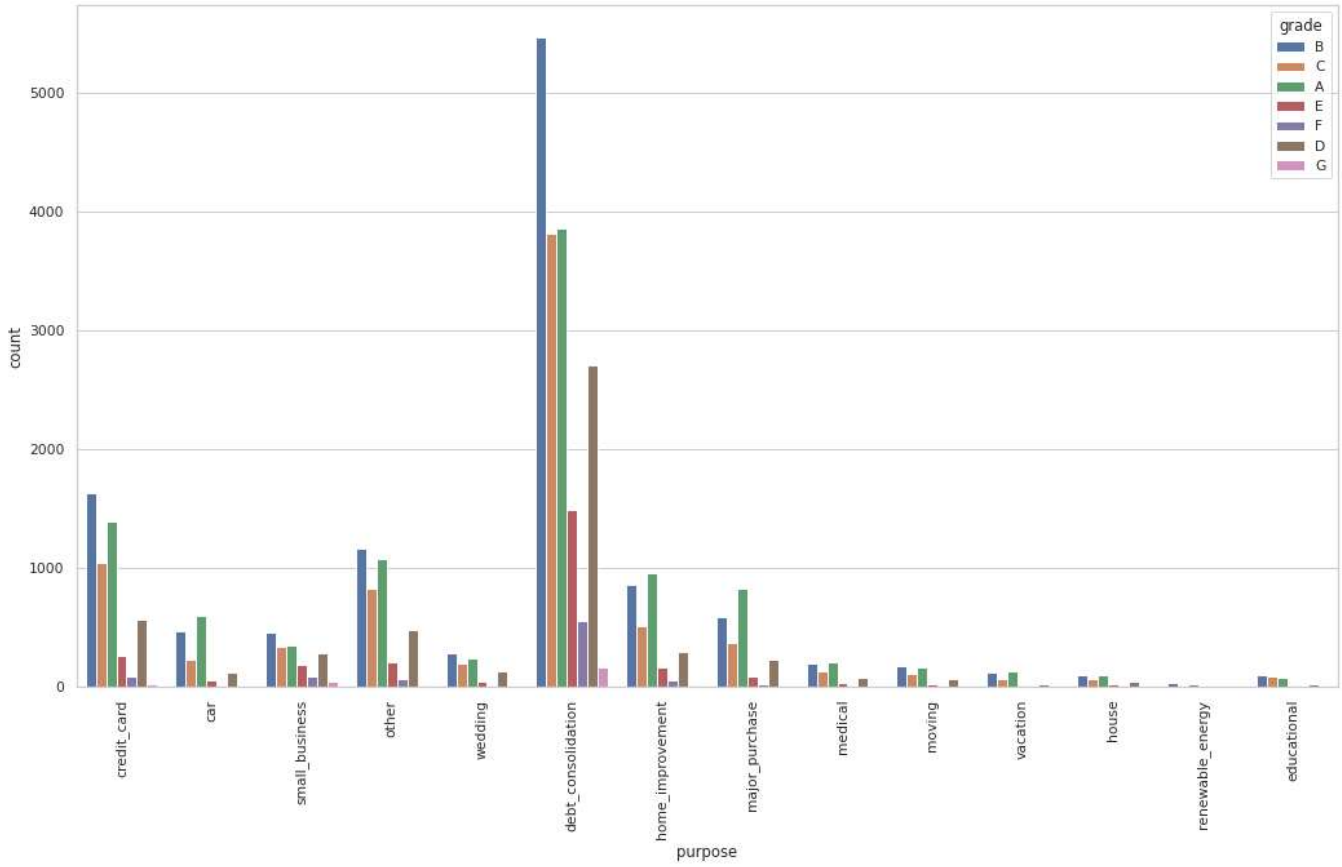
```
# Low interest rates have been mostly paid
# Extreme, High have highest defaulters in terms of ratio
# Medium also have high defaulters
drawCountplotWithHue(dfLendingclub,"int_rate_bins","loan_status_readable")
```



