```
## import libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')


#dataload
data_loan = pd.read_csv("loan.csv")


#see the data
data_loan.head(5)
```

	id	member_id	loan_amnt	funded_amnt	funded_amnt_inv	term	int_rate	instal
0	1077501	1296599	5000	5000	4975.0	36 months	10.65%	
1	1077430	1314167	2500	2500	2500.0	60 months	15.27%	
2	1077175	1313524	2400	2400	2400.0	36 months	15.96%	
3	1076863	1277178	10000	10000	10000.0	36 months	13.49%	
4	1075358	1311748	3000	3000	3000.0	60 months	12.69%	

5 rows × 111 columns

```
data_loan.shape
```

```
(39717, 111)
```

```
#getting the null values
data_loan.isnull().sum()
```

```
id                              0
member_id                       0
loan_amnt                       0
funded_amnt                     0
funded_amnt_inv                 0
                              ...
tax_liens                      39
tot_hi_cred_lim             39717
total_bal_ex_mort           39717
total_bc_limit              39717
total_il_high_credit_limit  39717
Length: 111, dtype: int64
```

*FROM the above analysis lots of data is null so revoving null characters *

```
Start coding or generate with AI.
```

```
data_loan.dropna(axis = 1, how = 'all', inplace = True)
data_loan.head(5)
```

	id	member_id	loan_amnt	funded_amnt	funded_amnt_inv	term	int_rate	instal
0	1077501	1296599	5000	5000	4975.0	36 months	10.65%	
1	1077430	1314167	2500	2500	2500.0	60 months	15.27%	
2	1077175	1313524	2400	2400	2400.0	36 months	15.96%	
3	1076863	1277178	10000	10000	10000.0	36 months	13.49%	
4	1075358	1311748	3000	3000	3000.0	60 months	12.69%	

5 rows × 57 columns

```
data_loan.info()
```

```
 1   member_id                   39717 non-null  int64
 2   loan_amnt                   39717 non-null  int64
 3   funded_amnt                 39717 non-null  int64
 4   funded_amnt_inv             39717 non-null  float64
 5   term                        39717 non-null  object
 6   int_rate                    39717 non-null  object
 7   installment                 39717 non-null  float64
 8   grade                       39717 non-null  object
 9   sub_grade                   39717 non-null  object
 10  emp_title                   37258 non-null  object
 11  emp_length                  38642 non-null  object
 12  home_ownership              39717 non-null  object
 13  annual_inc                  39717 non-null  float64
 14  verification_status         39717 non-null  object
 15  issue_d                     39717 non-null  object
 16  loan_status                 39717 non-null  object
 17  pymnt_plan                  39717 non-null  object
 18  url                         39717 non-null  object
 19  desc                        26775 non-null  object
 20  purpose                     39717 non-null  object
 21  title                       39706 non-null  object
 22  zip_code                    39717 non-null  object
 23  addr_state                  39717 non-null  object
 24  dti                         39717 non-null  float64
 25  delinq_2yrs                 39717 non-null  int64
 26  earliest_cr_line            39717 non-null  object
 27  inq_last_6mths              39717 non-null  int64
 28  mths_since_last_delinq      14035 non-null  float64
 29  mths_since_last_record      2786 non-null   float64
 30  open_acc                    39717 non-null  int64
 31  pub_rec                     39717 non-null  int64
 32  revol_bal                   39717 non-null  int64
 33  revol_util                  39667 non-null  object
 34  total_acc                   39717 non-null  int64
 35  initial_list_status         39717 non-null  object
 36  out_prncp                   39717 non-null  float64
 37  out_prncp_inv               39717 non-null  float64
 38  total_pymnt                 39717 non-null  float64
 39  total_pymnt_inv             39717 non-null  float64
 40  total_rec_prncp             39717 non-null  float64
 41  total_rec_int               39717 non-null  float64
 42  total_rec_late_fee          39717 non-null  float64
 43  recoveries                  39717 non-null  float64
 44  collection_recovery_fee     39717 non-null  float64
 45  last_pymnt_d                39646 non-null  object
 46  last_pymnt_amnt             39717 non-null  float64
 47  next_pymnt_d                1140 non-null   object
 48  last_credit_pull_d          39715 non-null  object
 49  collections_12_mths_ex_med  39661 non-null  float64
 50  policy_code                 39717 non-null  int64
 51  application_type            39717 non-null  object
 52  acc_now_delinq              39717 non-null  int64
 53  chargeoff_within_12_mths    39661 non-null  float64
 54  delinq_amnt                 39717 non-null  int64
 55  pub_rec_bankruptcies        39020 non-null  float64
 56  tax_liens                   39678 non-null  float64
dtypes: float64(20), int64(13), object(24)
memory usage: 17.3+ MB
```

```
data_loan.columns
```

```
Index(['id', 'member_id', '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', 'pymnt_plan', 'url', 'desc', 'purpose',
       'title', 'zip_code', 'addr_state', 'dti', 'delinq_2yrs',
       'earliest_cr_line', 'inq_last_6mths', 'mths_since_last_delinq',
       'mths_since_last_record', 'open_acc', 'pub_rec', 'revol_bal',
       'revol_util', 'total_acc', 'initial_list_status', 'out_prncp',
       'out_prncp_inv', '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',
       'next_pymnt_d', 'last_credit_pull_d', 'collections_12_mths_ex_med',
       'policy_code', 'application_type', 'acc_now_delinq',
       'chargeoff_within_12_mths', 'delinq_amnt', 'pub_rec_bankruptcies',
       'tax_liens'],
      dtype='object')
```

```
data_loan =data_loan[data_loan.loan_status != "Current"]
data_loan.loan_status.unique()
```

```
array(['Fully Paid', 'Charged Off'], dtype=object)
```

```
(data_loan.isna().sum()/len(data_loan.index))*100
```

```
id                            0.000000
member_id                     0.000000
loan_amnt                     0.000000
funded_amnt                   0.000000
funded_amnt_inv               0.000000
term                          0.000000
int_rate                      0.000000
installment                   0.000000
grade                         0.000000
sub_grade                     0.000000
emp_title                     6.185033
emp_length                    2.677761
home_ownership                0.000000
annual_inc                    0.000000
verification_status           0.000000
issue_d                       0.000000
loan_status                   0.000000
pymnt_plan                    0.000000
url                           0.000000
desc                         32.477901
purpose                       0.000000
title                         0.028514
zip_code                      0.000000
addr_state                    0.000000
dti                           0.000000
delinq_2yrs                   0.000000
earliest_cr_line              0.000000
inq_last_6mths                0.000000
mths_since_last_delinq       64.559193
mths_since_last_record       92.897322
open_acc                      0.000000
pub_rec                       0.000000
revol_bal                     0.000000
revol_util                    0.129611
total_acc                     0.000000
initial_list_status           0.000000
out_prncp                     0.000000
out_prncp_inv                 0.000000
total_pymnt                   0.000000
total_pymnt_inv               0.000000
total_rec_prncp               0.000000
total_rec_int                 0.000000
total_rec_late_fee            0.000000
recoveries                    0.000000
collection_recovery_fee       0.000000
last_pymnt_d                  0.184047
last_pymnt_amnt               0.000000
next_pymnt_d                100.000000
last_credit_pull_d            0.005184
collections_12_mths_ex_med    0.145164
policy_code                   0.000000
application_type              0.000000
acc_now_delinq                0.000000
chargeoff_within_12_mths      0.145164
delinq_amnt                   0.000000
pub_rec_bankruptcies          1.806776
```

```
tax_liens                     0.101097
dtype: float64
```

```
data_loan.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 38577 entries, 0 to 39716
Data columns (total 57 columns):
 #   Column                      Non-Null Count  Dtype  
---  ------                      --------------  -----  
 0   id                          38577 non-null  int64  
 1   member_id                   38577 non-null  int64  
 2   loan_amnt                   38577 non-null  int64  
 3   funded_amnt                 38577 non-null  int64  
 4   funded_amnt_inv             38577 non-null  float64
 5   term                        38577 non-null  object 
 6   int_rate                    38577 non-null  object 
 7   installment                 38577 non-null  float64
 8   grade                       38577 non-null  object 
 9   sub_grade                   38577 non-null  object 
 10  emp_title                   36191 non-null  object 
 11  emp_length                  37544 non-null  object 
 12  home_ownership              38577 non-null  object 
 13  annual_inc                  38577 non-null  float64
 14  verification_status         38577 non-null  object 
 15  issue_d                     38577 non-null  object 
 16  loan_status                 38577 non-null  object 
 17  pymnt_plan                  38577 non-null  object 
 18  url                         38577 non-null  object 
 19  desc                        26048 non-null  object 
 20  purpose                     38577 non-null  object 
 21  title                       38566 non-null  object 
 22  zip_code                    38577 non-null  object 
 23  addr_state                  38577 non-null  object 
 24  dti                         38577 non-null  float64
 25  delinq_2yrs                 38577 non-null  int64  
 26  earliest_cr_line            38577 non-null  object 
 27  inq_last_6mths              38577 non-null  int64  
 28  mths_since_last_delinq      13672 non-null  float64
 29  mths_since_last_record      2740 non-null   float64
 30  open_acc                    38577 non-null  int64  
 31  pub_rec                     38577 non-null  int64  
 32  revol_bal                   38577 non-null  int64  
 33  revol_util                  38527 non-null  object 
 34  total_acc                   38577 non-null  int64  
 35  initial_list_status         38577 non-null  object 
 36  out_prncp                   38577 non-null  float64
 37  out_prncp_inv               38577 non-null  float64
 38  total_pymnt                 38577 non-null  float64
 39  total_pymnt_inv             38577 non-null  float64
 40  total_rec_prncp             38577 non-null  float64
 41  total_rec_int               38577 non-null  float64
 42  total_rec_late_fee          38577 non-null  float64
 43  recoveries                  38577 non-null  float64
 44  collection_recovery_fee     38577 non-null  float64
 45  last_pymnt_d                38506 non-null  object 
 46  last_pymnt_amnt             38577 non-null  float64
 47  next_pymnt_d                0 non-null      object 
 48  last_credit_pull_d          38575 non-null  object 
 49  collections_12_mths_ex_med  38521 non-null  float64
 50  policy_code                 38577 non-null  int64  
 51  application_type            38577 non-null  object 
 52  acc_now_delinq              38577 non-null  int64  
```

```
print("Mode : " + data_loan.emp_length.mode()[0])
data_loan.emp_length.value_counts()
```

```
Mode : 10+ years
emp_length
10+ years    8488
< 1 year     4508
2 years      4291
3 years      4012
4 years      3342
5 years      3194
1 year       3169
6 years      2168
7 years      1711
8 years      1435
9 years      1226
Name: count, dtype: int64
```

