In [1]:
```python
from sklearn import preprocessing
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import cross_val_predict
from sklearn.metrics import average_precision_score, recall_score
from sklearn.metrics import f1_score
from sklearn.datasets import make_regression
from sklearn.ensemble import GradientBoostingRegressor
import joblib
import pickle
```

In [2]:
```python
# Update sklearn to prevent version mismatches
!pip install sklearn --upgrade
```

```
Requirement already up-to-date: sklearn in c:\users\glori\anaconda3\lib\site-packages (0.0)
Requirement already satisfied, skipping upgrade: scikit-learn in c:\users\glori\anaconda3\lib\site-packages (from sklearn) (0.23.2)
Requirement already satisfied, skipping upgrade: numpy>=1.13.3 in c:\users\glori\anaconda3\lib\site-packages (from scikit-learn->sklearn) (1.19.2)
Requirement already satisfied, skipping upgrade: threadpoolctl>=2.0.0 in c:\users\glori\anaconda3\lib\site-packages (from scikit-learn->sklearn) (2.1.0)
Requirement already satisfied, skipping upgrade: joblib>=0.11 in c:\users\glori\anaconda3\lib\site-packages (from scikit-learn->sklearn) (0.17.0)
Requirement already satisfied, skipping upgrade: scipy>=0.19.1 in c:\users\glori\anaconda3\lib\site-packages (from scikit-learn->sklearn) (1.5.2)
```

In [3]:
```python
# install joblib. This will be used to save your model.
# Restart your kernel after installing
!pip install joblib
```

```
Requirement already satisfied: joblib in c:\users\glori\anaconda3\lib\site-packages (0.17.0)
```

In [4]:
```python
import re
import os

import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import datetime as dt
```

In [5]:
```python
file_path = "Data/model_1_combine_data.csv"
```

In [6]:
```python
my_data = pd.read_csv(file_path, error_bad_lines=False, low_memory=False)
my_data
```

Out[6]:

	Unnamed: 0	Amount_Requested	Risk_Score	debt_to_income_ratio	State	Employment_Length	
0	421097	5000.0	669.0	21.80	OK	8	
1	421098	15000.0	704.0	18.29	FL	2	debt_
2	421099	11200.0	669.0	43.97	NH	0	
3	421100	25000.0	669.0	12.89	AL	10	debt_
4	421101	3000.0	764.0	0.58	WA	9	ma
...	...	...	...	...	...	...	
1081515	19698926	3000.0	535.0	1.54	CT	5	Med
1081516	19698936	6000.0	580.0	5.55	TX	0	
1081517	19698996	3000.0	561.0	0.00	OR	0	Debt
1081518	19699052	2500.0	573.0	8.55	NY	0	
1081519	19699073	2500.0	567.0	0.00	AL	2	

1081520 rows × 8 columns

In [7]:
```python
my_data['Loan_Status'].value_counts()
```

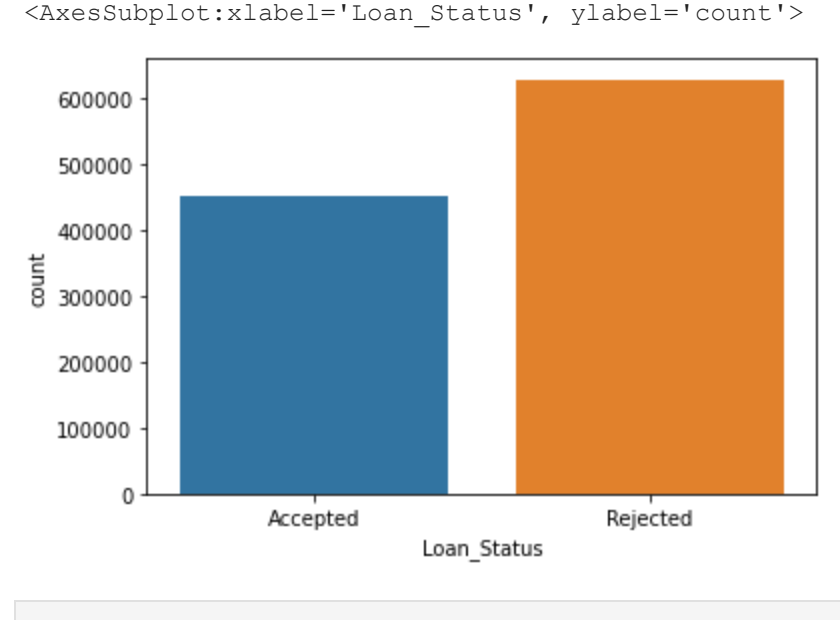
Out[7]:
```
Rejected    628344
Accepted    453176
Name: Loan_Status, dtype: int64
```

In [8]:
```python
#Understanding the split the reject and accept applications
print (my_data['Loan_Status'].value_counts(normalize=True))
```

```
Rejected    0.580982
Accepted    0.419018
Name: Loan_Status, dtype: float64
```

In [9]:
```python
#predicting loan status creating countplot
sns.countplot(x='Loan_Status', data=my_data)
```

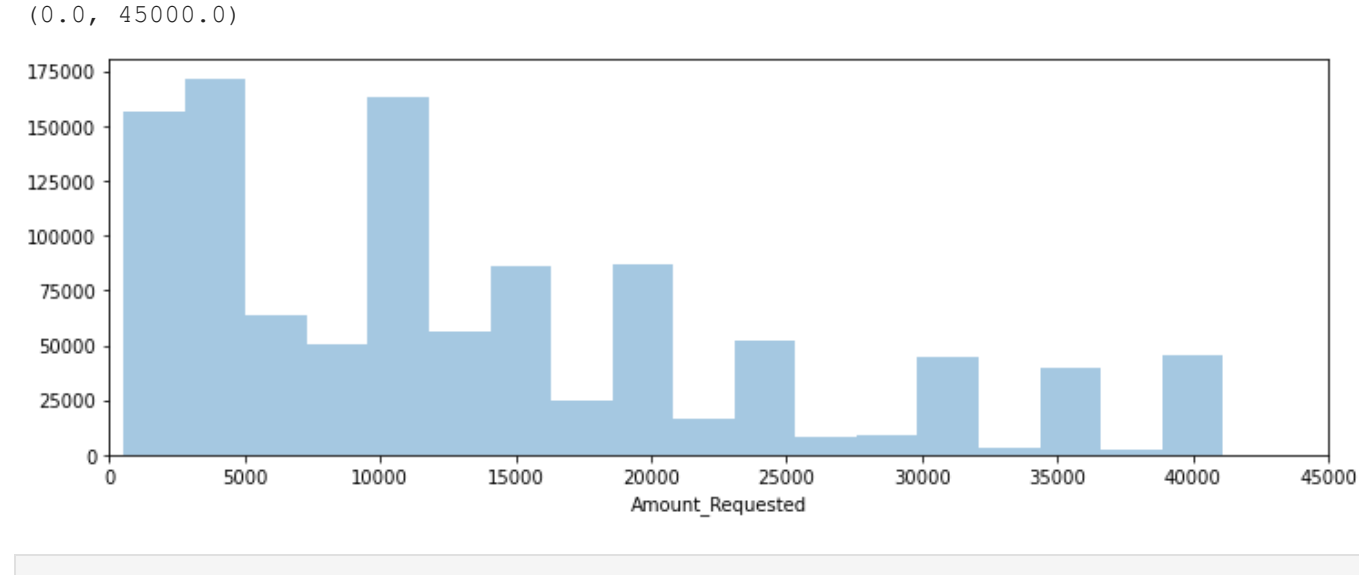
Out[9]: <AxesSubplot:xlabel='Loan_Status', ylabel='count'>



In [10]:
```python
#histogram of the loan amount
plt.figure(figsize=(12,4))
sns.distplot(my_data['Amount_Requested'], kde=False, bins=40)
plt.xlim(0,45000)
```

```
C:\Users\glori\anaconda3\lib\site-packages\seaborn\distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[10]: (0.0, 45000.0)



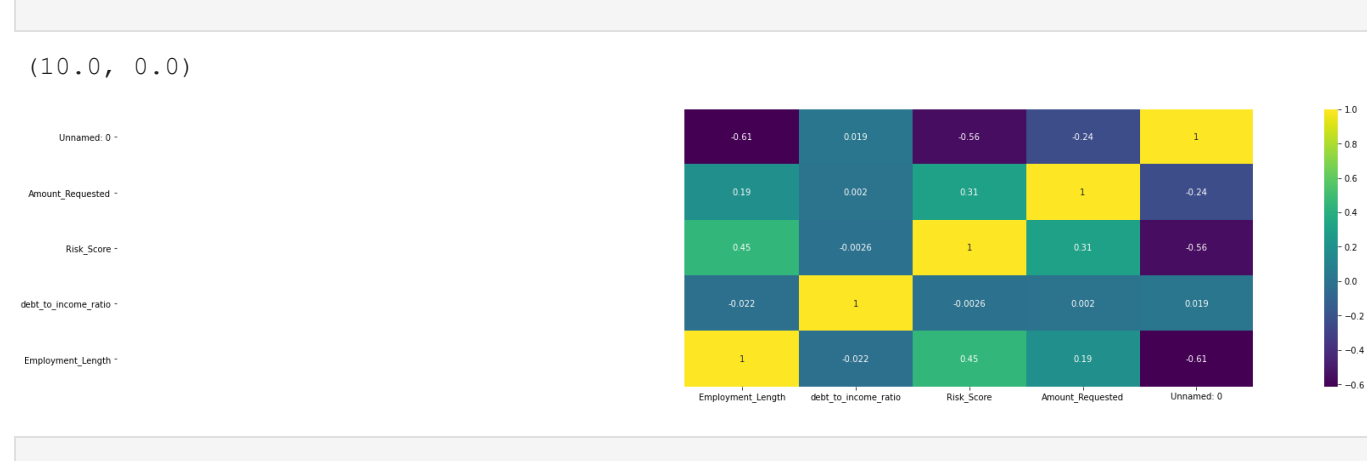
In [11]:
```python
#what is the correlation b/t the variables
my_data.corr()
```

Out[11]:

	Unnamed: 0	Amount_Requested	Risk_Score	debt_to_income_ratio	Employment_Length
Unnamed: 0	1.000000	-0.236809	-0.561502	0.019285	-0.613899
Amount_Requested	-0.236809	1.000000	0.310587	0.002001	0.190206
Risk_Score	-0.561502	0.310587	1.000000	-0.002608	0.449296
debt_to_income_ratio	0.019285	0.002001	-0.002608	1.000000	-0.021967
Employment_Length	-0.613899	0.190206	0.449296	-0.021967	1.000000

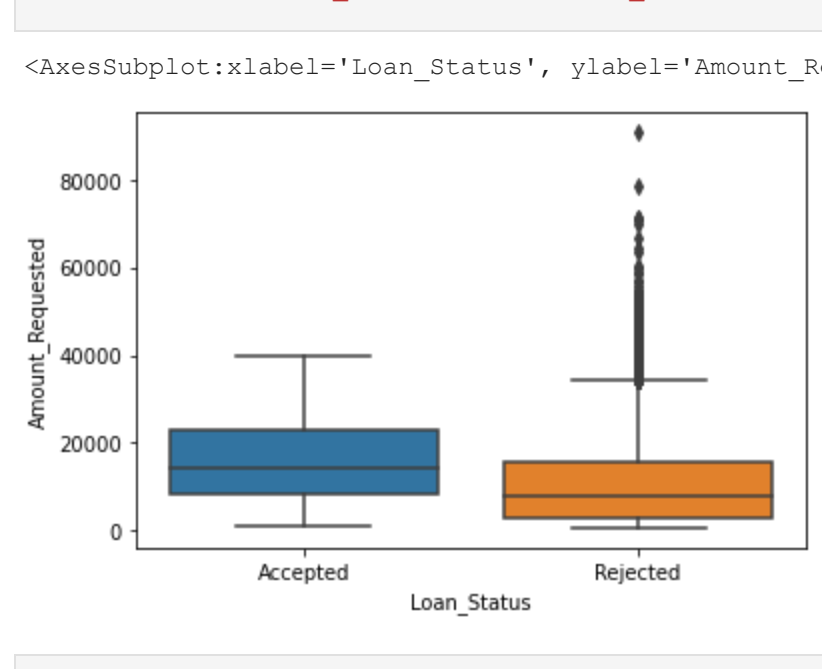
In [12]:
```python
#correlation using heatmap
plt.figure(figsize=(30, 6))
sns.heatmap(my_data.corr(), annot=True, cmap='viridis')
plt.xlim(10,0)
```

Out[12]: (10.0, 0.0)



In [13]:
```python
#boxplot showing relationship between the loan amount and loan status
sns.boxplot(x='Loan_Status', y='Amount_Requested', data=my_data)
```

Out[13]: <AxesSubplot:xlabel='Loan_Status', ylabel='Amount_Requested'>

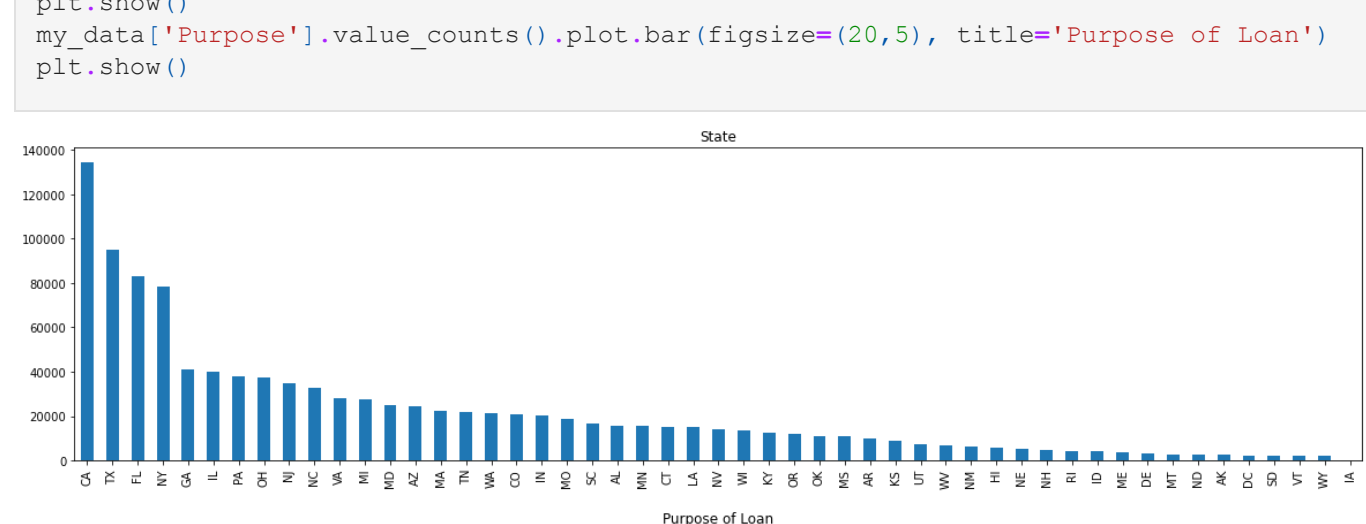


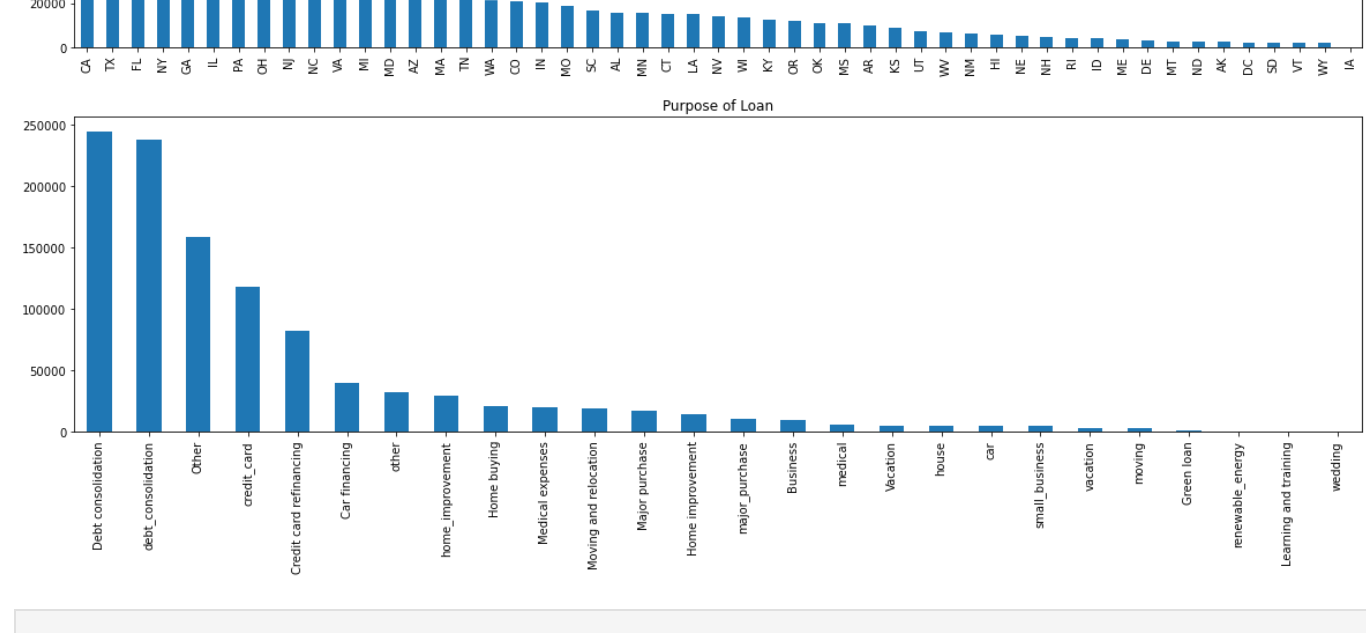
In [14]:
```python
#Loan Amount, grouped by Loan Status
my_data.groupby('Loan_Status')['Amount_Requested'].describe()
```

Out[14]:

Loan_Status	count	mean	std	min	25%	50%	75%	max
Accepted	453176.0	16304.636995	10200.954582	1000.0	8500.0	14400.0	22825.0	40000.0
Rejected	628344.0	11385.468589	10647.183241	525.0	3000.0	8000.0	15500.0	90725.0

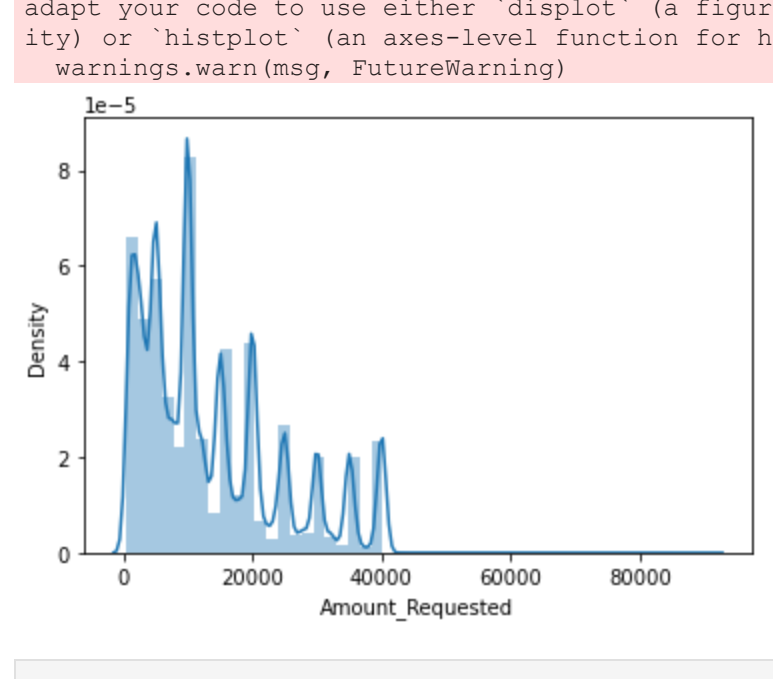
In [15]:
```python
#split of all categorical columns
my_data['State'].value_counts().plot.bar(figsize=(20,5), title='State')
plt.show()
my_data['Purpose'].value_counts().plot.bar(figsize=(20,5), title='Purpose of Loan')
plt.show()
```





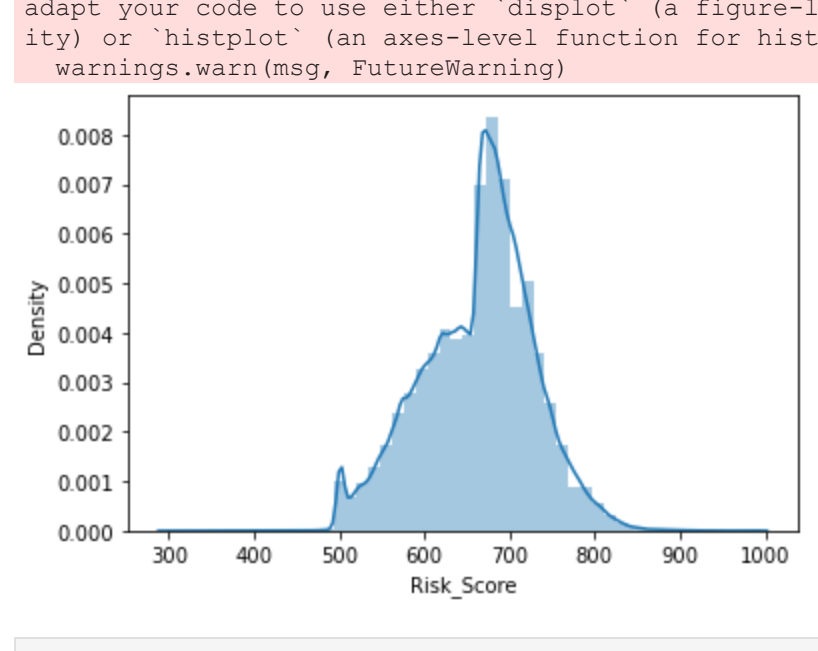
In [16]:
```python
#split of Numeric columns
sns.distplot(my_data['Amount_Requested'])
plt.show()
```