Loans are majorly taken for debt consolidation

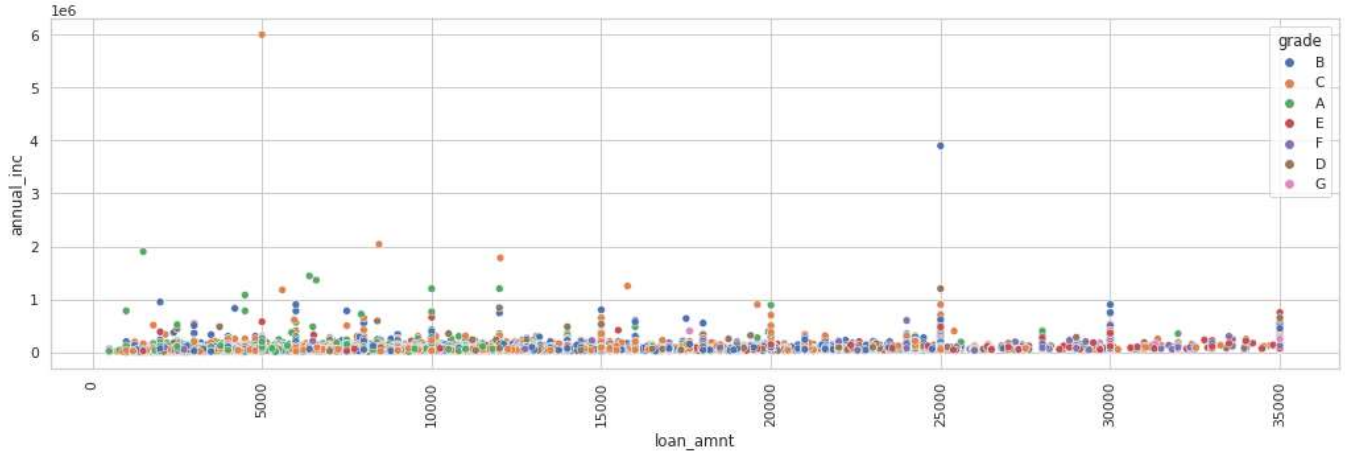
```
# highest loan is taken for debt consolidation
plt.figure(figsize=(10,5), dpi=70)
sns.countplot(data=dfLendingclub, x="purpose")
plt.xticks(rotation = 90)
plt.show()
```


```
drawCountplotWithHue(dfLendingclub,"purpose","grade")
```



All grades take loans

```
# People with low to high incomes take loans
plt.figure(figsize=(18,5), dpi=70)
sns.scatterplot(data=dfLendingclub, x="loan_amnt", y="annual_inc" , hue = "grade")
plt.xticks(rotation = 90)
plt.show()
```



Datetime analysis

```
convertToDateTime(dfLendingclub,'issue_d')
convertToDateTime(dfLendingclub,'last_pymnt_d')
convertToDateTime(dfLendingclub,'last_credit_pull_d')
```

```
def getDateParts(df,colname):
  df[colname+"month"] = df[colname].dt.month
  df[colname+"year"] = df[colname].dt.year
  df[colname+"dt"] = df[colname].dt.date
  df[colname+"dayOftheWeek"] = df[colname].dt.day_name
```

```
getDateParts(dfLendingclub,"issue_d")
getDateParts(dfLendingclub,"last_pymnt_d")
getDateParts(dfLendingclub,"last_credit_pull_d")
```