Start coding or generate with AI.

We can come to the conclusion that the mode value is higher than most frequent value

```
data_loan.emp_length.fillna(data_loan.emp_length.mode()[0], inplace = True)
data_loan.emp_length.isna().sum()
```

```
0
```

```
data_loan.emp_length.fillna(data_loan.emp_length.mode()[0], inplace = True)
data_loan.emp_length.isna().sum()
```

```
0
```

STANDERDIZE THE DATA

```
data_loan.int_rate = pd.to_numeric(data_loan.int_rate.apply(lambda x : x.split('%')[0]))
```

```
data_loan.emp_length = pd.to_numeric(data_loan.emp_length.apply(lambda x: 0 if "<" in x else (x.split('+')[0] if "+" in x else x.split()[0]))
```

```
data_loan.head(20)
```

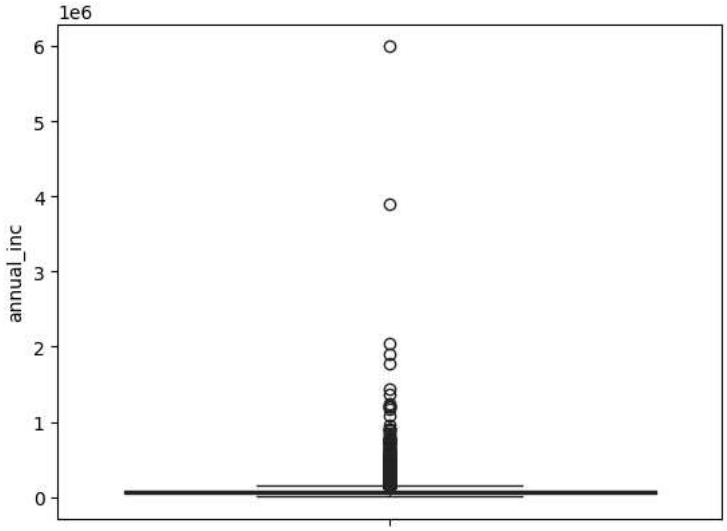
	id	member_id	loan_amnt	funded_amnt	funded_amnt_inv	term	int_rate	insta
0	1077501	1296599	5000	5000	4975.00000	36 months	10.65	
1	1077430	1314167	2500	2500	2500.00000	60 months	15.27	
2	1077175	1313524	2400	2400	2400.00000	36 months	15.96	
3	1076863	1277178	10000	10000	10000.00000	36 months	13.49	
5	1075269	1311441	5000	5000	5000.00000	36 months	7.90	
6	1069639	1304742	7000	7000	7000.00000	60 months	15.96	
7	1072053	1288686	3000	3000	3000.00000	36 months	18.64	
8	1071795	1306957	5600	5600	5600.00000	60 months	21.28	
9	1071570	1306721	5375	5375	5350.00000	60 months	12.69	
10	1070078	1305201	6500	6500	6500.00000	60 months	14.65	
11	1069908	1305008	12000	12000	12000.00000	36 months	12.69	
12	1064687	1298717	9000	9000	9000.00000	36 months	13.49	
13	1069866	1304956	3000	3000	3000.00000	36 months	9.91	
14	1069057	1303503	10000	10000	10000.00000	36 months	10.65	
15	1069759	1304871	1000	1000	1000.00000	36 months	16.29	
16	1065775	1299699	10000	10000	10000.00000	36 months	15.27	
17	1069971	1304884	3600	3600	3600.00000	36 months	6.03	
18	1062474	1294539	6000	6000	6000.00000	36 months	11.71	
19	1069742	1304855	9200	9200	9200.00000	36 months	6.03	
20	1069740	1284848	20250	20250	19142.16108	60 months	15.27	

20 rows × 57 columns

Outlier boxplot

```
sns.boxplot(data_loan['annual_inc'], color ="green")
```

```
<Axes: ylabel='annual_inc'>
```



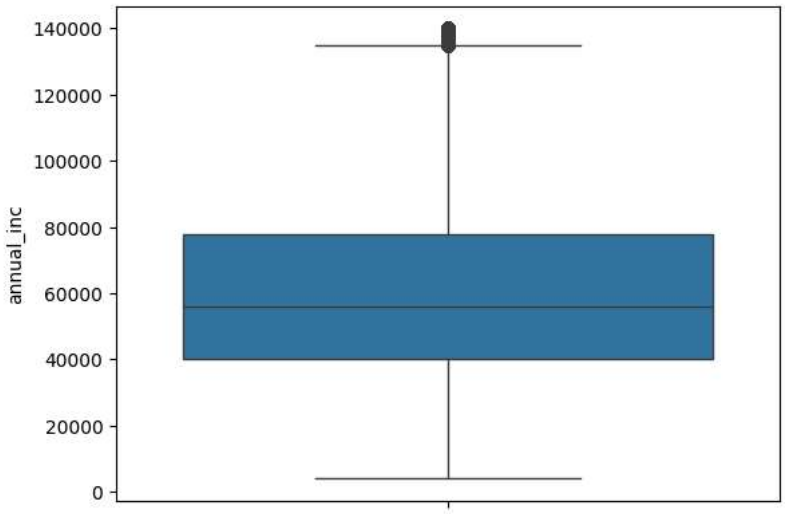

```
quantile = data_loan.annual_inc.quantile([0.5, 0.75,0.90, 0.95, 0.97,0.98, 0.99])
quantile
```

```
0.50     58868.0
0.75     82000.0
0.90    115000.0
0.95    140004.0
0.97    165000.0
0.98    187000.0
0.99    234144.0
Name: annual_inc, dtype: float64
```

```
per_95_annual_inc = data_loan['annual_inc'].quantile(0.95)
data_loan = data_loan[data_loan.annual_inc <= per_95_annual_inc]
```

```
sns.boxplot(data_loan.annual_inc)
```

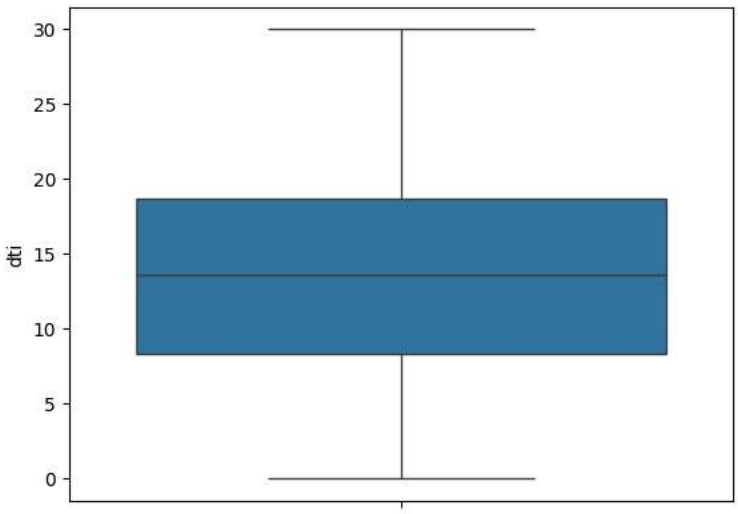
```
<Axes: ylabel='annual_inc'>
```



Now the "annual_inc" data looks good

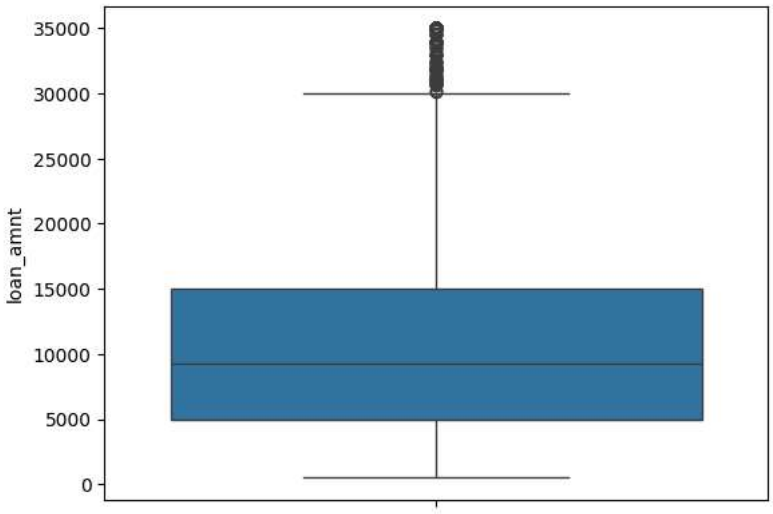
```
sns.boxplot(data_loan.dti)
```

```
<Axes: ylabel='dti'>
```




```
sns.boxplot(data_loan.loan_amnt)
```

```
<Axes: ylabel='loan_amnt'>
```

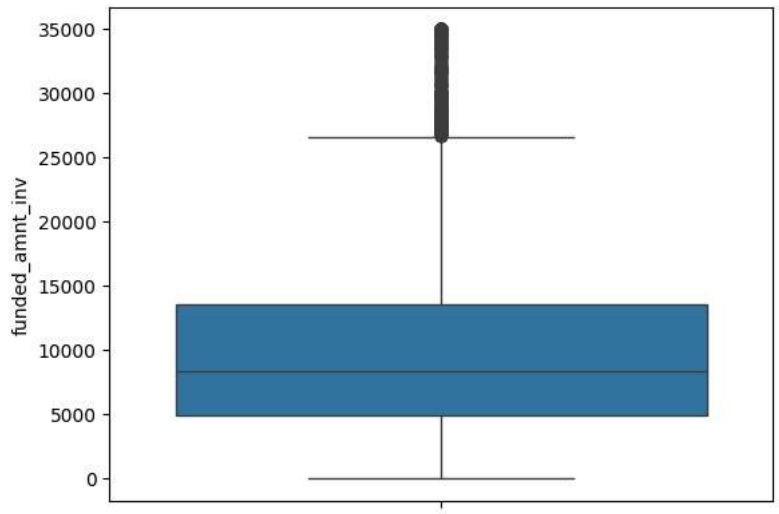



```
data_loan.loan_amnt.quantile([0.75,0.90,0.95,0.97,0.975, 0.98, 0.99, 1.0])
```

```
0.750    15000.0
0.900    20000.0
0.950    25000.0
0.970    25475.0
0.975    28000.0
0.980    30000.0
0.990    35000.0
1.000    35000.0
Name: loan_amnt, dtype: float64
```

```
sns.boxplot(data_loan.funded_amnt_inv)
```

```
<Axes: ylabel='funded_amnt_inv'>
```




```
data_loan.funded_amnt_inv.quantile([0.5,0.75,0.90,0.95,0.97,0.975, 0.98,0.985, 0.99, 1.0])
```

```
0.500     8375.000000
0.750    13623.731415
0.900    19750.000000
0.950    23941.875589
0.970    24975.000000
0.975    25350.000000
0.980    27950.000000
0.985    29925.000000
0.990    31954.028576
1.000    35000.000000
Name: funded_amnt_inv, dtype: float64
```

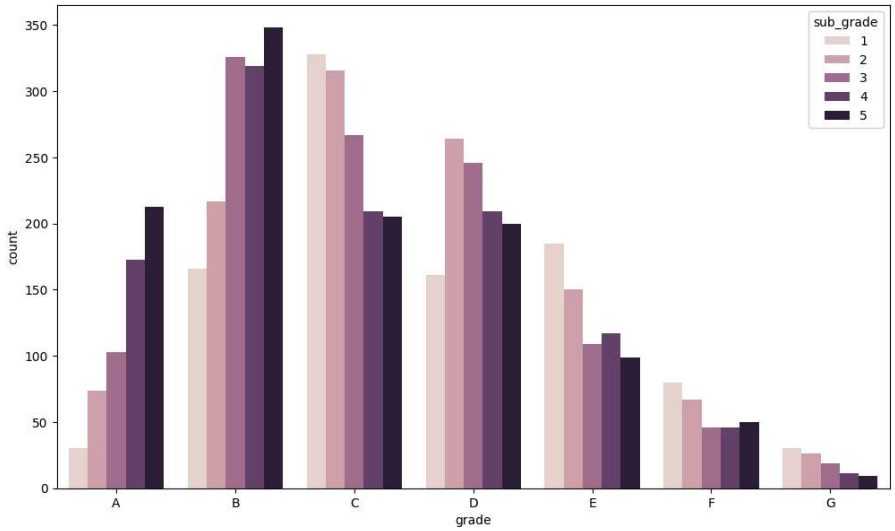
Visualizing Categorical Data

```
data_loan.sub_grade = pd.to_numeric(data_loan.sub_grade.apply(lambda x : x[-1]))
data_loan.sub_grade.head(5)
```

```
0    2
1    4
2    5
3    1
5    4
Name: sub_grade, dtype: int64
```

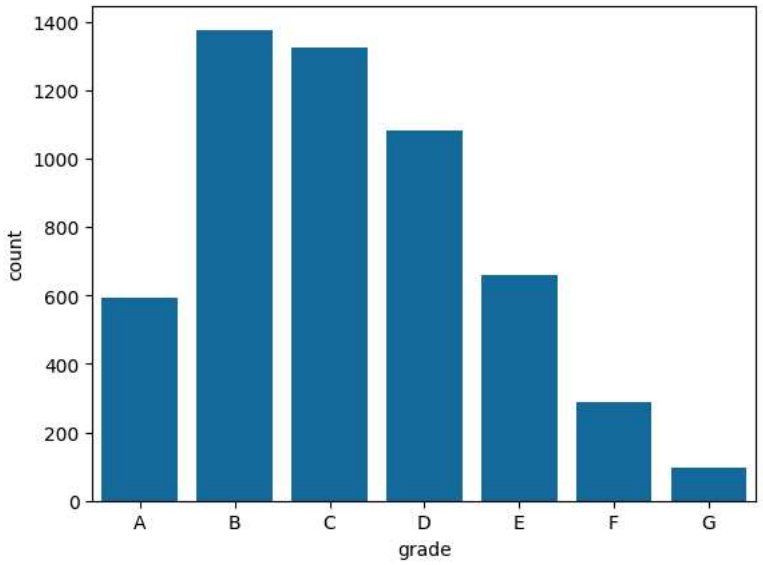
```
fig, ax = plt.subplots(figsize=(12,7))
sns.set_palette('colorblind')
sns.countplot(x = 'grade', order = ['A', 'B', 'C', 'D', 'E', 'F', 'G'] , hue = 'sub_grade',data = data_loan[data_loan.loan_status == 'Charge
```

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




```
sns.countplot(x = 'grade', data = data_loan[data_loan.loan_status == 'Charged Off'], order = ['A', 'B', 'C', 'D', 'E', 'F', 'G'])
```

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




```
data_loan['home_ownership'].unique()
```

```
array(['RENT', 'OWN', 'MORTGAGE', 'OTHER', 'NONE'], dtype=object)
```

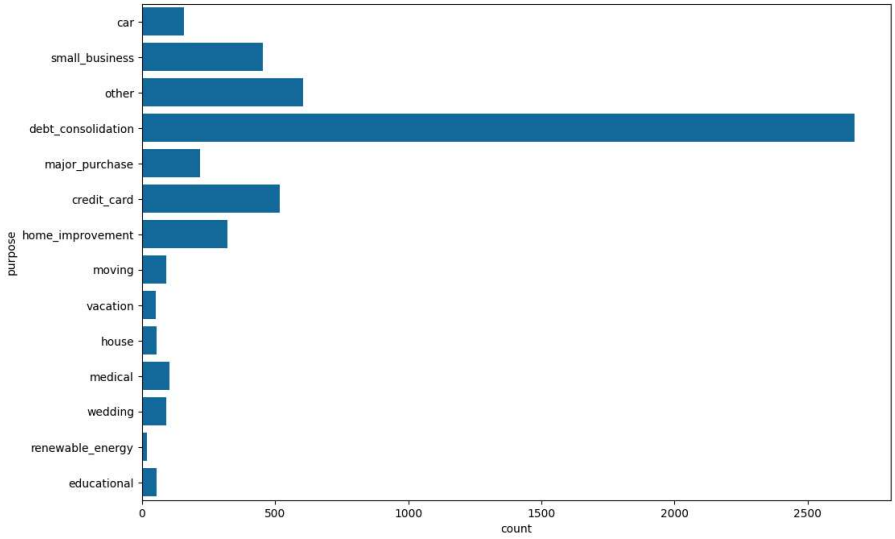
```
# replacing none values
data_loan['home_ownership'].replace(to_replace = ['NONE'],value='OTHER',inplace = True)
```

```
fig, ax = plt.subplots(figsize = (6,4))
ax.set(yscale = 'log')
sns.countplot(x='home_ownership', data=data_loan[data_loan['loan_status']=='Charged Off'])
```

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


```
fig, ax = plt.subplots(figsize = (12,8))
ax.set(xscale = 'linear')
sns.countplot(y ='purpose', data=data_loan[data_loan.loan_status == 'Charged Off'])
```

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

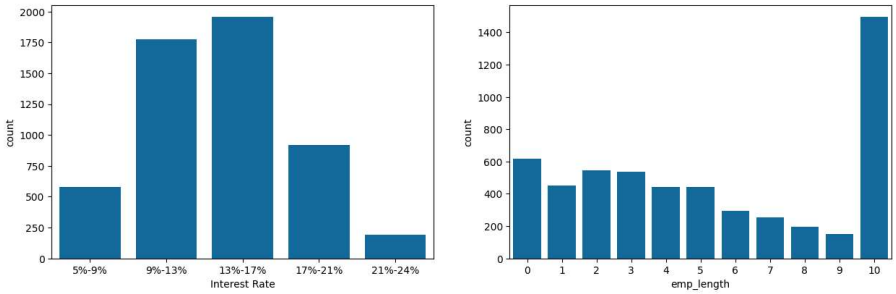



```
#creating bins for int_rate,open_acc,revol_util,total_acc
data_loan['int_rate_groups'] = pd.cut(data_loan['int_rate'], bins=5,precision =0,labels=['5%-9%','9%-13%','13%-17%','17%-21%','21%-24%'])
data_loan['open_acc_groups'] = pd.cut(data_loan['open_acc'],bins = 5,precision =0,labels=['2-10','10-19','19-27','27-36','36-44'])
data_loan['total_acc_groups'] = pd.cut(data_loan['total_acc'], bins=5,precision =0,labels=['2-20','20-37','37-55','55-74','74-90'])
data_loan['annual_inc_groups'] = pd.cut(data_loan['annual_inc'], bins=5,precision =0,labels =['3k-31k','31k-58k','58k-85k','85k-112k','112k-
```

Intrest rate wrt bins

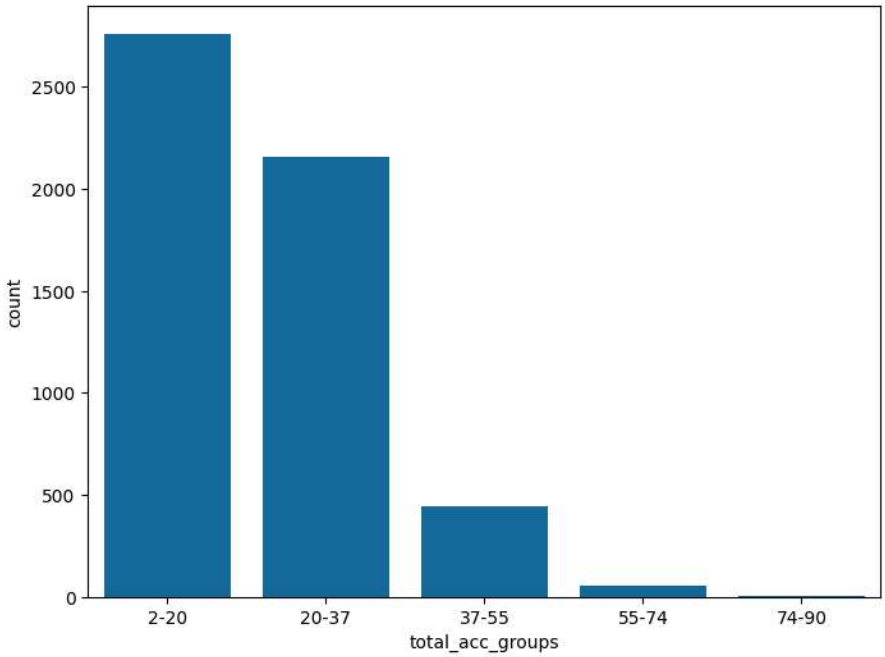
```
fig, ax = plt.subplots(figsize = (15,10))
plt.subplot(221)
sns.countplot(x='int_rate_groups', data=data_loan[data_loan.loan_status == 'Charged Off'])
plt.xlabel('Interest Rate')
plt.subplot(222)
sns.countplot(x='emp_length', data=data_loan[data_loan.loan_status == 'Charged Off'])
```

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



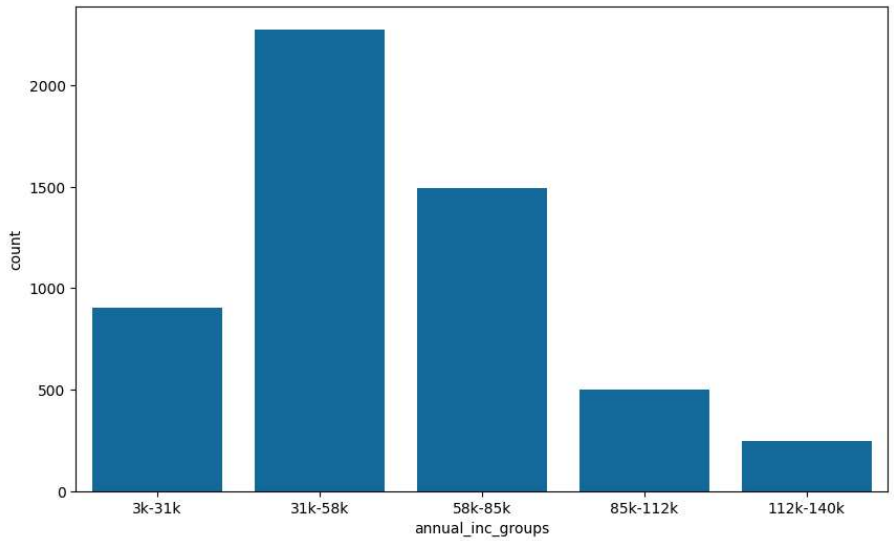

```
fig, ax = plt.subplots(figsize = (8,6))
ax.set_yscale('linear')
sns.countplot(x='total_acc_groups', data=data_loan[data_loan.loan_status == 'Charged Off'])
```

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



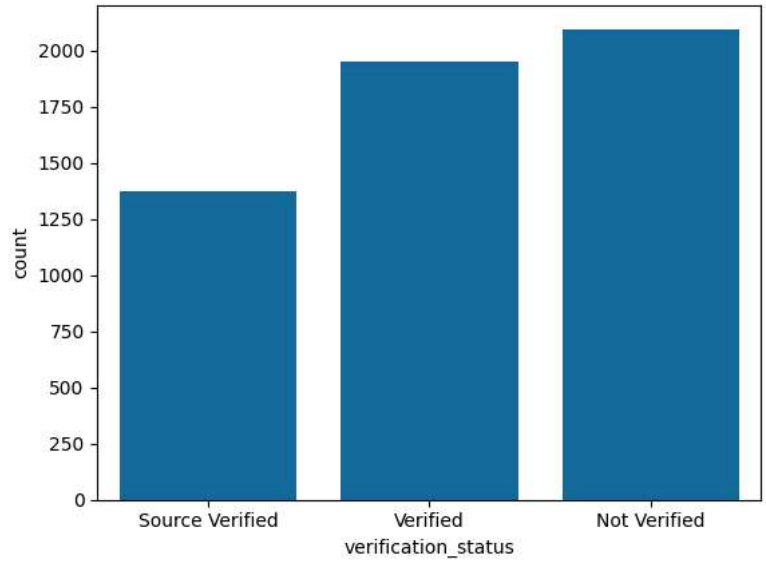

```
fig, ax = plt.subplots(figsize = (10,6))
sns.countplot(x='annual_inc_groups', data=data_loan[data_loan.loan_status == 'Charged Off'])
```

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




```
sns.countplot(x='verification_status', data=data_loan[data_loan['loan_status']=='Charged Off'])
```

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




```
sns.countplot(y='term', data=data_loan[data_loan['loan_status']=='Charged Off'])
```

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


```
fig,ax = plt.subplots(figsize = (10,8))
ax.set_yscale('linear')
sns.countplot(x='inq_last_6mths', data=data_loan[data_loan['loan_status']=='Charged Off'])
```

```
<Axes: xlabel='inq_last_6mths', ylabel='count'>
```