```
C:\Users\glori\anaconda3\lib\site-packages\seaborn\distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```



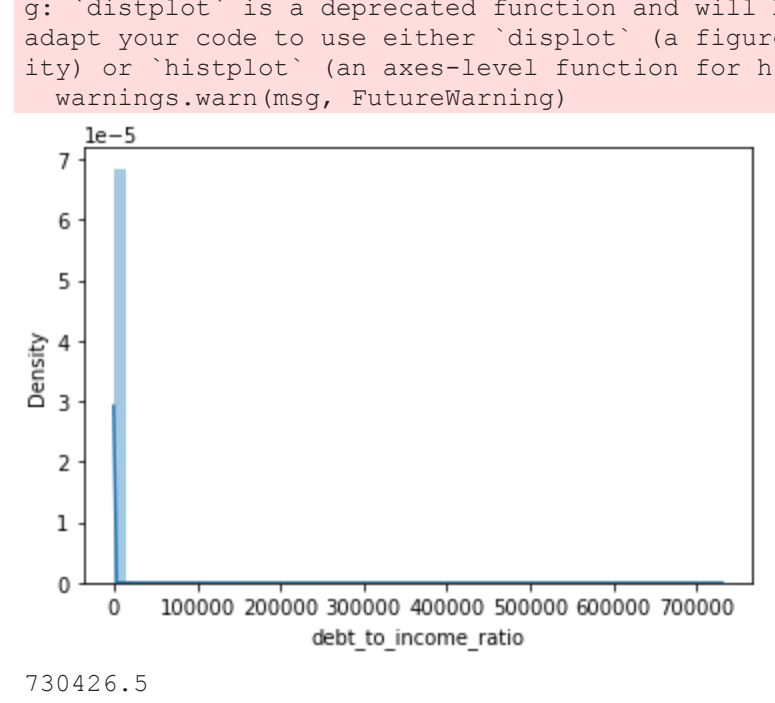
In [17]:
```python
#split of numeric columns
sns.distplot(my_data['Risk_Score'])
plt.show()
```

```
C:\Users\glori\anaconda3\lib\site-packages\seaborn\distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```



In [18]:
```python
# understanding split of all Numeric Columns
sns.distplot(my_data['debt_to_income_ratio'])
plt.show()

print(my_data['debt_to_income_ratio'].max())
print('---------------')
print(my_data['debt_to_income_ratio'].min())
print('---------------')
print(my_data[['debt_to_income_ratio','Loan_Status']].sort_values(by='debt_to_income_
```

```
C:\Users\glori\anaconda3\lib\site-packages\seaborn\distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```




```
730426.5
---------------
0.0
---------------
         debt_to_income_ratio Loan_Status
1081519                   0.0    Rejected
72018                     0.0    Accepted
912669                    0.0    Rejected
912668                    0.0    Rejected
912667                    0.0    Rejected
...                       ...         ...
752158               167650.0    Rejected
922204               183650.0    Rejected
810079               192200.0    Rejected
811546               196100.0    Rejected
783878               730426.5    Rejected

[1081520 rows x 2 columns]
```

In [19]:
```python
#define categorical and numerical features
categorical_features = ['State', 'Purpose', 'Loan_Status']

numerical_features = ['Amount_Requested', 'Risk_Score', 'debt_to_income_ratio', 'Emplo

features = categorical_features + numerical_features

#define the features
print('Categorical Feature:\t', len(categorical_features))
print('Numerical Feature:\t', len(numerical_features))
print('Total Features:\t\t', len(features))
```

```
Categorical Feature:     3
Numerical Feature:       4
Total Features:          7
```

In [20]:
```python
my_data
```

Out[20]:

	Unnamed: 0	Amount_Requested	Risk_Score	debt_to_income_ratio	State	Employment_Length	
0	421097	5000.0	669.0	21.80	OK	8	
1	421098	15000.0	704.0	18.29	FL	2	debt_
2	421099	11200.0	669.0	43.97	NH	0	
3	421100	25000.0	669.0	12.89	AL	10	debt_
4	421101	3000.0	764.0	0.58	WA	9	ma
...	...	...	...	...	...	...	
1081515	19698926	3000.0	535.0	1.54	CT	5	Med
1081516	19698936	6000.0	580.0	5.55	TX	0	
1081517	19698996	3000.0	561.0	0.00	OR	0	Debt
1081518	19699052	2500.0	573.0	8.55	NY	0	
1081519	19699073	2500.0	567.0	0.00	AL	2	

1081520 rows × 8 columns

In [21]:
```python
loan_df=my_data.drop(['Unnamed: 0'], axis=1).fillna(-1)
loan_df
```

Out[21]:

	Amount_Requested	Risk_Score	debt_to_income_ratio	State	Employment_Length	Purpose
0	5000.0	669.0	21.80	OK	8	other
1	15000.0	704.0	18.29	FL	2	debt_consolidation
2	11200.0	669.0	43.97	NH	0	medical
3	25000.0	669.0	12.89	AL	10	debt_consolidation
4	3000.0	764.0	0.58	WA	9	major_purchase
...	...	...	...	...	...	...
1081515	3000.0	535.0	1.54	CT	5	Medical expenses
1081516	6000.0	580.0	5.55	TX	0	Car financing
1081517	3000.0	561.0	0.00	OR	0	Debt consolidation
1081518	2500.0	573.0	8.55	NY	0	Other
1081519	2500.0	567.0	0.00	AL	2	Car financing