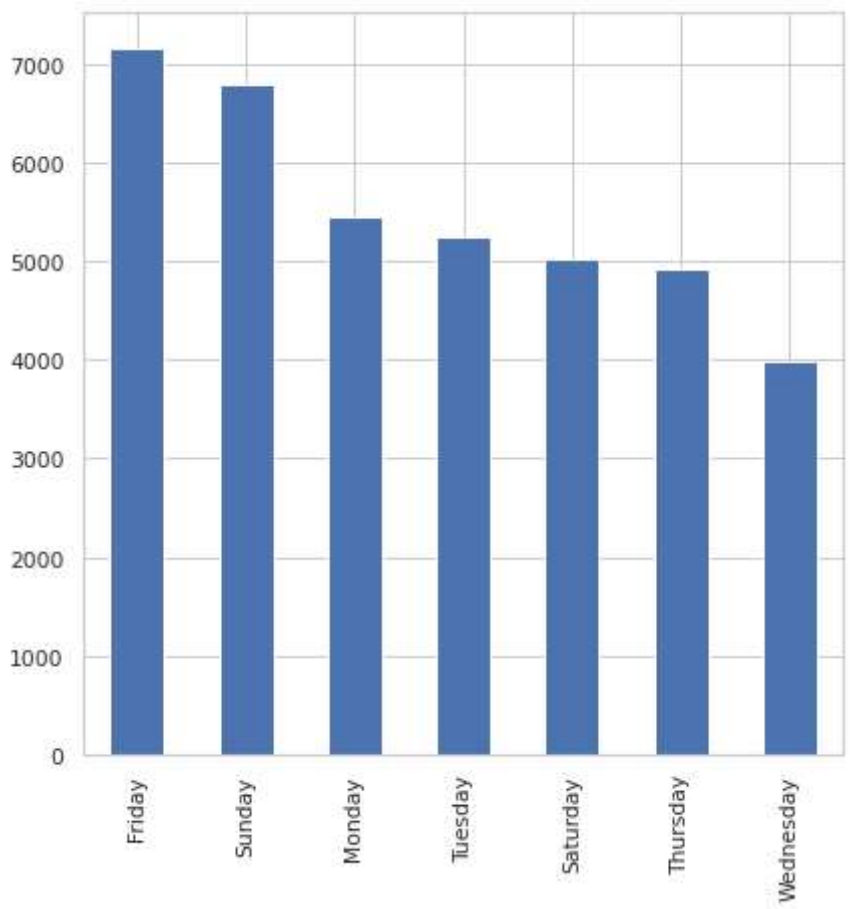
```
dfLendingclub.columns
```

```
Index(['loan_amnt', 'funded_amnt', 'funded_amnt_inv', 'term', 'int_rate',
       'installment', 'grade', 'sub_grade', 'emp_title', 'emp_length',
       'home_ownership', 'annual_inc', 'verification_status', 'issue_d',
       'loan_status', 'purpose', 'title', 'zip_code', 'addr_state', 'dti',
       'delinq_2yrs', 'earliest_cr_line', 'inq_last_6mths', 'open_acc',
       'pub_rec', 'revol_bal', 'revol_util', 'total_acc',
       'initial_list_status', 'total_pymnt', 'total_pymnt_inv',
       'total_rec_prncp', 'total_rec_int', 'total_rec_late_fee', 'recoveries',
       'collection_recovery_fee', 'last_pymnt_d', 'last_pymnt_amnt',
       'last_credit_pull_d', 'pub_rec_bankruptcies', 'excess_loan',
```

```
       'loan_status_readable', 'int_rate_bins', 'issue_dmonth', 'issue_dyear',
       'issue_ddt', 'issue_ddayOftheWeek', 'last_pymnt_dmonth',
       'last_pymnt_dyear', 'last_pymnt_ddt', 'last_pymnt_ddayOftheWeek',
       'last_credit_pull_dmonth', 'last_credit_pull_dyear',
       'last_credit_pull_ddt', 'last_credit_pull_ddayOftheWeek'],
      dtype='object')
```

Loans were issued all days of the week

```
plt.figure(figsize=(7,7), dpi = 70)
dfLendingclub["issue_d"].dt.day_name().value_counts().sort_values(ascending=False).plot(kind=
plt.show()
```



Presenttion and Recommendations

1. Interest rates less than 10% have less defaulters.
2. Highest loan is taken by grade A, B
3. They are defaulters in every grade.
4. Most of the loans are taken for debt consolidation.
5. The number of defaulters are less compared to people who re-pay.

6. Loans are issued almost all days of the week.
7. Loans above 18% have good ratio of defaulters.
8. Loan amount, installment have a good direct corelation.
9. The year is missing across all date time columns.
10. Loans taken against credit cards have higher interest rates.
11. Lower intest rates for A, B grades.
12. High rates of intrest for grades F,G