In [1]:

```
#importing required libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
sns.set_style("darkgrid")
import os
from sklearn.linear_model import LinearRegression
from sklearn.metrics import *
from sklearn.ensemble import RandomForestRegressor
from yellowbrick.model_selection import FeatureImportances
from sklearn.model_selection import train_test_split
from sklearn import linear_model
from sklearn.tree import DecisionTreeRegressor
from sklearn.model_selection import cross_val_score
from sklearn.neighbors import KNeighborsRegressor
from sklearn.linear_model import Ridge
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import Pipeline
from yellowbrick.regressor import AlphaSelection
from sklearn.linear_model import RidgeCV
```

In [223]:

```
os.getcwd()
```

Out[223]:

```
'C:\\Users\\leand'
```

In [2]:
```
beer_data=pd.read_csv('Consumo_cerveja.csv')
beer_data.head()
```

Out[2]:

	Data	Temperatura Media (C)	Temperatura Minima (C)	Temperatura Maxima (C)	Precipitacao (mm)	Final de Semana	Consumo de cerveja (litros)
0	2015-01-01	27,3	23,9	32,5	0	0.0	25.461
1	2015-01-02	27,02	24,5	33,5	0	0.0	28.972
2	2015-01-03	24,82	22,4	29,9	0	1.0	30.814
3	2015-01-04	23,98	21,5	28,6	1,2	1.0	29.799
4	2015-01-05	23,82	21	28,3	0	0.0	28.900

In [4]:
```
#translating the column names fom spanish to english
beer_data.columns=['date','mean_temp','max_temp','min_temp','precipitation','endofweek','beer_consumption_1000']
```

In [5]:
```
#missing values
beer_data.shape
```

Out[5]:
```
(941, 7)
```

In [6]:
```
#this data is only fo the year 2015 comprising of 366 days so we can ignore rows 366 to 941 which contain missing data
beer_data=beer_data.iloc[0:365,:]
beer_data.shape
```

Out[6]:
```
(365, 7)
```

In [7]:
```
#check for missing values
beer_data.isnull().sum()
```

Out[7]:
```
date                    0
mean_temp               0
max_temp                0
min_temp                0
precipitation           0
endofweek               0
beer_consumption_1000   0
dtype: int64
```

In [8]:
```
#changing the index to start from 1 so it matches with the day of the year
beer_data.index= beer_data.index+1
```

In [9]:
```
beer_data.head()
```

Out[9]:

	date	mean_temp	max_temp	min_temp	precipitation	endofweek	beer_consumption_1000
1	2015-01-01	27,3	23,9	32,5	0	0.0	25.461
2	2015-01-02	27,02	24,5	33,5	0	0.0	28.972
3	2015-01-03	24,82	22,4	29,9	0	1.0	30.814
4	2015-01-04	23,98	21,5	28,6	1,2	1.0	29.799
5	2015-01-05	23,82	21	28,3	0	0.0	28.900

In [10]:
```
#we need to convert , into . and vice vesra as temp and rainfaill are usually epesented by decimal point notation and
#beer_consumption in thousands of litres

comma_to_dot = lambda x: x.replace(',','.')
```

In [11]:
```
beer_data.loc[:,['mean_temp','max_temp','min_temp','precipitation']]=beer_data.select_dtypes(['object']).iloc[:,1:5].a
pplymap(comma_to_dot)
```

In [12]:

```
#assigning proper datatypes to the columns
beer_data['date']=pd.to_datetime(beer_data['date'])
str_cols=beer_data.select_dtypes(['object']).columns

for val in str_cols:
    beer_data[val]=pd.to_numeric(beer_data[val])


endofweekconv = lambda x : str(x)[0]
beer_data['endofweek']=beer_data.endofweek.apply(endofweekconv)
```

In [13]:

```
beer_data.dtypes
```

Out[13]:

```
date                     datetime64[ns]
mean_temp                       float64
max_temp                        float64
min_temp                        float64
precipitation                   float64
endofweek                        object
beer_consumption_1000           float64
dtype: object
```

In [14]:

```
#adding day of week as a new column
beer_data['day']=beer_data['date'].dt.strftime("%A")
```

In [15]:

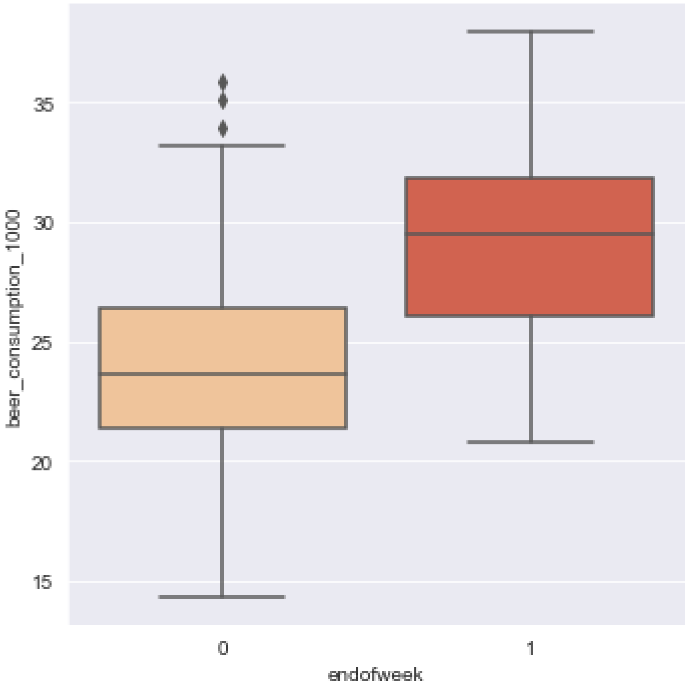
```
beer_data.head(9)
```

Out[15]:

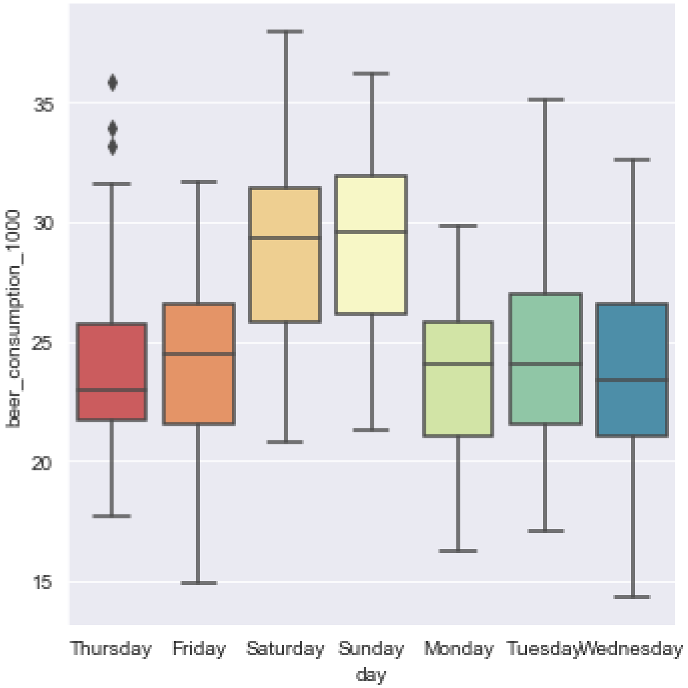
	date	mean_temp	max_temp	min_temp	precipitation	endofweek	beer_consumption_1000	day
1	2015-01-01	27.30	23.9	32.5	0.0	0	25.461	Thursday
2	2015-01-02	27.02	24.5	33.5	0.0	0	28.972	Friday
3	2015-01-03	24.82	22.4	29.9	0.0	1	30.814	Saturday
4	2015-01-04	23.98	21.5	28.6	1.2	1	29.799	Sunday
5	2015-01-05	23.82	21.0	28.3	0.0	0	28.900	Monday
6	2015-01-06	23.78	20.1	30.5	12.2	0	28.218	Tuesday
7	2015-01-07	24.00	19.5	33.7	0.0	0	29.732	Wednesday
8	2015-01-08	24.90	19.5	32.8	48.6	0	28.397	Thursday
9	2015-01-09	28.20	21.9	34.0	4.4	0	24.886	Friday

In [276]:
```
#It seems there is higher beer consumtion on weekends
sns.catplot(x="endofweek", y="beer_consumption_1000", kind="box", data=beer_data,palette='OrRd')
```

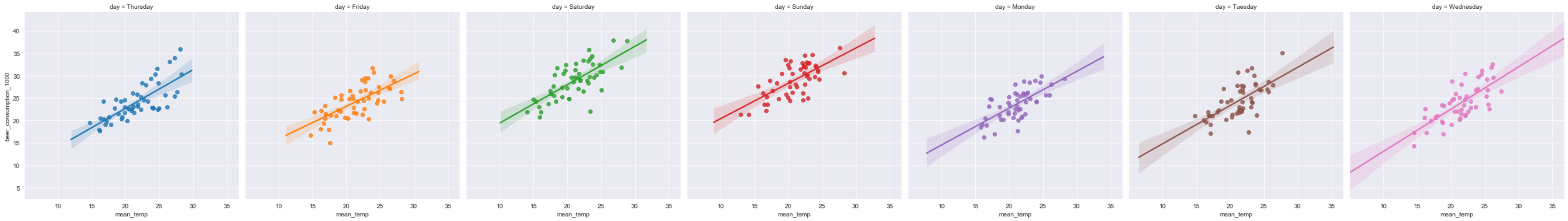
Out[276]:
```
<seaborn.axisgrid.FacetGrid at 0x2a16e429808>
```



```
In [280]: #There is a marked increase in beer consumtion on SATUDRAY and SUNDAY
          sns.catplot(x="day", y="beer_consumption_1000", kind="box", data=beer_data,palette='Spectral')

Out[280]: <seaborn.axisgrid.FacetGrid at 0x2a16e6fe2c8>
```

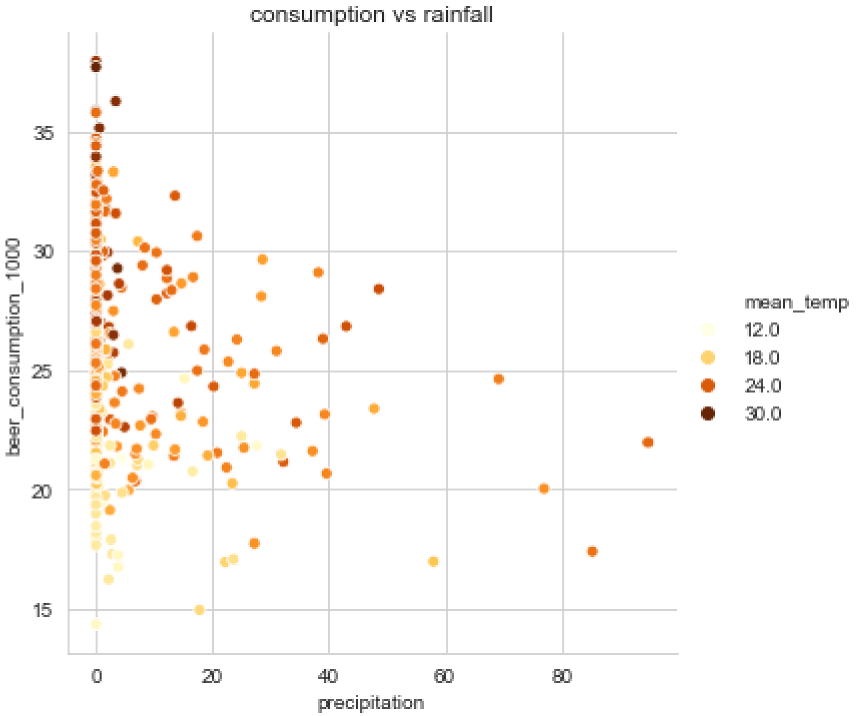


```
In [286]: #There seems to be a positive relationship between temperature and beer consumption fo evey day of the week.
          sns.lmplot(x="mean_temp", y="beer_consumption_1000", data=beer_data,hue='day',col='day');
```



In [299]:
```
#Since most days of the year in So Paulo have little o no rainfall,it is hard to infer any relationship between rainfa
ll and beer consumption
sns.set_style("whitegrid")
sns.relplot(x="precipitation", y="beer_consumption_1000", data=beer_data,hue='mean_temp',palette="YlOrBr")
plt.title('consumption vs rainfall')
```

Out[299]:
```
Text(0.5, 1, 'consumption vs rainfall')
```



In [16]:
```
#adding a new binary ain? column
rainy=[]
def did_it_rain(rain):
    for val in rain:
        if val>0:
            rainy.append(1)

        elif val==0:
            rainy.append(0)
```

In [17]:

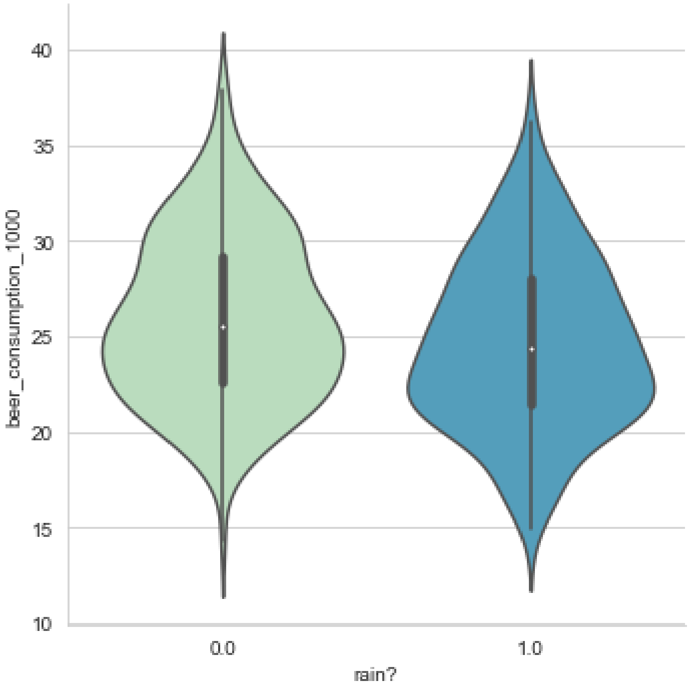
```
did_it_rain(beer_data['precipitation'])

k=pd.Series(rainy,name="rain?")
k.index=k.index+1
beer_data=pd.concat([beer_data,k],axis=1)

beer_data.head()
```

Out[17]:

	date	mean_temp	max_temp	min_temp	precipitation	endofweek	beer_consumption_1000	day	rain?
1	2015-01-01	27.30	23.9	32.5	0.0	0	25.461	Thursday	0
2	2015-01-02	27.02	24.5	33.5	0.0	0	28.972	Friday	0
3	2015-01-03	24.82	22.4	29.9	0.0	1	30.814	Saturday	0
4	2015-01-04	23.98	21.5	28.6	1.2	1	29.799	Sunday	1
5	2015-01-05	23.82	21.0	28.3	0.0	0	28.900	Monday	0

In [429]:
```
#we notice a slight increase in consumption on rainy days
sns.catplot(x="rain?", y="beer_consumption_1000",kind="violin", data=beer_data,palette='GnBu')
```

Out[429]:
```
<seaborn.axisgrid.FacetGrid at 0x2a170b2fb08>
```



In [466]:
```
#grouping consumption by month of year into a new dataset called monthly_data
monthly_data=beer_data.iloc[:,[0,6]]
monthly_data['month']=monthly_data.date.dt.month
```

```
C:\Users\leand\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: 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
```

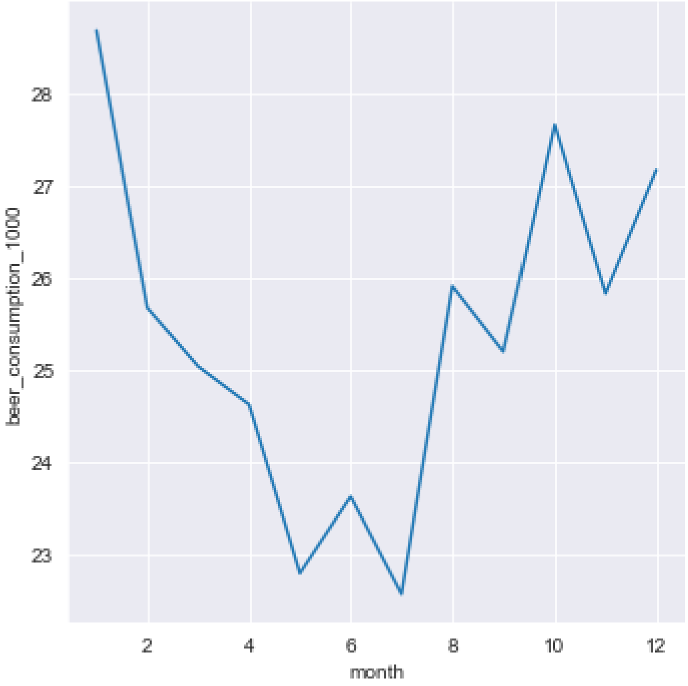
In [489]:
```
monthly_data.index=np.arange(12)
```

In [490]:
```
monthly_data
```

Out[490]:

	beer_consumption_1000	month
0	28.677645	1
1	25.673143	2
2	25.036387	3
3	24.624100	4
4	22.798387	5
5	23.627067	6
6	22.572871	7
7	25.908968	8
8	25.198133	9
9	27.653194	10
10	25.828200	11
11	27.169516	12

In [493]:
```
#Adding the month to the data we notice that the consumption of beer dips towards the middle of the year but not by mu
ch
sns.set_style("darkgrid")
sns.relplot(x="month", y="beer_consumption_1000",kind="line", data=monthly_data);
```



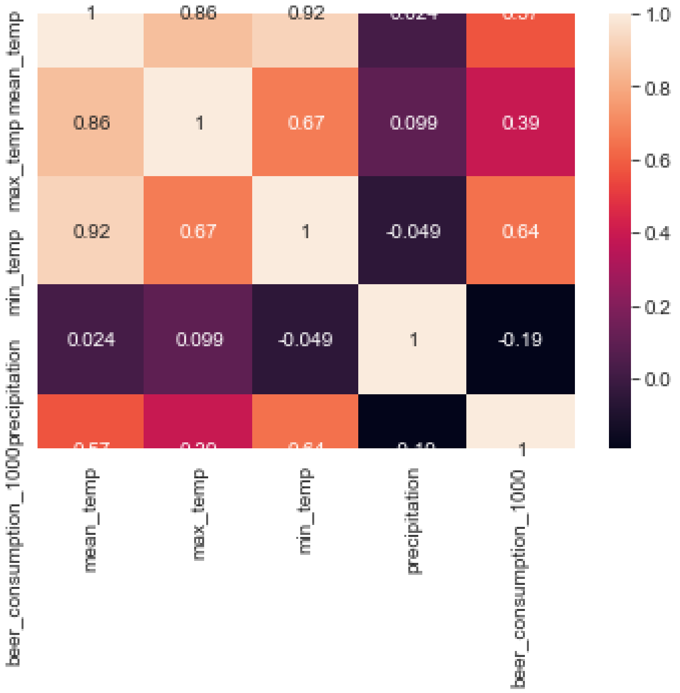
In [22]:
```
numeric_columns=beer_data.iloc[:,[1,2,3,4,6]].corr()
```

In [23]:

```
#None of the features are too correlated with beer consumtio
sns.heatmap(numeric_columns, annot=True)
```

Out[23]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1cab147e8c8>
```



In [24]:

```
cor_target = abs(numeric_columns["beer_consumption_1000"])

cor_target[cor_target>0.6]
```

Out[24]:

```
min_temp                 0.642672
beer_consumption_1000    1.000000
Name: beer_consumption_1000, dtype: float64
```

In [19]:

```
reg_columns_data=beer_data.iloc[:,[1,2,3,4,5]]
reg_columns_target=beer_data.iloc[:,6]
reg_columns_data
```

Out[19]:

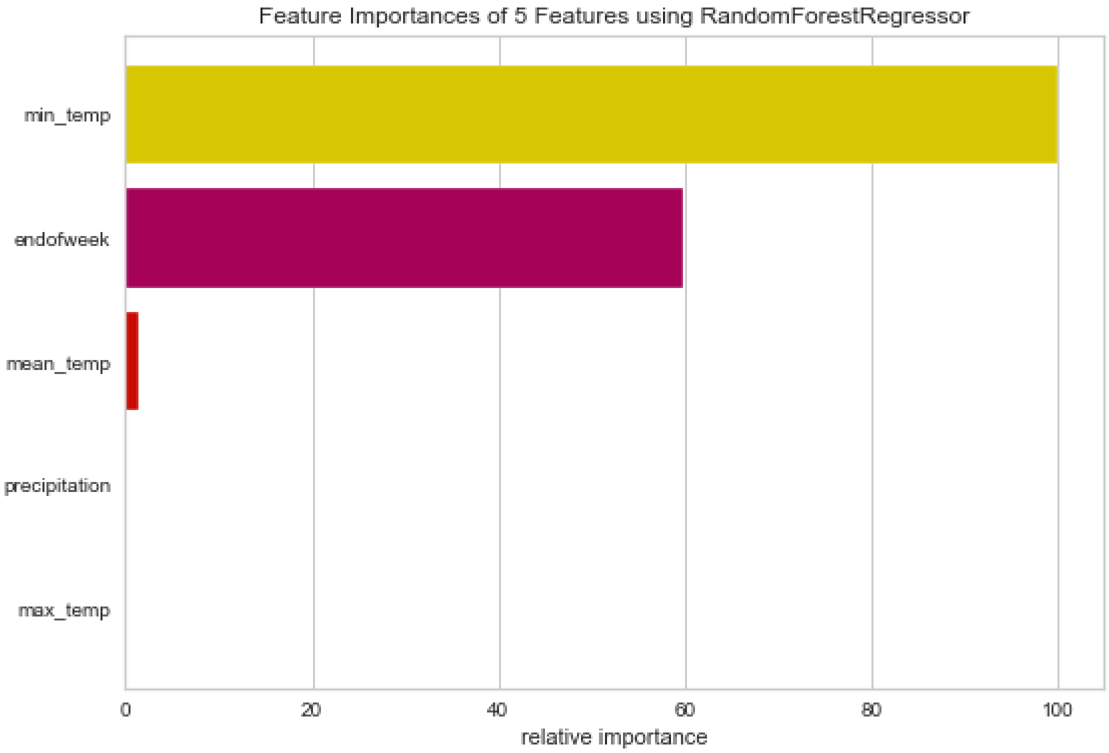
	mean_temp	max_temp	min_temp	precipitation	endofweek
1	27.30	23.9	32.5	0.0	0
2	27.02	24.5	33.5	0.0	0
3	24.82	22.4	29.9	0.0	1
4	23.98	21.5	28.6	1.2	1
5	23.82	21.0	28.3	0.0	0
...	...	...	...	...	...
361	24.00	21.1	28.2	13.6	1
362	22.64	21.1	26.7	0.0	0
363	21.68	20.3	24.1	10.3	0
364	21.38	19.3	22.4	6.3	0
365	24.76	20.2	29.0	0.0	0

365 rows × 5 columns

In [32]:

```
#Finding important features using a random forest model
rf = RandomForestRegressor(max_depth=2, random_state=0)
main_features = FeatureImportances(rf)
main_features.fit(reg_columns_data, reg_columns_target)
main_features.show()
```

```
C:\Users\leand\Anaconda3\lib\site-packages\sklearn\ensemble\forest.py:245: FutureWarning: The default value of n_esti
mators will change from 10 in version 0.20 to 100 in 0.22.
  "10 in version 0.20 to 100 in 0.22.", FutureWarning)
```



Out[32]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1cab1d3c6c8>
```

In [28]:
```
#Choosing the temperature variables and end-of-week as the final features and split the data into test and train datasets
reg_data=reg_columns_data.iloc[:,[2,4]]

reg_target=beer_data.iloc[:,6]

X_train, X_test, y_train, y_test = train_test_split(reg_data,reg_target,random_state=1,shuffle=True,test_size=0.2)
```

In [29]:
```
#Running 5 fold cross validation on five different models
#(linear regression,LASSO,RIDGE,Random Forest,K neares neighbours)
models = []
models.append(('LR', LinearRegression()))
models.append(('LASSO', linear_model.Lasso()))
models.append(('KNN', KNeighborsRegressor()))
models.append(('DTREE', DecisionTreeRegressor()))
models.append(('RIDGE',Ridge(alpha=0.5)))
```

In [32]:
```
#lnear regression and Ridge have the lowest absolute error
results = []
names = []
for name, model in models:

    cv_results = cross_val_score(model, X_train, y_train, cv=3, scoring='neg_mean_absolute_error')
    results.append(cv_results)
    names.append(name)
    msg = "%s: %f (%f)" % (name, cv_results.mean(), cv_results.std())
    print(msg)
```

```
LR: -2.024904 (0.116993)
LASSO: -2.731539 (0.129341)
KNN: -2.248236 (0.086699)
DTREE: -2.702475 (0.140801)
RIDGE: -2.024084 (0.117107)
```

In [33]:

```
#Even after acaling the data though standard scaler transformation ,lnear regression and Ridge have the lowest absolute error
pre_process = ColumnTransformer([
                      ('scale',StandardScaler(),['min_temp','endofweek']) ])
pipelines = []
pipelines.append(('SCALEDLR', Pipeline([('PR',pre_process),('LR', LinearRegression())])))
pipelines.append(('ScaledLASSO', Pipeline([('PR',pre_process),('LASSO', linear_model.Lasso())])))
pipelines.append(('ScaledIDGE', Pipeline([('PR',pre_process),('RIDGE', Ridge())])))
pipelines.append(('ScaledKNN', Pipeline([('PR',pre_process),('KNN', KNeighborsRegressor())])))
pipelines.append(('ScaledTREE', Pipeline([('PR',pre_process),('CART', DecisionTreeRegressor())])))

results = []
names = []

for name, model in pipelines:
    cv_results = cross_val_score(model, X_train, y_train, cv=5, scoring='neg_mean_absolute_error')
    results.append(cv_results)
    names.append(name)
    msg = "%s: %f (%f)" % (name, cv_results.mean(), cv_results.std())
    print(msg)
```

```
SCALEDLR: -2.034520 (0.137741)
ScaledLASSO: -2.339683 (0.256080)
ScaledIDGE: -2.033867 (0.137458)
ScaledKNN: -2.149664 (0.114568)
ScaledTREE: -2.590317 (0.241393)
```

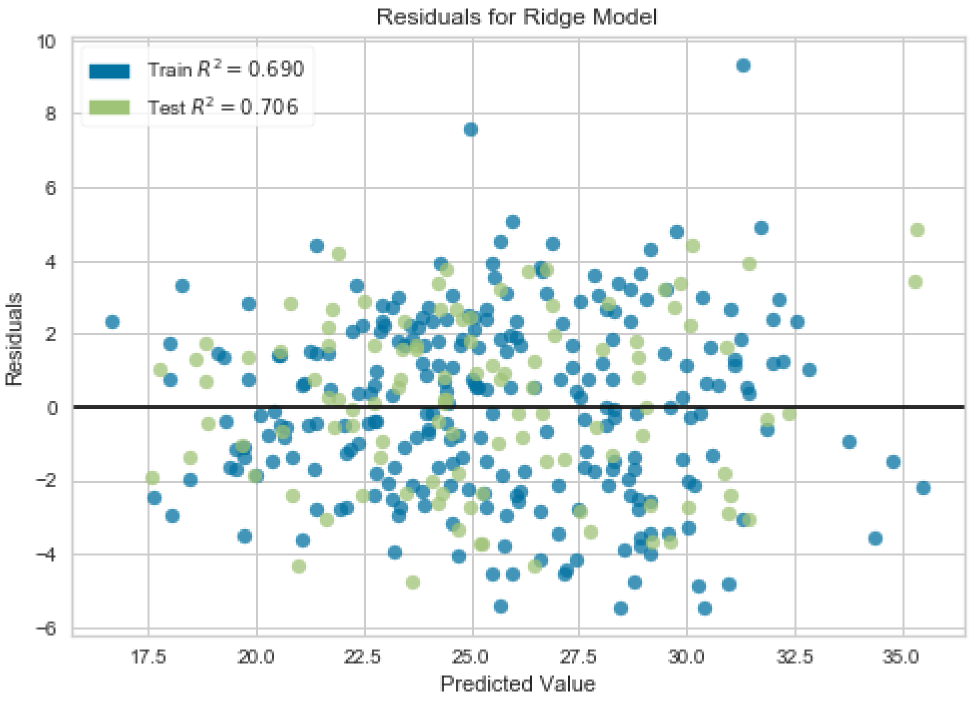
In [653]:

```
#tuning the alpha parameter
alphas = np.linspace(0.1, 1, 50)
clf = RidgeCV(alphas=alphas).fit(X_train, y_train)
clf.alpha_
```

Out[653]:

```
0.2653061224489796
```

In [671]:
```
#plotting the residuals for the train and test data fo the Ridge model.
from yellowbrick.regressor import ResidualsPlot
lr = Ridge(alpha=.265)

lr.fit(X_train,y_train)
ypred=lr.predict(X_test)
visualizer = ResidualsPlot(lr,hist=False)

visualizer.fit(X_train, y_train)  # Fit the training data to the visualizer
visualizer.score(X_test, y_test)  # Evaluate the model on the test data
visualizer.show()                 # Finalize and render the figure
```



Out[671]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2a17aaa0108>
```