1081520 rows × 7 columns

In [22]:
```python
# df[df.b > 10]
dti_values_over100 = loan_df[loan_df.debt_to_income_ratio > 100]
```

In [23]:
```python
print(dti_values_over100.info())
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 22081 entries, 493 to 1081423
Data columns (total 7 columns):
 #   Column                Non-Null Count  Dtype
---  ------                --------------  -----
 0   Amount_Requested      22081 non-null  float64
 1   Risk_Score            22081 non-null  float64
 2   debt_to_income_ratio  22081 non-null  float64
 3   State                 22081 non-null  object
 4   Employment_Length     22081 non-null  int64
 5   Purpose               22081 non-null  object
 6   Loan_Status           22081 non-null  object
dtypes: float64(3), int64(1), object(3)
memory usage: 1.3+ MB
None
```

In [24]:
```python
dti_values_over100.head()
```

Out[24]:

	Amount_Requested	Risk_Score	debt_to_income_ratio	State	Employment_Length	Purpose	L
493	28000.0	704.0	112.20	NV	0	debt_consolidation	
643	40000.0	709.0	101.46	OH	4	debt_consolidation	
1229	10000.0	714.0	114.27	TX	9	debt_consolidation	
1683	9000.0	684.0	106.66	IL	4	credit_card	
1879	35000.0	714.0	102.47	UT	0	debt_consolidation	

In [25]:
```python
dti_values_over100["Loan_Status"].value_counts()
```

Out[25]:
```
Rejected    21193
Accepted      888
Name: Loan_Status, dtype: int64
```

In [26]:
```python
clean_dti_data=loan_df[loan_df.debt_to_income_ratio < 100]
```

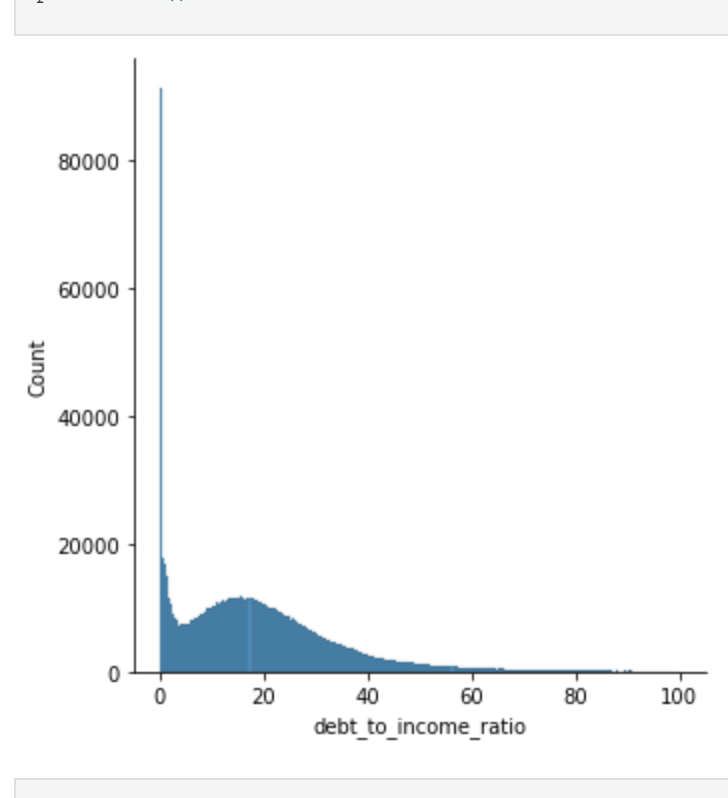
In [27]:
```python
clean_dti_data
```

Out[27]:

	Amount_Requested	Risk_Score	debt_to_income_ratio	State	Employment_Length	Purpose
0	5000.0	669.0	21.80	OK	8	other
1	15000.0	704.0	18.29	FL	2	debt_consolidation
2	11200.0	669.0	43.97	NH	0	medical
3	25000.0	669.0	12.89	AL	10	debt_consolidation
4	3000.0	764.0	0.58	WA	9	major_purchase
...	...	...	...	...	...	...
1081515	3000.0	535.0	1.54	CT	5	Medical expenses
1081516	6000.0	580.0	5.55	TX	0	Car financing
1081517	3000.0	561.0	0.00	OR	0	Debt consolidation
1081518	2500.0	573.0	8.55	NY	0	Other
1081519	2500.0	567.0	0.00	AL	2	Car financing

1034236 rows × 7 columns

In [28]:
```python
sns.displot(clean_dti_data["debt_to_income_ratio"])
plt.show()
```

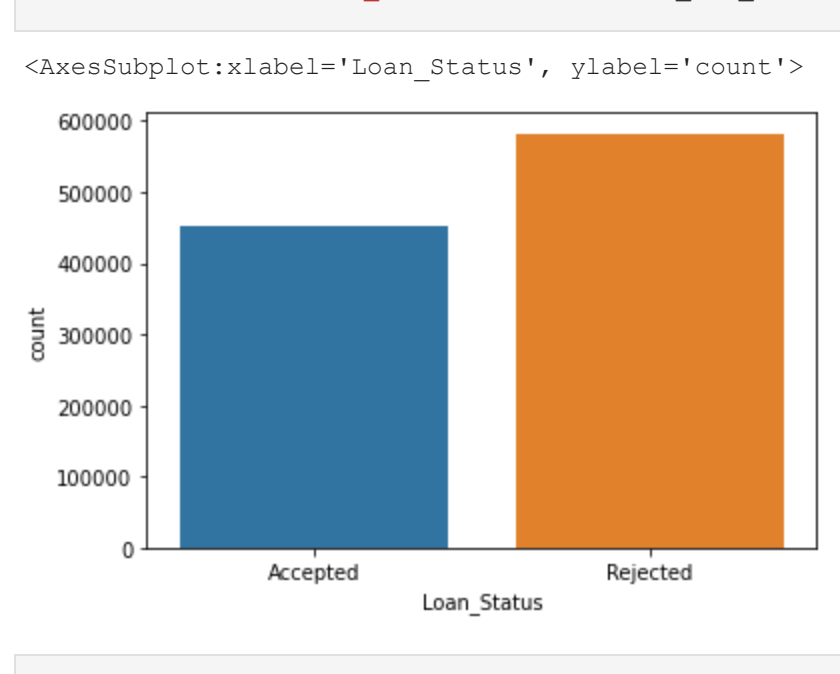


In [29]:
```python
#plotting the clean data
print(clean_dti_data["Loan_Status"].value_counts(normalize=True))
```

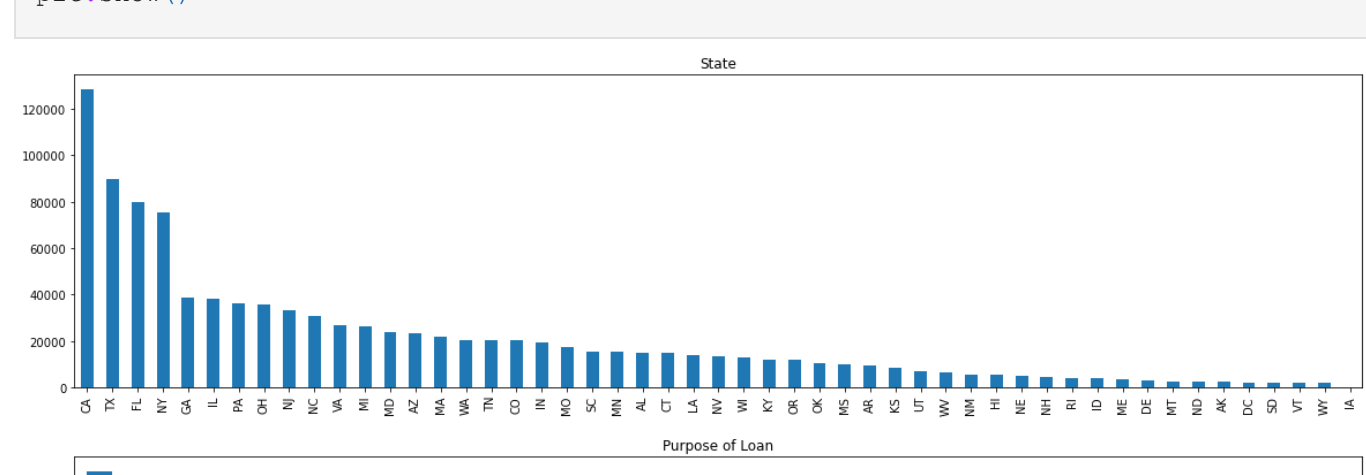
```
Rejected    0.562685
Accepted    0.437315
Name: Loan_Status, dtype: float64
```

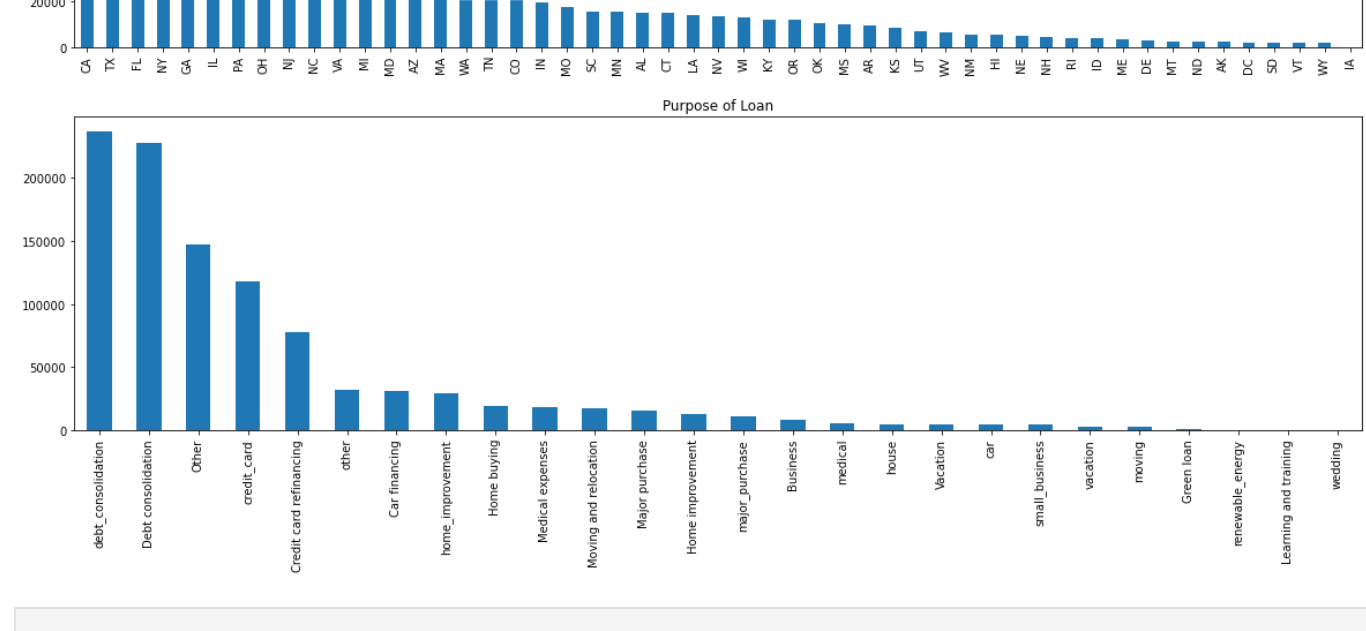
In [30]:
```python
#Dependent Variable - Loan Status
sns.countplot(x='Loan_Status', data=clean_dti_data)
```

Out[30]: <AxesSubplot:xlabel='Loan_Status', ylabel='count'>



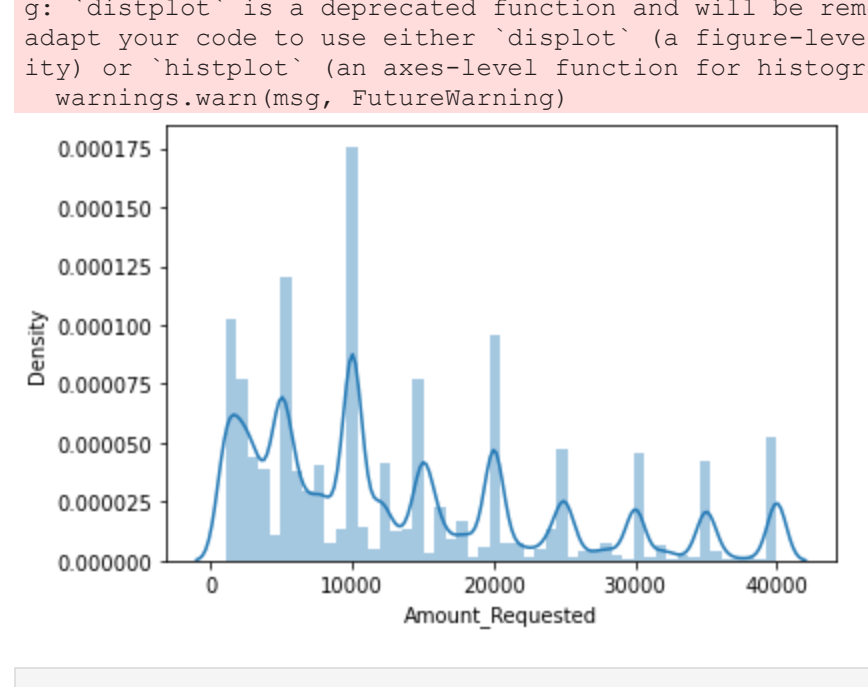
In [31]:
```python
clean_dti_data['State'].value_counts().plot.bar(figsize=(20,5), title='State')
plt.show()
clean_dti_data['Purpose'].value_counts().plot.bar(figsize=(20,5), title='Purpose of Lo
plt.show()
```



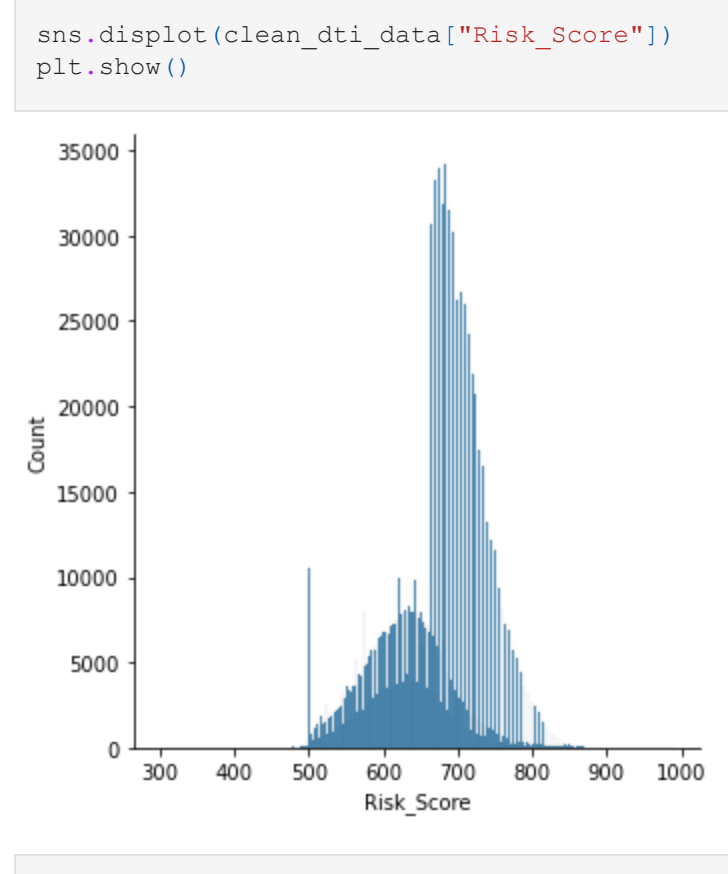


In [32]:
```python
sns.distplot(clean_dti_data["Amount_Requested"])
plt.show()
```

```
C:\Users\glori\anaconda3\lib\site-packages\seaborn\distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```



In [33]:
```python
sns.displot(clean_dti_data["Risk_Score"])
plt.show()
```



In [34]:
```python
#Loan purpose recategorized
clean_dti_data.loc[(clean_dti_data.Purpose == "debt_consolidation"), "Purpose"] = "Deb
clean_dti_data.loc[(clean_dti_data.Purpose == "other"), "Purpose"] = "Other"
clean_dti_data.loc[(clean_dti_data.Purpose == "car"), "Purpose"] = "Car Financing"
clean_dti_data.loc[(clean_dti_data.Purpose == "home_improvement"), "Purpose"] = "Home
clean_dti_data.loc[(clean_dti_data.Purpose == "moving"), "Purpose"] = "Relocation Expe
clean_dti_data.loc[(clean_dti_data.Purpose == "major_purchase"), "Purpose"] = "Major P
clean_dti_data.loc[(clean_dti_data.Purpose == "medical"), "Purpose"] = "Medical Expens
clean_dti_data.loc[(clean_dti_data.Purpose == "house"), "Purpose"] = "Home Buying"
clean_dti_data.loc[(clean_dti_data.Purpose == "vacation"), "Purpose"] = "Vacation"
clean_dti_data.loc[(clean_dti_data.Purpose == "small_business"), "Purpose"] = "Busines
clean_dti_data.loc[(clean_dti_data.Purpose == "renewable_energy"), "Purpose"] = "Energ
```

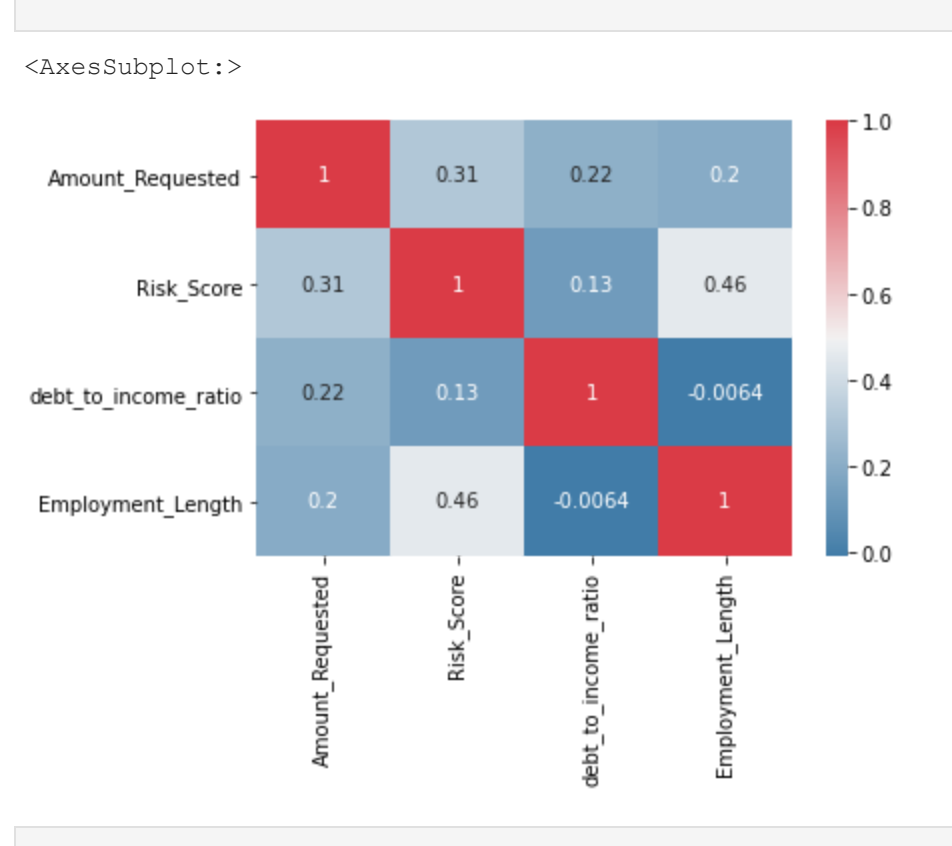
```
C:\Users\glori\anaconda3\lib\site-packages\pandas\core\indexing.py:1765: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  isetter(loc, value)
```

In [35]:
```python
#Cleaned Purpose Column
clean_dti_data["Purpose"].value_counts()
```

Out[35]:
```
Debt consolidation         463923
Other                      179281
credit_card                118031
Credit card refinancing     77889
Car financing               31333
Home Improvement            29363
Home buying                 19056
Medical expenses            18315
Moving and relocation       17612
Major purchase              15669
Home improvement            13046
Business                    13010
Major Purchase              10754
Vacation                     7780
Medical Expense              5783
Home Buying                  4921
Car Financing                4546
Relocation Expense           2825
Green loan                    808
Energy Loan                   252
Learning and training          34
wedding                         5
Name: Purpose, dtype: int64
```

In [36]:
```python
# plot the heatmap
corr = clean_dti_data.corr()
sns.heatmap(corr, xticklabels=corr.columns, yticklabels=corr.columns, annot=True, cmap
```

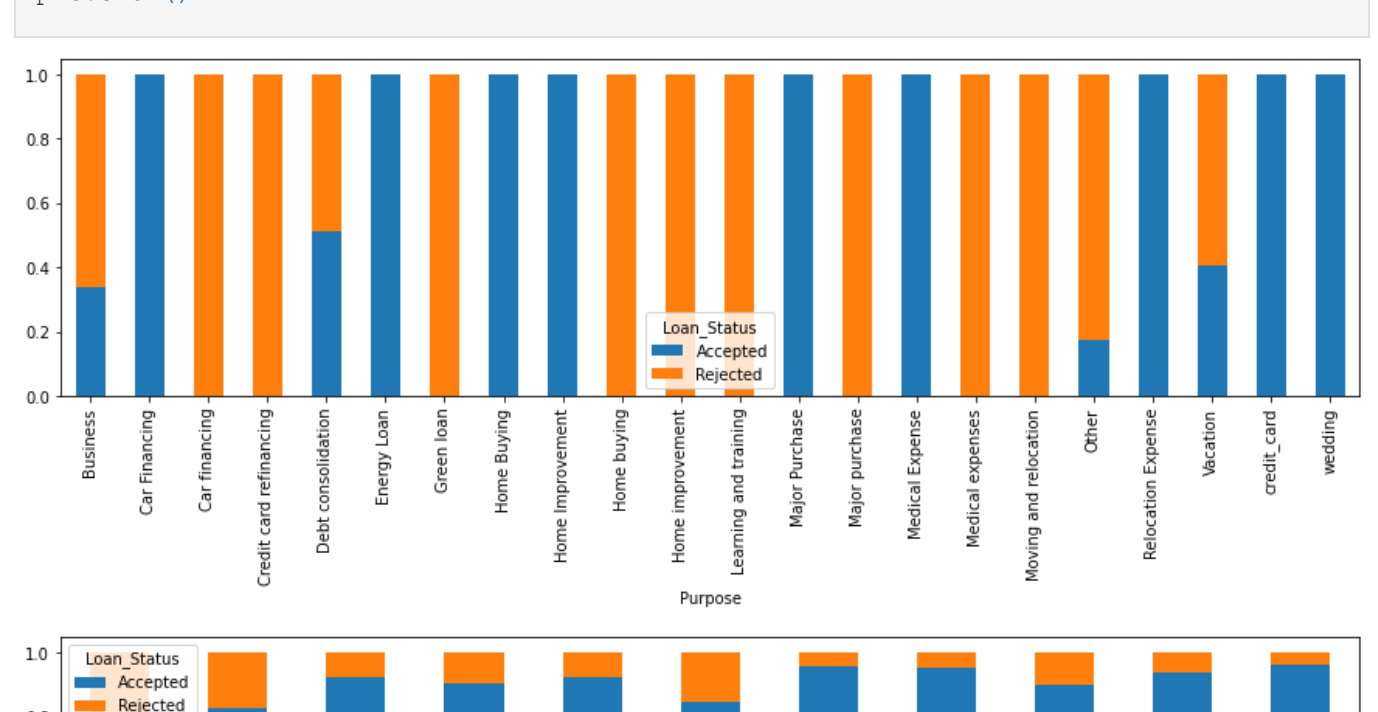
Out[36]: <AxesSubplot:>

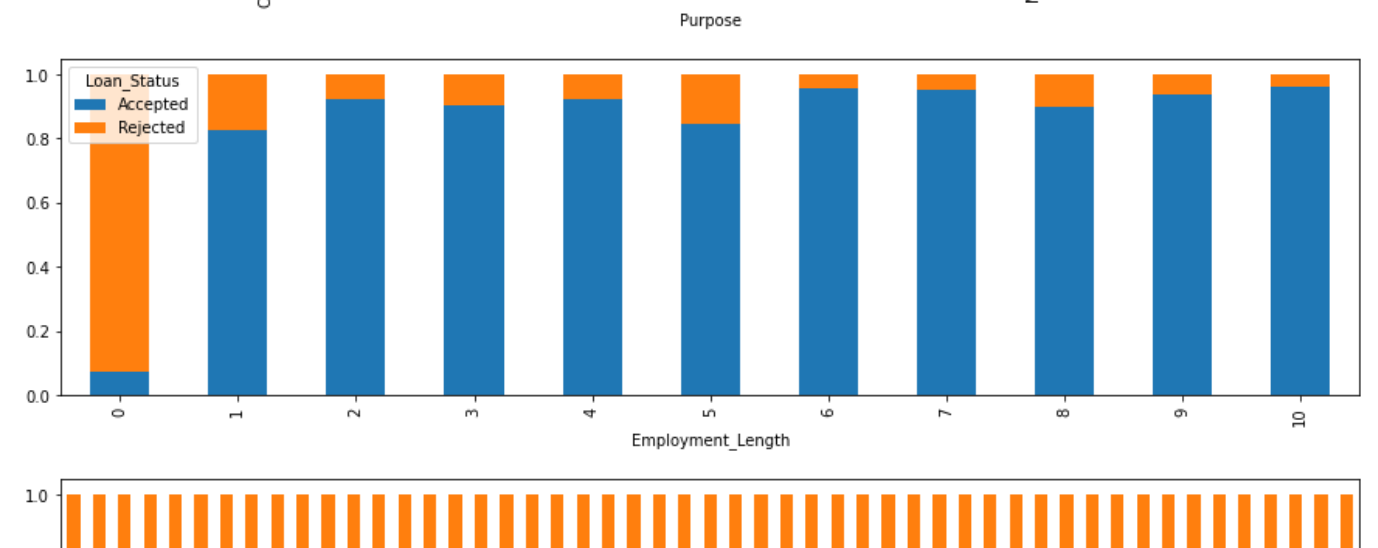


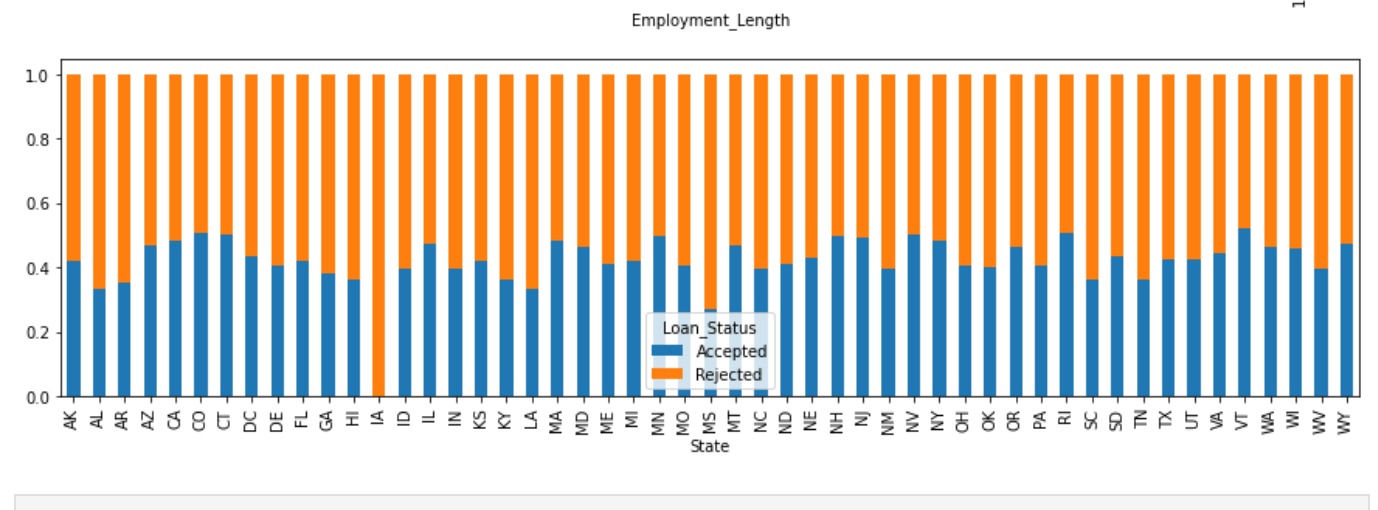
In [37]:
```python
clean_dti_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1034236 entries, 0 to 1081519
Data columns (total 7 columns):
 #   Column                Non-Null Count    Dtype
---  ------                --------------    -----
 0   Amount_Requested      1034236 non-null  float64
 1   Risk_Score            1034236 non-null  float64
 2   debt_to_income_ratio  1034236 non-null  float64
 3   State                 1034236 non-null  object
 4   Employment_Length     1034236 non-null  int64
 5   Purpose               1034236 non-null  object
 6   Loan_Status           1034236 non-null  object
dtypes: float64(3), int64(1), object(3)
memory usage: 63.1+ MB
```

In [38]:
```python
Loan_Purpose = pd.crosstab(clean_dti_data["Purpose"], clean_dti_data["Loan_Status"])
Employment_Length = pd.crosstab(clean_dti_data["Employment_Length"], clean_dti_data["
State = pd.crosstab(clean_dti_data["State"], clean_dti_data["Loan_Status"])

Loan_Purpose.div(Loan_Purpose.sum(1).astype(float), axis = 0).plot(kind='bar', stacke
plt.show()
Employment_Length.div(Employment_Length.sum(1).astype(float), axis = 0).plot(kind='ba
plt.show()
State.div(State.sum(1).astype(float), axis = 0).plot(kind='bar', stacked=True, figsize
plt.show()
```



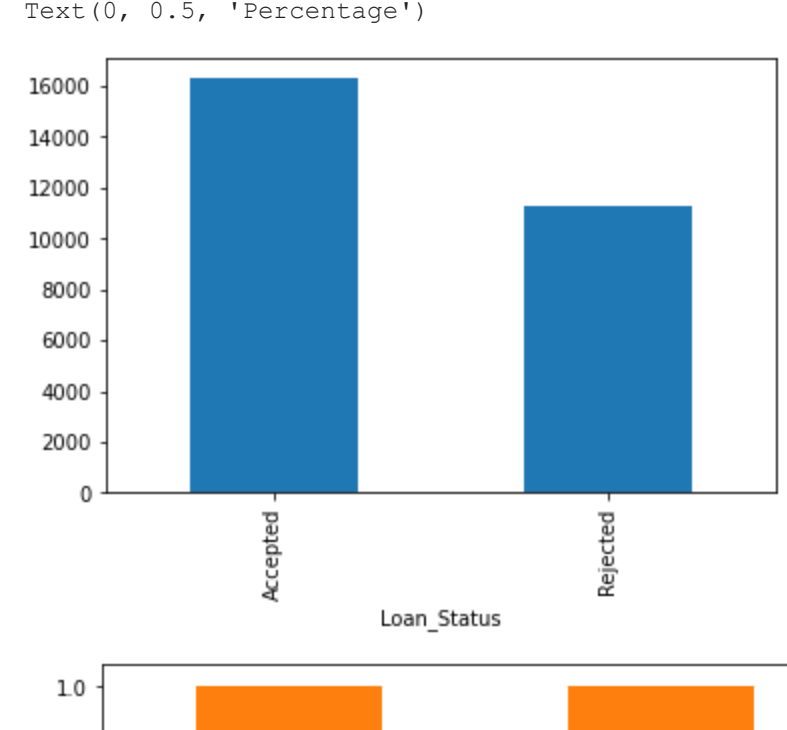


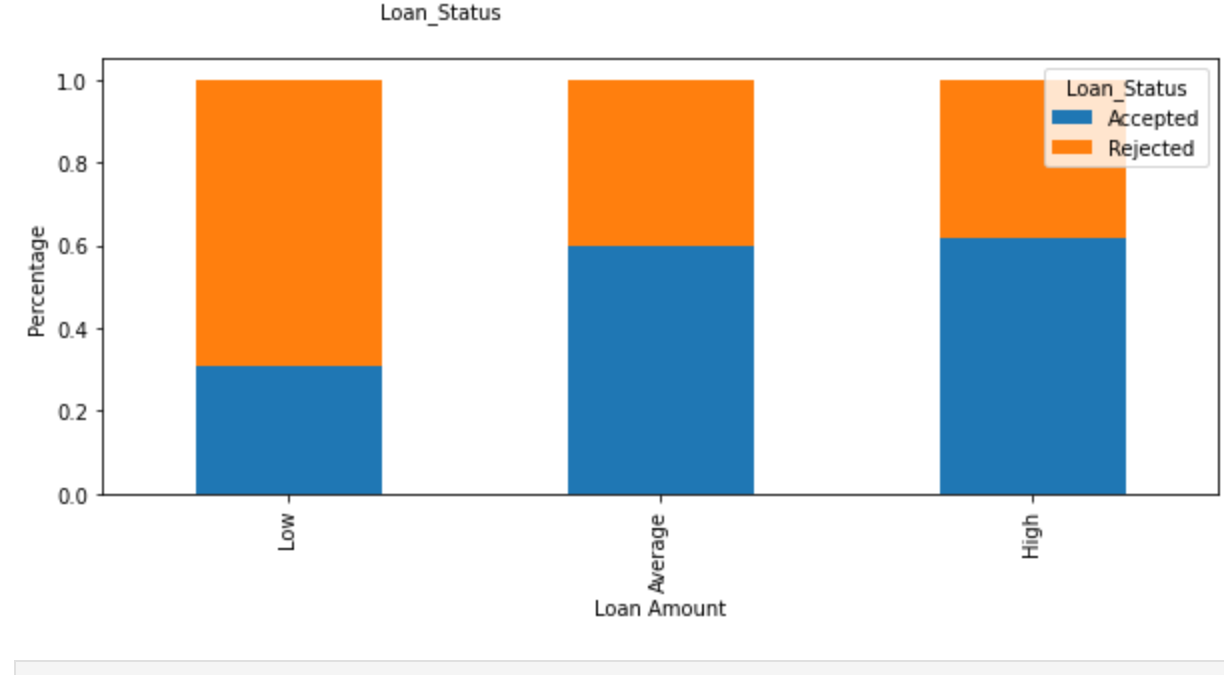


In [39]:
```python
clean_dti_data.groupby("Loan_Status")["Amount_Requested"].mean().plot.bar()

bins=[0,10000,20000,30000]
group=['Low','Average','High']

clean_dti_data['Amount_Requested_bins']=pd.cut(clean_dti_data['Amount_Requested'],bins

Amount_Requested_bins=pd.crosstab(clean_dti_data['Amount_Requested_bins'],clean_dti_da
Amount_Requested_bins.div(Amount_Requested_bins.sum(1).astype(float), axis=0).plot(kin
plt.xlabel('Loan Amount')
plt.ylabel('Percentage')
```

```
<ipython-input-39-30b0929a1dde>:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  clean_dti_data['Amount_Requested_bins']=pd.cut(clean_dti_data['Amount_Requested'],bins,labels=group)
```

Out[39]: Text(0, 0.5, 'Percentage')





In [40]:
```python
#plot risk scores
bins=[0,629,689,719,850]
group=['Bad','Fair','Good','Excellent']

clean_dti_data['Risk_Score_bins']=pd.cut(clean_dti_data['Risk_Score'],bins,labels=grou

Risk_Score_bins=pd.crosstab(clean_dti_data['Risk_Score_bins'],clean_dti_data['Loan_Sta
Risk_Score_bins.div(Risk_Score_bins.sum(1).astype(float), axis=0).plot(kind='bar', sta
plt.xlabel('Risk Score')
plt.ylabel('Percentage')
```

```
<ipython-input-40-efd6e5cc71f5>:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  clean_dti_data['Risk_Score_bins']=pd.cut(clean_dti_data['Risk_Score'],bins,labels=group)
```

Out[40]: Text(0, 0.5, 'Percentage')

In [41]:
```
#Turn the Loan Status into a binary variable to see correlation between that and nume

clean_dti_data = clean_dti_data.drop(['Risk_Score_bins', 'Amount_Requested_bins'], ax
```

In [42]:
```
#Use this table to work with
model_data = clean_dti_data.copy()
model_data
```

Out[42]:

	Amount_Requested	Risk_Score	debt_to_income_ratio	State	Employment_Length	Purpose	Loa
0	5000.0	669.0	21.80	OK	8	Other	
1	15000.0	704.0	18.29	FL	2	Debt consolidation	
2	11200.0	669.0	43.97	NH	0	Medical Expense	
3	25000.0	669.0	12.89	AL	10	Debt consolidation	
4	3000.0	764.0	0.58	WA	9	Major Purchase	
...	...	...	...	...	...	...	
1081515	3000.0	535.0	1.54	CT	5	Medical expenses	
1081516	6000.0	580.0	5.55	TX	0	Car financing	
1081517	3000.0	561.0	0.00	OR	0	Debt consolidation	
1081518	2500.0	573.0	8.55	NY	0	Other	
1081519	2500.0	567.0	0.00	AL	2	Car financing	

1034236 rows × 7 columns

In [43]:
```
columns_to_be_encoded=['Loan_Status', 'State', 'Purpose']
for column in columns_to_be_encoded:
    le=preprocessing.LabelEncoder()
    le.fit(list(model_data[column].values))
    model_data[column]=le.transform(list(model_data[column].values))
    with open(f'{column}.pickle', 'wb') as file:
        pickle.dump(le, file, pickle.HIGHEST_PROTOCOL)
model_data
```

Out[43]:

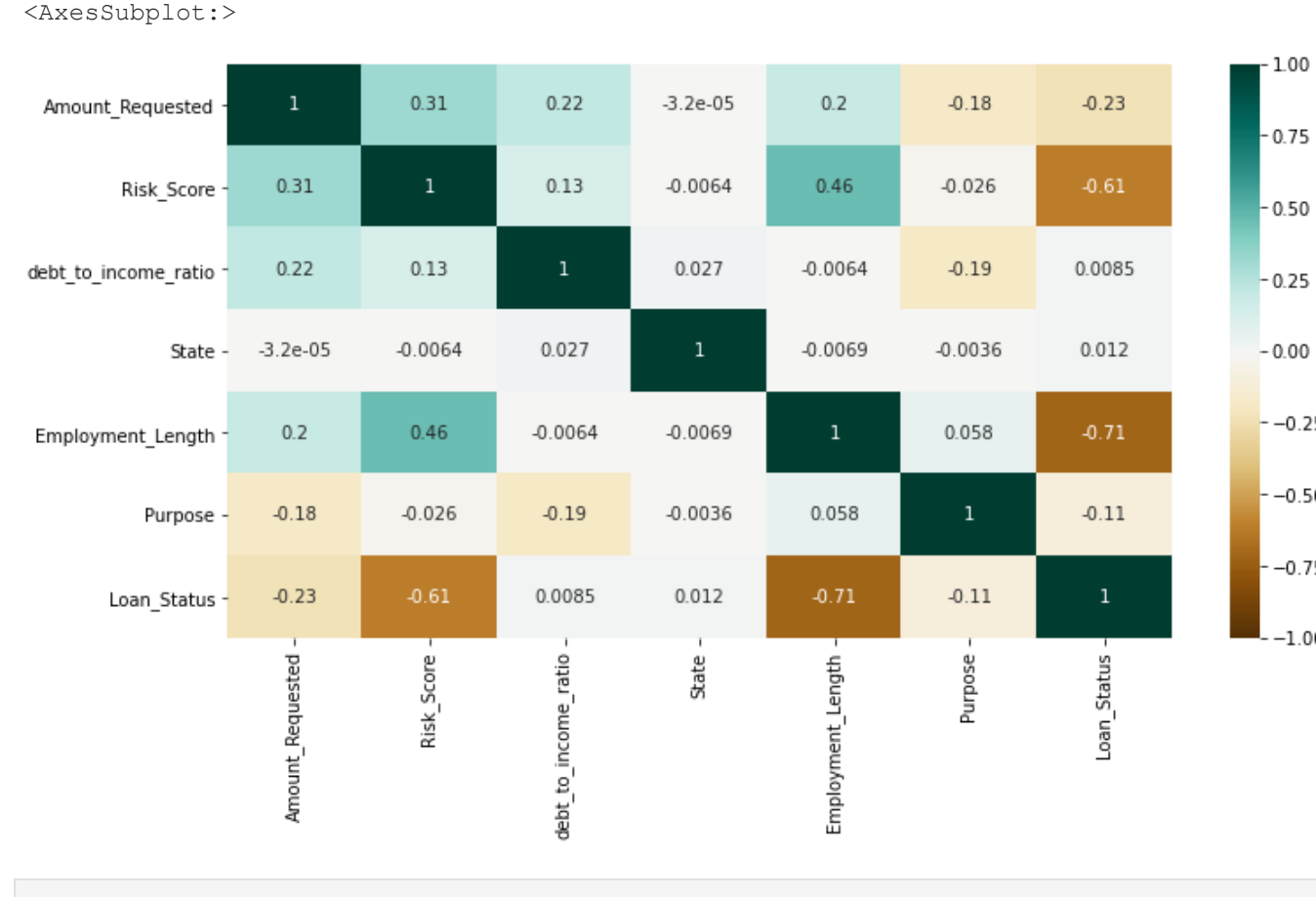
	Amount_Requested	Risk_Score	debt_to_income_ratio	State	Employment_Length	Purpose	Loan_S
0	5000.0	669.0	21.80	36	8	17	
1	15000.0	704.0	18.29	9	2	4	
2	11200.0	669.0	43.97	30	0	14	
3	25000.0	669.0	12.89	1	10	4	
4	3000.0	764.0	0.58	47	9	12	
...	...	...	...	...	...	...	
1081515	3000.0	535.0	1.54	6	5	15	
1081516	6000.0	580.0	5.55	43	0	2	
1081517	3000.0	561.0	0.00	37	0	4	
1081518	2500.0	573.0	8.55	34	0	17	
1081519	2500.0	567.0	0.00	1	2	2	

1034236 rows × 7 columns

In [44]:
```
#Independent Variable
X=model_data.drop(['Loan_Status'], axis=1)
y=model_data['Loan_Status']
```

In [45]:
```
new_model_corr = model_data.corr()
plt.figure(figsize=(12, 6))
sns.heatmap(new_model_corr, vmin=-1, vmax=1, annot=True, cmap='BrBG')
```

Out[45]: <AxesSubplot:>



In [46]:
```
X
```

Out[46]:

	Amount_Requested	Risk_Score	debt_to_income_ratio	State	Employment_Length	Purpose
0	5000.0	669.0	21.80	36	8	17
1	15000.0	704.0	18.29	9	2	4
2	11200.0	669.0	43.97	30	0	14
3	25000.0	669.0	12.89	1	10	4
4	3000.0	764.0	0.58	47	9	12
...	...	...	...	...	...	...
1081515	3000.0	535.0	1.54	6	5	15
1081516	6000.0	580.0	5.55	43	0	2
1081517	3000.0	561.0	0.00	37	0	4
1081518	2500.0	573.0	8.55	34	0	17
1081519	2500.0	567.0	0.00	1	2	2

1034236 rows × 6 columns

In [47]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=.33, random_state=
```

In [48]:
```
#DecisionTreeClassifier

dtree= DecisionTreeClassifier (random_state=42)
dtree.fit(X_train, y_train)
```

Out[48]:
```
DecisionTreeClassifier(random_state=42)
```

In [49]:
```
y_pred=dtree.predict(X_test)
```

In [50]:
```
#What is the perfect prediction
confusion_matrix(y_test, y_pred)
```

Out[50]:
```
array([[145658,   3656],
       [  3561, 188423]], dtype=int64)
```

In [51]:
```
#Precision Score
print("Precision Score", average_precision_score(y_test, y_pred), "--What percentage o
print("Recall", recall_score(y_test, y_pred), "--What percentage of positive cases did
print(cross_val_score(dtree, X_test, y_pred, cv=5, scoring = "accuracy"))
print(f1_score(y_test, y_pred))
```

```
Precision Score 0.9732044890796665 --What percentage of predictions were correct?
Recall 0.9814515792982749 --What percentage of positive cases did you catch?
[0.97505127 0.97713156 0.97427483 0.97885993 0.97765862]
0.9812088120959321
```

In [ ]:

In [ ]:

In [ ]: