In [3]:

```
import numpy as np
import pandas as pd
import datetime as dt
from scipy import stats

import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, classification_report
from sklearn.ensemble import RandomForestRegressor
```

In [5]:

```
call = pd.read_csv('H2HBABBA3069.csv')
df = pd.DataFrame(call)
df.columns
```

Out[5]:

```
Index(['business_code', 'cust_number', 'name_customer', 'clear_date',
       'buisness_year', 'doc_id', 'posting_date', 'document_create_date',
       'document_create_date.1', 'due_in_date', 'invoice_currency',
       'document type', 'posting_id', 'area_business', 'total_open_amount',
       'baseline_create_date', 'cust_payment_terms', 'invoice_id', 'isOpen'],
      dtype='object')
```

In [6]:

```
df_drop = df.drop(['document_create_date.1'], axis=1)

# finding nan values
df_drop.isna().sum()
```

Out[6]:

```
business_code                 0
cust_number                   0
name_customer                 0
clear_date                10000
buisness_year                 0
doc_id                        0
posting_date                  0
document_create_date          0
due_in_date                   0
invoice_currency              0
document type                 0
posting_id                    0
area_business             50000
total_open_amount             0
baseline_create_date          0
cust_payment_terms            0
invoice_id                    3
isOpen                        0
dtype: int64
```

In [7]:

```
df_drop1 = df_drop.drop(['area_business'], axis = 1)

# There are 4175 rows with clear date missing which is useful in finding payment delay predictions, so these rows are useless.
df_drop2 = df_drop1.dropna(axis = 0, how ='any') # additionally removing those null values too for invoice_id
df_drop2.shape
```

Out[7]:

```
(39997, 17)
```

In [8]:

```
def change_date(x_type):
    x = str(x_type)
    year = int(x[0:4])
    month = int(x[4:6])
    day = int(x[6:])
    return dt.datetime(year, month, day)
```

In [9]:

```
df_drop2['due_date'] = df_drop2['due_in_date'].apply(change_date)
df_drop2['clear_date']= pd.to_datetime(df_drop2['clear_date'])

# Creating target variable
df_drop2['target'] = (df_drop2['clear_date'] - df_drop2['due_date']).dt.days
# df_drop2.head(5) target value +ve means there was a delay in payment.
```

```
C:\Users\hp\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: SettingWithC
opyWarning:
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: http://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  """Entry point for launching an IPython kernel.
C:\Users\hp\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: SettingWithC
opyWarning:
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: http://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy

C:\Users\hp\Anaconda3\lib\site-packages\ipykernel_launcher.py:5: SettingWithC
opyWarning:
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: http://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  """
```

In [10]:

```
df_drop2['document_create_date'] = df_drop2['document_create_date'].apply(change_date)
df_drop2['baseline_create_date'] = df_drop2['baseline_create_date'].apply(change_date)

print(pd.to_datetime(df_drop2['document_create_date']).min())
print(pd.to_datetime(df_drop2['document_create_date']).max())
```

```
2018-12-27 00:00:00
2020-02-27 00:00:00

C:\Users\hp\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: SettingWithC
opyWarning:
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: http://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  """Entry point for launching an IPython kernel.
C:\Users\hp\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: SettingWithC
opyWarning:
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: http://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
```

In [11]:

```
x_train = df_drop2[df_drop2['document_create_date'] <= '2020-01-01'].copy()
x_test = df_drop2[df_drop2['document_create_date'] > '2020-01-01'].copy()
```

In [12]:

```
x_train.describe()
```

Out[12]:

	buisness_year	doc_id	due_in_date	posting_id	total_open_amount	invoice_id
count	34977.000000	3.497700e+04	3.497700e+04	34977.0	34977.000000	3.497700e+04
mean	2019.008720	2.012170e+09	2.019082e+07	1.0	32151.640152	2.012170e+09
std	0.092974	2.782505e+08	1.123117e+03	0.0	39865.508409	2.782505e+08
min	2019.000000	1.928502e+09	2.018123e+07	1.0	0.630000	1.928502e+09
25%	2019.000000	1.929092e+09	2.019042e+07	1.0	4797.000000	1.929092e+09
50%	2019.000000	1.929612e+09	2.019071e+07	1.0	17277.790000	1.929612e+09
75%	2019.000000	1.930028e+09	2.019101e+07	1.0	46554.280000	1.930028e+09
max	2020.000000	2.960605e+09	2.020030e+07	1.0	860880.000000	2.960605e+09

In [13]:

```
x_test.describe()
```

Out[13]:

```
       buisness_year        doc_id   due_in_date  posting_id  total_open_amount    invoice_id
count         5020.0  5.020000e+03  5.020000e+03      5020.0        5020.000000  5.020000e+03
 mean         2020.0  2.008882e+09  2.020022e+07         1.0       31511.953223  2.008882e+09
  std            0.0  2.717071e+08  1.943337e+02         0.0       37358.136612  2.717071e+08
  min         2020.0  1.930334e+09  2.019113e+07         1.0          10.950000  1.930334e+09
  25%         2020.0  1.930410e+09  2.020020e+07         1.0        4601.797500  1.930410e+09
  50%         2020.0  1.930469e+09  2.020022e+07         1.0       16799.745000  1.930469e+09
  75%         2020.0  1.930536e+09  2.020030e+07         1.0       46697.057500  1.930536e+09
  max         2020.0  2.960617e+09  2.020061e+07         1.0      321350.000000  2.960617e+09
```

In [14]:

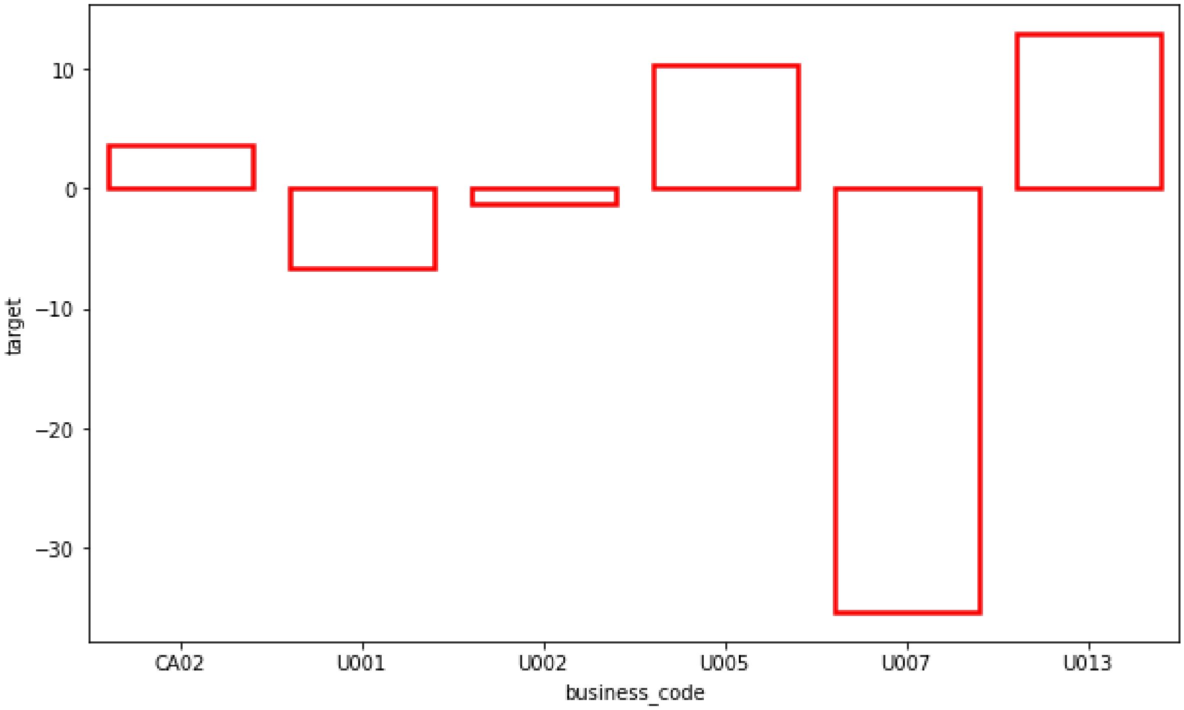
```
X_train = x_train.drop(['posting_id', 'posting_id', 'document type'], axis = 1)
X_test = x_test.drop(['posting_id', 'posting_id', 'document type'], axis = 1)
```

In [15]:

```
temp = pd.DataFrame(X_train.groupby(['business_code'], axis=0, as_index=False)['target'].m
ean())
plt.figure(figsize=(10,6))
sns.barplot(x="business_code", y="target",data=temp,linewidth=2.5, facecolor=(1, 1, 1, 0),
                 errcolor=".4", edgecolor="red")
```

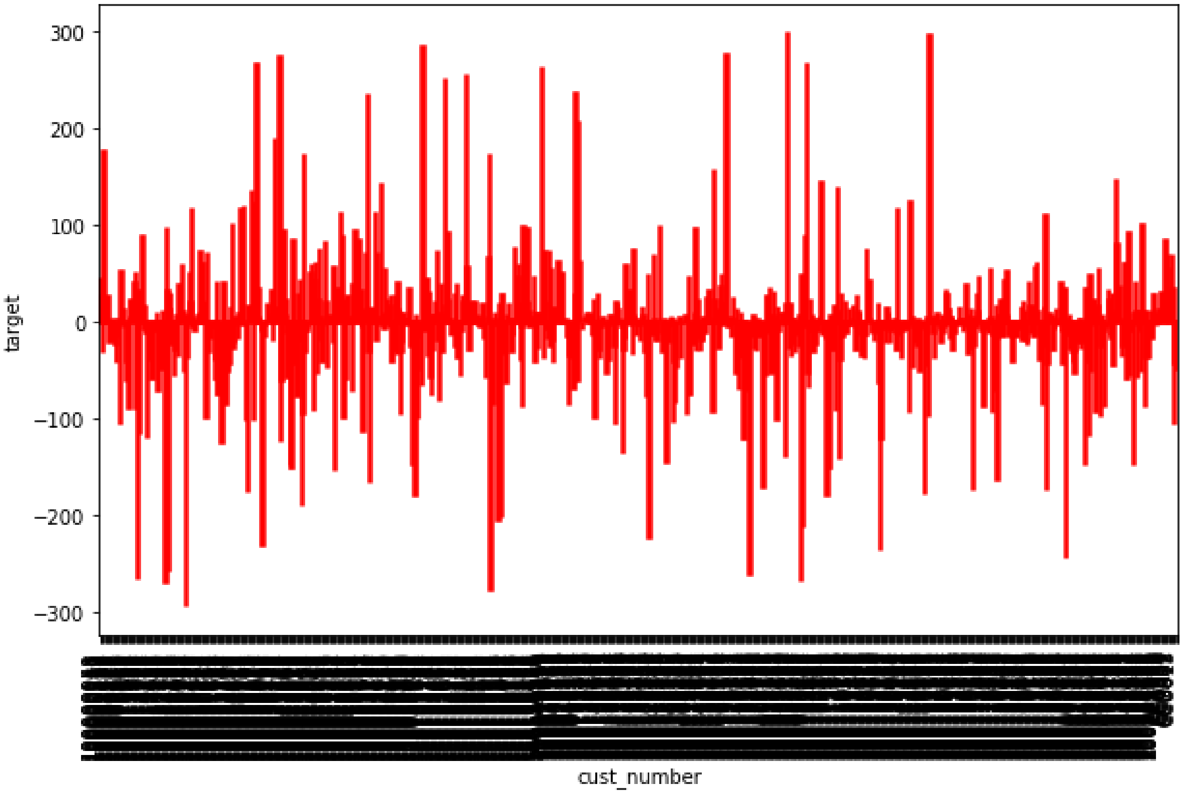
Out[15]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x21a85024588>
```



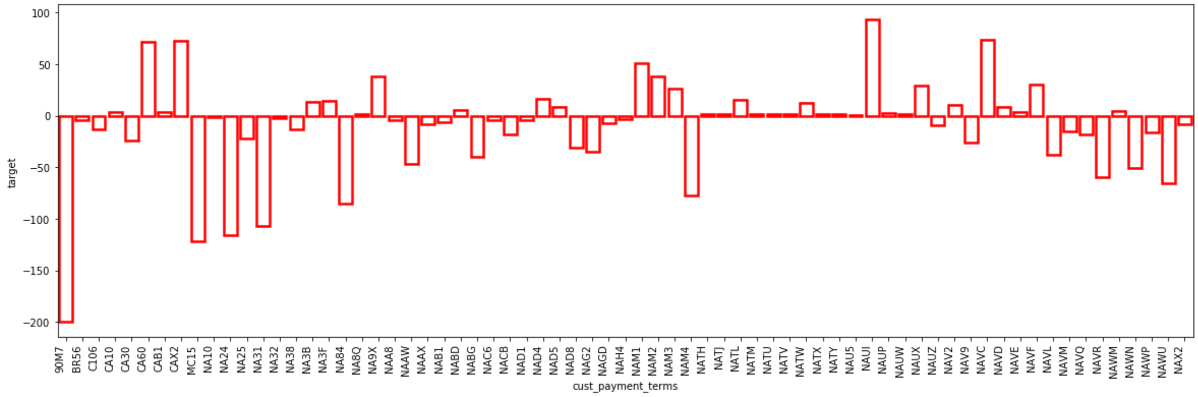
In [16]:

```
temp = pd.DataFrame(X_train.groupby(['cust_number'], axis=0, as_index=False)['target'].mea
n())
plt.figure(figsize=(10,6))
graph = sns.barplot(x="cust_number", y="target",data=temp,linewidth=2.5, facecolor=(1, 1,
1, 0),
                 errcolor=".4", edgecolor="red")

graph = graph.set_xticklabels(graph.get_xticklabels(),
                          rotation=90,
                          horizontalalignment='right')
```



In [17]:

```
temp = pd.DataFrame(X_train.groupby(['cust_payment_terms'], axis=0, as_index=False)['target'].mean())
plt.figure(figsize=(20,6))
graph = sns.barplot(x="cust_payment_terms", y="target",data=temp,linewidth=2.5, facecolor=(1, 1, 1, 0),
                 errcolor=".4", edgecolor="red")

graph = graph.set_xticklabels(graph.get_xticklabels(),
                           rotation=90,
                           horizontalalignment='right')
```

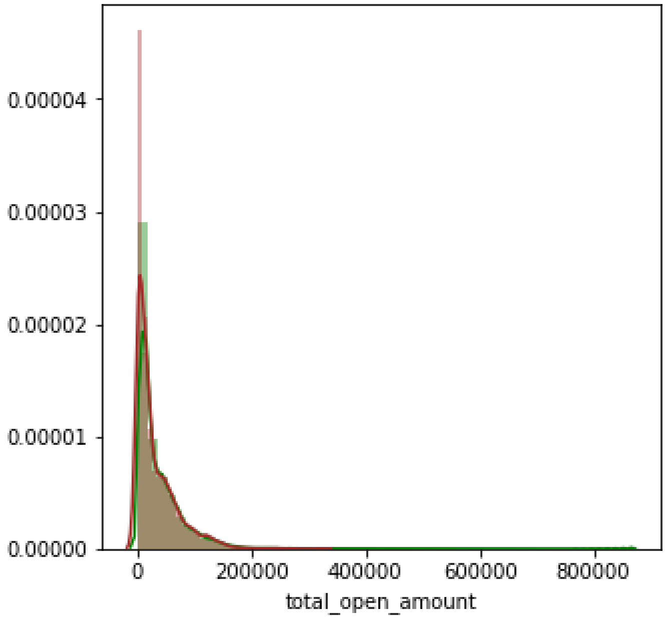


In [18]:

```
plt.figure(figsize=(5,5))
plt.figure(1)
sns.distplot(X_train['total_open_amount'],color='green')
sns.distplot(X_test['total_open_amount'],color='brown')
```

Out[18]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x21a9e212d88>
```



In [19]:

```
def Transform(x):
    return np.log(x)

X_train['total_open_amount'] = X_train['total_open_amount'].apply(Transform)
X_test['total_open_amount'] = X_test['total_open_amount'].apply(Transform)
```

In [21]:

```
X_train['cust_number'].nunique()
```

Out[21]:

```
981
```

In [22]:

```
X_test['cust_number'].nunique()
```

Out[22]:

```
486
```

In [23]:

```
X_train = X_train.drop([ 'due_in_date', 'isOpen'], axis = 1)
X_test = X_test.drop([ 'due_in_date', 'isOpen'], axis = 1)
```

In [24]:

```
X_train.head(1)
```

Out[24]:

	business_code	cust_number	name_customer	clear_date	buisness_year	doc_id	posting
2	U001	200759878	SA in	2019-12-27	2019	1930251991	09-1

In [25]:

```
ref = dict(X_train['cust_number'].value_counts())


X_train['cust_number_new'] = X_train['cust_number'].map(ref)
```

In [26]:

```
ref1 = dict(X_test['cust_number'].value_counts())


X_test['cust_number_new'] = X_test['cust_number'].map(ref1)
```

In [27]:

```
X_train = X_train.replace(['U002', 'U005', 'U007'], 'other')
X_test = X_test.replace(['U002', 'U005', 'U007'], 'other')

business = pd.get_dummies(X_train['business_code'])
business1 = pd.get_dummies(X_test['business_code'])
# Above in the business_code column we can see they are categorical ones, so we make new f
eature
# out of them
X_train = pd.concat([X_train, business], axis=1)
X_test = pd.concat([X_test, business1], axis=1)

X_train.head()
```

Out[27]:

	business_code	cust_number	name_customer	clear_date	buisness_year	doc_id	posting
2	U001	200759878	SA in	2019-12-27	2019	1930251991	09-1
3	U001	200797984	PIGGLY foundation	2019-01-28	2019	1928606578	11-0
4	U001	200769623	WAL-MAR trust	2019-07-30	2019	1929628633	19-0
5	U001	200769623	WAL-MAR trust	2019-10-07	2019	1929560422	30-0
8	U001	200763814	SYSCO F trust	2019-04-11	2019	1929941294	30-0

In [28]:

```
ref2 = dict(X_train['cust_payment_terms'].value_counts())


X_train['cust_payment_terms_new'] = X_train['cust_payment_terms'].map(ref2)
```

In [29]:

```
ref3 = dict(X_test['cust_payment_terms'].value_counts())


X_test['cust_payment_terms_new'] = X_test['cust_payment_terms'].map(ref3)
```

In [30]:

```
X_train.head(2)
```

Out[30]:

	business_code	cust_number	name_customer	clear_date	buisness_year	doc_id	postinc
2	U001	200759878	SA in	2019-12-27	2019	1930251991	09-12
3	U001	200797984	PIGGLY foundation	2019-01-28	2019	1928606578	11-01

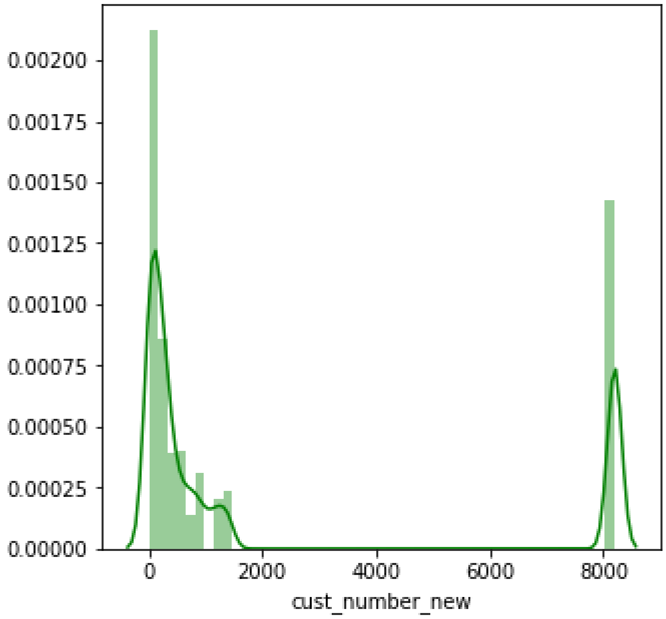
2 rows × 21 columns

In [31]:

```
plt.figure(figsize=(5,5))
plt.figure(1)
sns.distplot(X_train['cust_number_new'],color='green')
```

Out[31]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x21a9b14bc08>
```

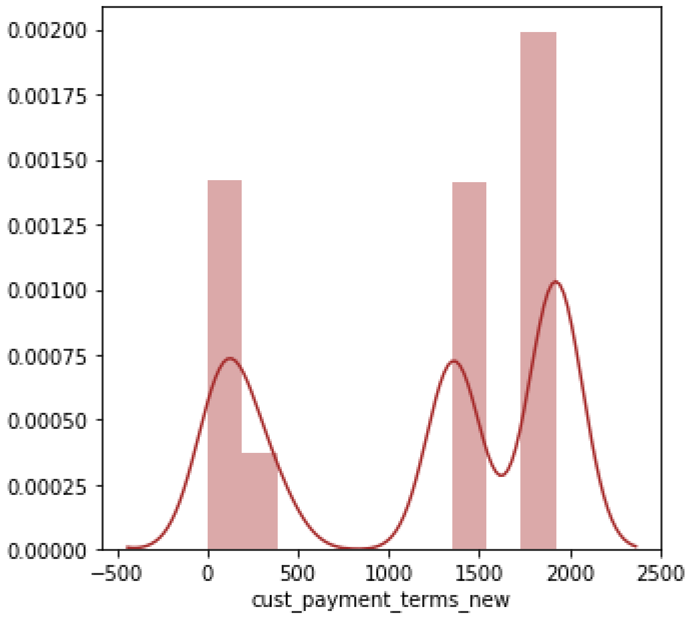


In [32]:

```
plt.figure(figsize=(5,5))
plt.figure(1)
sns.distplot(X_test['cust_payment_terms_new'],color='brown')
```

Out[32]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x21a9a729688>
```



In [33]:

```
X_train['cust_number_new'].skew()
```

Out[33]:

```
1.2175907294870238
```

In [34]:

```
X_train['cust_payment_terms_new'].skew()
```

Out[34]:

```
-0.35956011208792543
```

In [35]:

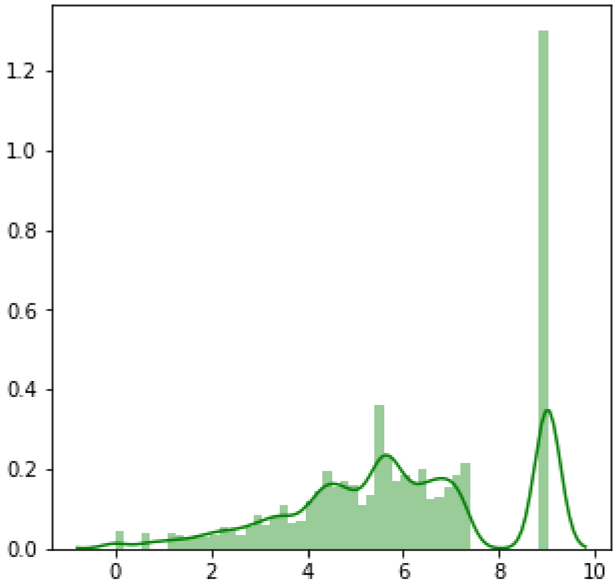
```
from scipy.stats import boxcox
```

In [36]:

```
df = boxcox(X_train['cust_number_new'], 0.0)
# df1 = boxcox(df, 0.0)
plt.figure(figsize=(5,5))
plt.figure(1)
sns.distplot(df,color='green')
```

Out[36]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x21a9e152d08>
```



In [37]:

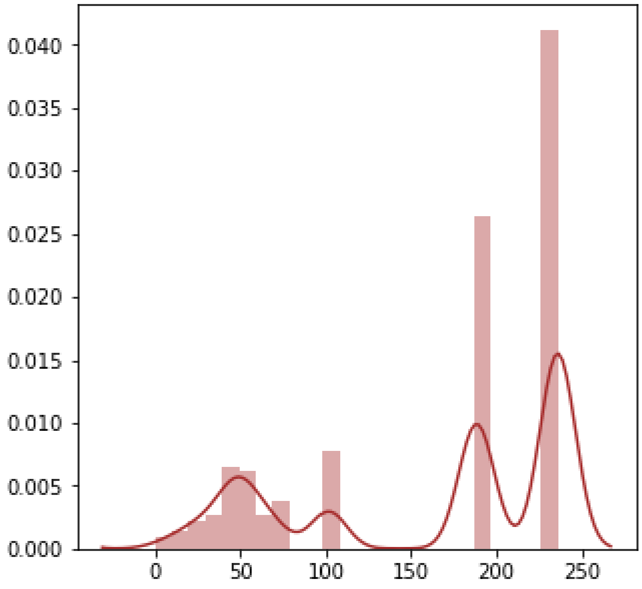
```
X_train['cust_number_new'] = df
```

In [38]:

```
df1 = boxcox(X_train['cust_payment_terms_new'], 0.5)
# df1 = boxcox(df, 0.0)
plt.figure(figsize=(5,5))
plt.figure(1)
sns.distplot(df1,color='brown')
```

Out[38]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x21a9be791c8>
```



In [39]:

```
X_train['cust_payment_terms_new'] = df1
```

In [40]:

```
df2 = boxcox(X_test['cust_number_new'], 0.0)
X_test['cust_number_new'] = df2
```

In [41]:

```
df3 = boxcox(X_test['cust_payment_terms_new'], 0.0)
X_test['cust_payment_terms_new'] = df3
```

In [42]:

```
import datetime as dt
X_train['year'] = X_train['document_create_date'].dt.year
X_train['month'] = X_train['document_create_date'].dt.month
X_train['day'] = X_train['document_create_date'].dt.day
X_train['week'] = X_train['document_create_date'].dt.week
X_train['which_day'] = X_train['document_create_date'].dt.dayofweek
X_train['quarter'] = X_train['document_create_date'].dt.quarter
```

In [43]:

```
X_train.columns
```

Out[43]:

```
Index(['business_code', 'cust_number', 'name_customer', 'clear_date',
       'buisness_year', 'doc_id', 'posting_date', 'document_create_date',
       'invoice_currency', 'total_open_amount', 'baseline_create_date',
       'cust_payment_terms', 'invoice_id', 'due_date', 'target',
       'cust_number_new', 'CA02', 'U001', 'U013', 'other',
       'cust_payment_terms_new', 'year', 'month', 'day', 'week', 'which_day',
       'quarter'],
      dtype='object')
```

In [44]:

```
invoice_dic = {'USD': 1, 'CAD': 0}
X_train['invoice_currency'] = X_train['invoice_currency'].map(invoice_dic)
```

In [45]:

```
X_test['year'] = X_test['document_create_date'].dt.year
X_test['month'] = X_test['document_create_date'].dt.month
X_test['day'] = X_test['document_create_date'].dt.day
X_test['week'] = X_test['document_create_date'].dt.week
X_test['which_day'] = X_test['document_create_date'].dt.dayofweek
X_test['quarter'] = X_test['document_create_date'].dt.quarter

X_test['invoice_currency'] = X_test['invoice_currency'].map(invoice_dic)
```

In [46]:

```
X_train1 = X_train.drop(['business_code', 'cust_number', 'name_customer', 'doc_id', 'cust_
payment_terms'
                        , 'invoice_id'], axis = 1)

X_test1 = X_test.drop(['business_code', 'cust_number', 'name_customer', 'doc_id', 'cust_pa
yment_terms'
                        , 'invoice_id'], axis = 1)
```

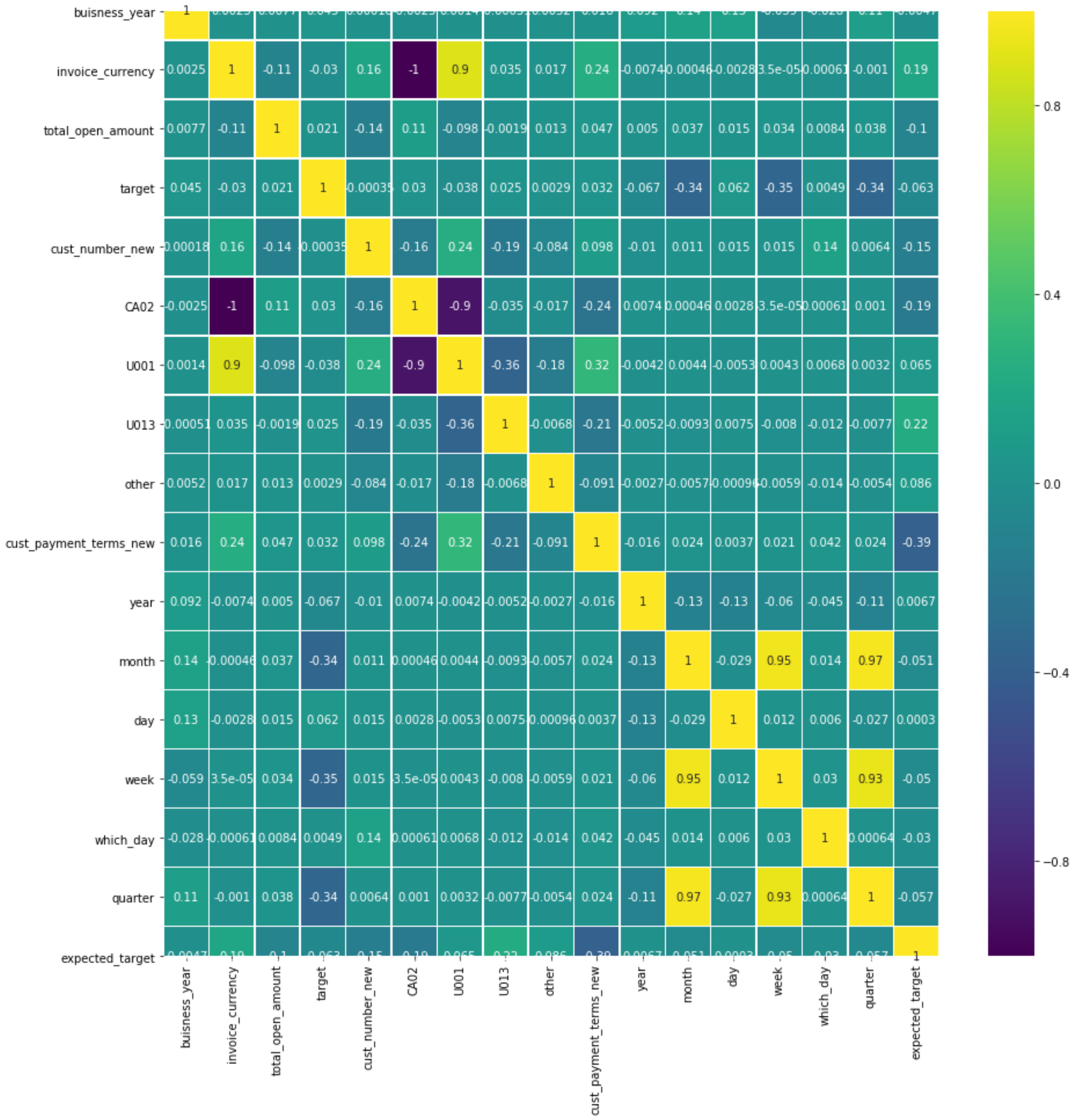
In [47]:

```
X_train1['clear_date']= pd.to_datetime(X_train1['clear_date'])

# Creating target variable
X_train1['expected_target'] = (X_train1['due_date'] - X_train1['baseline_create_date']).dt.days

X_test1['clear_date']= pd.to_datetime(X_test1['clear_date'])

# Creating target variable
X_test1['expected_target'] = (X_test1['due_date'] - X_test1['baseline_create_date']).dt.days
```

In [48]:

```
plt.figure(figsize=(15,15))
sns.heatmap(X_train1.corr(),annot=True,cmap='viridis',linewidths=.5)
```

```
Out[48]:

<matplotlib.axes._subplots.AxesSubplot at 0x21a9bf7a4c8>
```


buisness_year 1
invoice_currency 0.0025 1 -0.11 -0.03 0.16 -1 0.9 0.035 0.017 0.24 -0.0074 -0.00046 -0.0028 3.5e-05 -0.00061 -0.001 0.19
total_open_amount 0.0077 -0.11 1 0.021 -0.14 0.11 -0.098 -0.0019 0.013 0.047 0.005 0.037 0.015 0.034 0.0084 0.038 -0.1
target 0.045 -0.03 0.021 1 -0.00035 0.03 -0.038 0.025 0.0029 0.032 -0.067 -0.34 0.062 -0.35 0.0049 -0.34 -0.063
cust_number_new 0.00018 0.16 -0.14 0.00035 1 -0.16 0.24 -0.19 -0.084 0.098 -0.01 0.011 0.015 0.015 0.14 0.0064 -0.15
CA02 -0.0025 -1 0.11 0.03 -0.16 1 -0.9 -0.035 -0.017 -0.24 0.0074 0.00046 0.0028 -3.5e-05 0.00061 0.001 -0.19
U001 0.0014 0.9 -0.098 -0.038 0.24 -0.9 1 -0.36 -0.18 0.32 -0.0042 0.0044 -0.0053 0.0043 0.0068 0.0032 0.065
U013 0.00051 0.035 -0.0019 0.025 -0.19 -0.035 -0.36 1 -0.0068 -0.21 -0.0052 -0.0093 0.0075 -0.008 -0.012 -0.0077 0.22
other 0.0052 0.017 0.013 0.0029 -0.084 -0.017 -0.18 -0.0068 1 -0.091 -0.0027 -0.0057 -0.00096 -0.0059 -0.014 -0.0054 0.086
cust_payment_terms_new 0.016 0.24 0.047 0.032 0.098 -0.24 0.32 -0.21 -0.091 1 -0.016 0.024 0.0037 0.021 0.042 0.024 -0.39
year 0.092 -0.0074 0.005 -0.067 -0.01 0.0074 -0.0042 -0.0052 -0.0027 -0.016 1 -0.13 -0.13 -0.06 -0.045 -0.11 0.0067
month 0.14 -0.00046 0.037 -0.34 0.011 0.00046 0.0044 -0.0093 -0.0057 0.024 -0.13 1 -0.029 0.95 0.014 0.97 -0.051
day 0.13 -0.0028 0.015 0.062 0.015 0.0028 -0.0053 0.0075 -0.00096 0.0037 -0.13 -0.029 1 0.012 0.006 -0.027 0.0003
week -0.059 3.5e-05 0.034 -0.35 0.015 -3.5e-05 0.0043 -0.008 -0.0059 0.021 -0.06 0.95 0.012 1 0.03 0.93 -0.05
which_day -0.028 -0.00061 0.0084 0.0049 0.14 0.00061 0.0068 -0.012 -0.014 0.042 -0.045 0.014 0.006 0.03 1 0.00064 -0.03
quarter 0.11 -0.001 0.038 -0.34 0.0064 0.001 0.0032 -0.0077 -0.0054 0.024 -0.11 0.97 -0.027 0.93 0.00064 1 -0.057
expected_target 1
buisness_year
invoice_currency
total_open_amount
target
cust_number_new
CA02
U001
U013
other
cust_payment_terms_new
year
month
day
week
which_day
quarter
expected_target
0.8
0.4
0.0
−0.4
−0.8

In [49]:

```
X_final = X_train1.drop(['clear_date', 'posting_date', 'document_create_date', 'baseline_create_date','due_date'], axis = 1)

X_final_test = X_test1.drop(['clear_date', 'posting_date', 'document_create_date', 'baseline_create_date','due_date'], axis = 1)
```

In [50]:

```
X_final = X_final.drop(['CA02', 'week', 'U001'], axis = 1)

X_final_test = X_final_test.drop(['CA02', 'week', 'U001'], axis = 1)
```

In [51]:

```
X_final['target'] = X_train1['target']
```

In [52]:

```
y = X_final['target']
X_final = X_final.drop(['target'], axis = 1)
Xtrain ,Xtest, ytrain, ytest = train_test_split(X_final, y, test_size = 0.1, random_state=0)
```

In [53]:

```
l = list(np.isfinite(ytrain))
print([x for x in l if x == False])
```

```
[]
```

In [54]:

```
lp = list(np.isfinite(Xtrain))
print([x for x in lp if x == False])
```

```
[]
```

In [55]:

```
random_model = RandomForestRegressor(n_estimators=500, random_state = 42)
```

In [56]:

```
random_model.fit(Xtrain, ytrain)

y_pred3 = random_model.predict(Xtest)

#Checking the accuracy
random_model_accuracy = round(random_model.score(Xtrain, ytrain)*100,2)
print(round(random_model_accuracy, 2), '%')
```

```
93.82 %
```

In [57]:

```
random_model_accuracy1 = round(random_model.score(Xtest, ytest)*100,2)
print(round(random_model_accuracy1, 2), '%')
```

```
51.25 %
```

In [58]:

```
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
xtrain = sc.fit_transform(Xtrain)
xtest = sc.transform(Xtest)
```

In [59]:

```
random_model.fit(xtrain, ytrain)
y_pred = random_model.predict(xtest)
```

In [60]:

```
random_model_accuracy2 = round(random_model.score(xtrain, ytrain)*100,2)
print(round(random_model_accuracy2, 2), '%')
```

```
93.83 %
```

In [61]:

```
random_model_accuracy3 = round(random_model.score(xtest, ytest)*100,2)
print(round(random_model_accuracy3, 2), '%')
```

```
51.21 %
```

In [62]:

```
print(random_model.get_params())
```

```
{'bootstrap': True, 'criterion': 'mse', 'max_depth': None, 'max_features': 'a
uto', 'max_leaf_nodes': None, 'min_impurity_decrease': 0.0, 'min_impurity_spl
it': None, 'min_samples_leaf': 1, 'min_samples_split': 2, 'min_weight_fractio
n_leaf': 0.0, 'n_estimators': 500, 'n_jobs': None, 'oob_score': False, 'rando
m_state': 42, 'verbose': 0, 'warm_start': False}
```

In [63]:

```
from sklearn.model_selection import RandomizedSearchCV
# Number of trees in random forest
n_estimators = [int(x) for x in np.linspace(start = 200, stop = 700, num = 10)]
# Number of features to consider at every split
max_features = ['auto', 'sqrt']
# Maximum number of levels in tree
max_depth = [int(x) for x in np.linspace(10, 55, num = 11)]
max_depth.append(None)
# Minimum number of samples required to split a node
min_samples_split = [2, 5, 10]
# Minimum number of samples required at each leaf node
min_samples_leaf = [1, 2, 4]
# Method of selecting samples for training each tree
bootstrap = [True, False]
# Create the random grid
random_grid = {'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf,
               'bootstrap': bootstrap}
print(random_grid)
```

```
{'n_estimators': [200, 255, 311, 366, 422, 477, 533, 588, 644, 700], 'max_fea
tures': ['auto', 'sqrt'], 'max_depth': [10, 14, 19, 23, 28, 32, 37, 41, 46, 5
0, 55, None], 'min_samples_split': [2, 5, 10], 'min_samples_leaf': [1, 2, 4],
'bootstrap': [True, False]}
```

In [64]:

```
rf = RandomForestRegressor()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores

# n_iter, which controls the number of different combinations to try, and cv which is the
 number of folds to use for cross validation
rf_random = RandomizedSearchCV(estimator = rf, param_distributions = random_grid, n_iter =
100, cv = 3, verbose=2, random_state=42, n_jobs = -1)
# Fit the random search model
rf_random.fit(xtrain, ytrain)
```

```
Fitting 3 folds for each of 100 candidates, totalling 300 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  25 tasks      | elapsed:  3.7min
[Parallel(n_jobs=-1)]: Done 146 tasks      | elapsed: 15.8min
[Parallel(n_jobs=-1)]: Done 300 out of 300 | elapsed: 33.9min finished
```

Out[64]:

```
RandomizedSearchCV(cv=3, error_score='raise-deprecating',
                   estimator=RandomForestRegressor(bootstrap=True,
                                                   criterion='mse',
                                                   max_depth=None,
                                                   max_features='auto',
                                                   max_leaf_nodes=None,
                                                   min_impurity_decrease=0.0,
                                                   min_impurity_split=None,
                                                   min_samples_leaf=1,
                                                   min_samples_split=2,
                                                   min_weight_fraction_leaf=
0.0,
                                                   n_estimators='warn',
                                                   n_jobs=None, oob_score=Fal
se,
                                                   random_sta...
                   iid='warn', n_iter=100, n_jobs=-1,
                   param_distributions={'bootstrap': [True, False],
                                        'max_depth': [10, 14, 19, 23, 28, 32,
                                                      37, 41, 46, 50, 55,
                                                      None],
                                        'max_features': ['auto', 'sqrt'],
                                        'min_samples_leaf': [1, 2, 4],
                                        'min_samples_split': [2, 5, 10],
                                        'n_estimators': [200, 255, 311, 366,
                                                         422, 477, 533, 588,
                                                         644, 700]},
                   pre_dispatch='2*n_jobs', random_state=42, refit=True,
                   return_train_score=False, scoring=None, verbose=2)
```

In [65]:

```
rf_random.best_params_
```

Out[65]:

```
{'n_estimators': 644,
 'min_samples_split': 10,
 'min_samples_leaf': 1,
 'max_features': 'sqrt',
 'max_depth': 19,
 'bootstrap': False}
```

In [66]:

```
random_model1 = RandomForestRegressor(n_estimators = 588, min_samples_split = 10, min_samples_leaf = 1, max_features = 'sqrt',
                                      max_depth = None, bootstrap = True)
```

In [67]:

```
random_model1.fit(Xtrain, ytrain)

y_pred3 = random_model1.predict(Xtest)

#Checking the accuracy
random_model_accuracy = round(random_model1.score(Xtrain, ytrain)*100,2)
print(round(random_model_accuracy, 2), '%')
```

```
76.31 %
```

In [68]:

```
random_model_accuracy1 = round(random_model1.score(Xtest, ytest)*100,2)
print(round(random_model_accuracy1, 2), '%')
```

```
53.81 %
```

In [ ]: