remove outliers and log chang y to improve performance

May 24, 2019

I try to remove some outliers in X for better performance. Also use log transfer y. Fit in Ridge and Lasso with clean data. Use grid search to improve performance.

In [1]:
```
import numpy as np
import pandas as pd
from matplotlib import pyplot as plt
import seaborn as sns

%matplotlib inline
```

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

Out[2]:
```
   Id  MSSubClass  LotFrontage  LotArea  OverallQual  OverallCond  YearBuilt  \
0   1          60         65.0     8450            7            5       2003
1   2          20         80.0     9600            6            8       1976
2   3          60         68.0    11250            7            5       2001
3   4          70         60.0     9550            7            5       1915
4   5          60         84.0    14260            8            5       2000

   YearRemodAdd  ExterQual  ExterCond          ...            SaleType_ConLI  \
0          2003          3          2          ...                         0
1          1976          2          2          ...                         0
2          2002          3          2          ...                         0
3          1970          2          2          ...                         0
4          2000          3          2          ...                         0

   SaleType_ConLw  SaleType_New  SaleType_Oth  SaleType_WD  \
0               0             0             0            1
1               0             0             0            1
2               0             0             0            1
3               0             0             0            1
4               0             0             0            1

   SaleCondition_AdjLand  SaleCondition_Alloca  SaleCondition_Family  \
0                      0                     0                     0
1                      0                     0                     0
2                      0                     0                     0
```

```
3                       0                      0                      0
4                       0                      0                      0

   SaleCondition_Normal  SaleCondition_Partial
0                     1                      0
1                     1                      0
2                     1                      0
3                     0                      0
4                     1                      0

[5 rows x 534 columns]
```

In [3]:
```
clean_data.columns
```

Out[3]:
```
Index(['Id', 'MSSubClass', 'LotFrontage', 'LotArea', 'OverallQual',
       'OverallCond', 'YearBuilt', 'YearRemodAdd', 'ExterQual', 'ExterCond',
       ...
       'SaleType_ConLI', 'SaleType_ConLw', 'SaleType_New', 'SaleType_Oth',
       'SaleType_WD', 'SaleCondition_AdjLand', 'SaleCondition_Alloca',
       'SaleCondition_Family', 'SaleCondition_Normal',
       'SaleCondition_Partial'],
      dtype='object', length=534)
```

In [4]:
```
y=clean_data['SalePrice']
clean_data=clean_data.drop(['SalePrice'],axis=1) #drop the y in clean_data
X = clean_data.iloc[:,1:] # drop the id column
X.shape
```

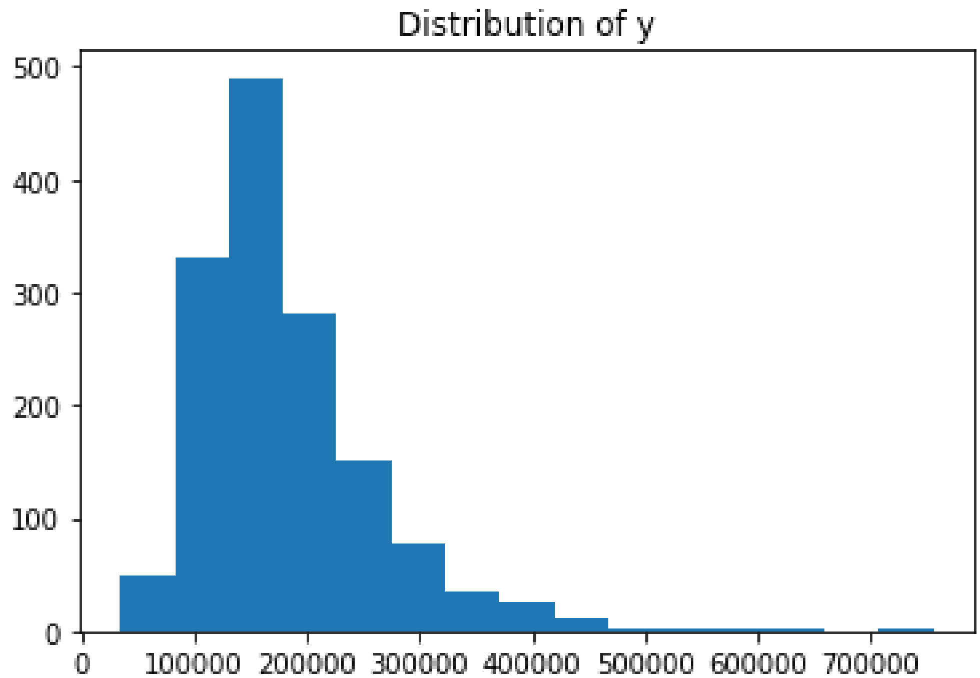
Out[4]:
```
(1459, 532)
```

In [5]:
```
y.describe()
```

Out[5]:
```
count      1459.000000
mean     180930.394791
std       79468.964025
min       34900.000000
25%      129950.000000
50%      163000.000000
75%      214000.000000
max      755000.000000
Name: SalePrice, dtype: float64
```

In [6]:
```
plt.hist(y,bins=15)
plt.title('Distribution of y')
# Basically the first and last 9 bins have little samples,
#it's hard to predict these small groups of data,so drop it first.
```

Out[6]:
```
Text(0.5,1,'Distribution of y')
```




```
In [7]: from sklearn.model_selection import train_test_split
        from sklearn.linear_model import Lasso
        X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=4
        # scaling
        from sklearn.preprocessing import StandardScaler
        scaler = StandardScaler()
        X_train_sc = scaler.fit_transform(X_train)
        X_test_sc = scaler.transform(X_test)
```

```
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/preprocessing/data.py:625: DataCo
  return self.partial_fit(X, y)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/base.py:462: DataConversionWarni
  return self.fit(X, **fit_params).transform(X)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:8: DataConversionWa
```

```
In [8]: clf = Lasso(random_state=42)
        clf.fit(X_train_sc,y_train)
        y_test_pred = clf.predict(X_test_sc)
        y_train_pred = clf.predict(X_train_sc)
        from sklearn.metrics import mean_squared_error
        from math import sqrt
        mse = mean_squared_error(y_test, y_test_pred)
        sqrt(mse)
```

```
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
```

```
Out[8]: 33069.93524702181
```

```
In [9]: # grid search to get the best hyperparameter.
        from sklearn.model_selection import GridSearchCV
        parameters = { 'max_iter':[1000,2000,5000],'alpha':[1, 10,100,1000,10000]}
        ls = Lasso(random_state=42)
        clf = GridSearchCV(ls, parameters, cv=5)
        clf.fit(X_train_sc,y_train)
        y_test_pred = clf.predict(X_test_sc)
        y_train_pred = clf.predict(X_train_sc)
```

```
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
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  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
```
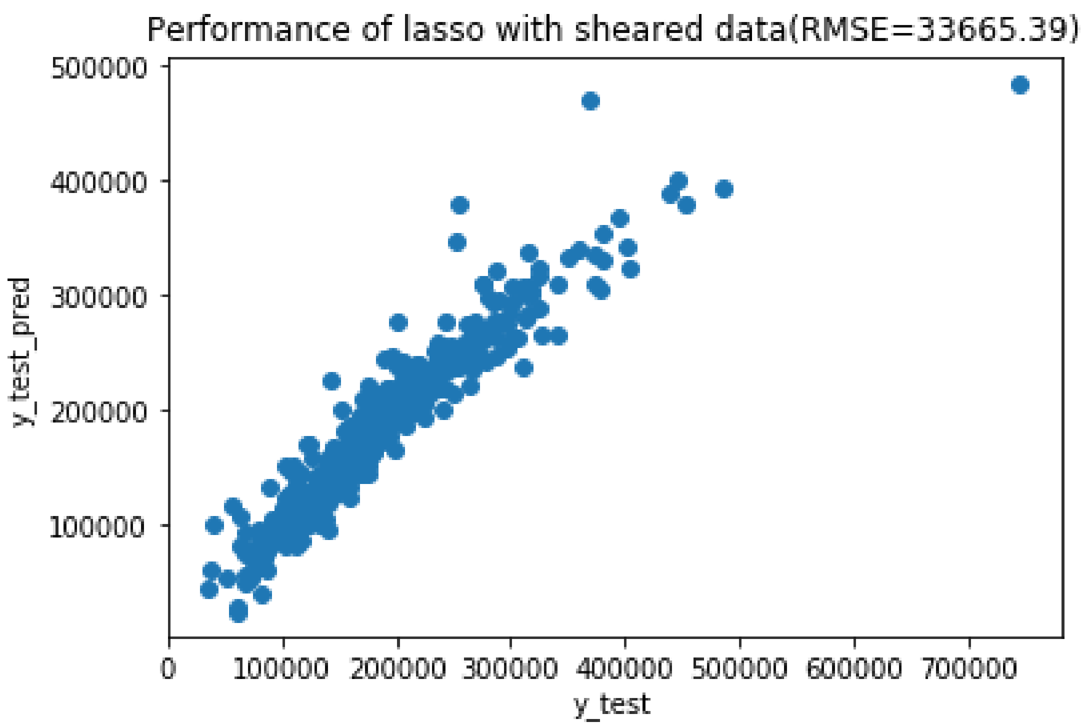

```
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/model_selection/_search.py:841: D
  DeprecationWarning)
```

```
In [10]: mse_test = mean_squared_error(y_test, y_test_pred)
         sqrt(mse_test)

Out[10]: 26802.87448312158
```

```
In [11]: plt.scatter(y_test, y_test_pred)
         plt.title('Performance of lasso with sheared data(RMSE=33665.39)')
         plt.xlabel('y_test')
         plt.ylabel('y_test_pred')

Out[11]: Text(0,0.5,'y_test_pred')
```




```
In [12]: clf.best_score_
         # R2

Out[12]: 0.8037315767569586
```

0.1 Remove outliers in X

In [13]:
```
y_true_comb = np.hstack([y_train,y_test])
len(y_true_comb)
```

Out[13]:
```
1459
```

In [14]:
```
X_true_comb = np.vstack([X_train_sc,X_test_sc])
X_true_comb = pd.DataFrame(X_true_comb,columns=X.columns)
```

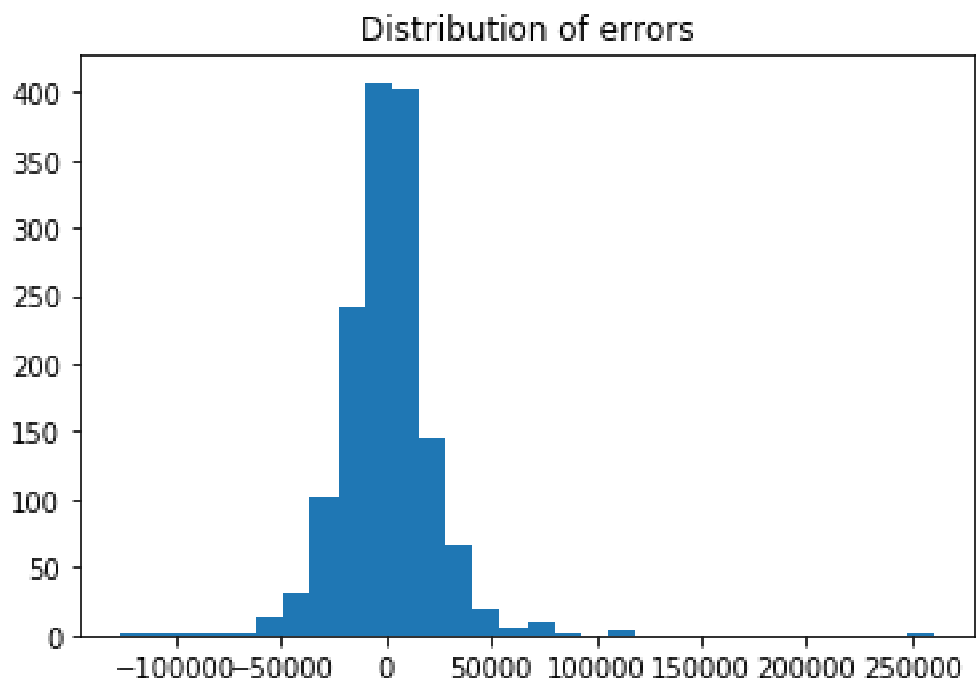
In [15]:
```
y_pred = clf.predict(X_true_comb)
```

In [16]:
```
error =y_true_comb-y_pred
error
```

Out[16]:
```
array([-14028.48554686,  18869.90785598,  31935.99323894, ...,
        20869.21771686, -35026.38340765, -29035.94844561])
```

In [17]:
```
plt.hist(y_true_comb-y_pred,bins = 30)
plt.title('Distribution of errors')
```

Out[17]:
```
Text(0.5,1,'Distribution of errors')
```



In [18]:
```
strange_X = X_true_comb[error<-60000]
strange_X
```

Out[18]:

```
      MSSubClass  LotFrontage   LotArea  OverallQual  OverallCond  YearBuilt  \
700     0.052093    -1.673021  0.148034    -0.090550     1.328141   0.176179
1064   -0.881004     1.196449  0.191906     1.376930    -0.494482   1.197285
1094   -0.881004     0.259479 -0.175261    -0.824290    -0.494482  -0.647293
1152   -0.881004     0.903646  0.075925     1.376930    -0.494482   1.098468
1167   -0.881004     1.723495  0.265211     1.376930    -0.494482   1.131407
1173   -0.881004    -1.673021  2.028113    -0.090550    -2.317105  -0.482598
1218    0.285367    -0.209006 -0.194760    -1.558029    -1.405794  -1.701337
1299   -0.881004     0.230199  1.331579    -0.824290     2.239452  -0.120270

      YearRemodAdd  ExterQual  ExterCond  BsmtQual          ...            \
700       0.492087  -0.692465   2.661743  0.577925          ...
1064      1.165509   2.756348  -0.217113  1.689151          ...
1094     -1.576280  -2.416871  -0.217113 -0.533302          ...
1152      1.021204   1.031941  -0.217113  1.689151          ...
1167      1.021204   1.031941  -0.217113  0.577925          ...
1173     -0.469944   1.031941  -0.217113 -0.533302          ...
1218     -1.672484  -0.692465  -3.095969 -0.533302          ...
1299      0.876900  -0.692465  -0.217113 -0.533302          ...

      SaleType_ConLI  SaleType_ConLw  SaleType_New  SaleType_Oth  SaleType_WD  \
700        -0.031311       -0.044302     -0.309020     -0.031311     0.393672
1064       -0.031311       -0.044302      3.236033     -0.031311    -2.540188
1094       -0.031311       -0.044302     -0.309020     -0.031311     0.393672
1152       -0.031311       -0.044302      3.236033     -0.031311    -2.540188
1167       -0.031311       -0.044302     -0.309020     -0.031311     0.393672
1173       -0.031311       -0.044302     -0.309020     -0.031311     0.393672
1218       -0.031311       -0.044302     -0.309020     -0.031311     0.393672
1299       -0.031311       -0.044302     -0.309020     -0.031311     0.393672

      SaleCondition_AdjLand  SaleCondition_Alloca  SaleCondition_Family  \
700               -0.062715             -0.076885             -0.126176
1064              -0.062715             -0.076885             -0.126176
1094              -0.062715             13.006409             -0.126176
1152              -0.062715             -0.076885             -0.126176
1167              -0.062715             -0.076885             -0.126176
1173              -0.062715             13.006409             -0.126176
1218              -0.062715             -0.076885             -0.126176
1299              -0.062715             -0.076885             -0.126176

      SaleCondition_Normal  SaleCondition_Partial
700               0.470417              -0.310918
1064             -2.125775               3.216278
1094             -2.125775              -0.310918
1152             -2.125775               3.216278
1167              0.470417              -0.310918
1173             -2.125775              -0.310918
1218              0.470417              -0.310918
```

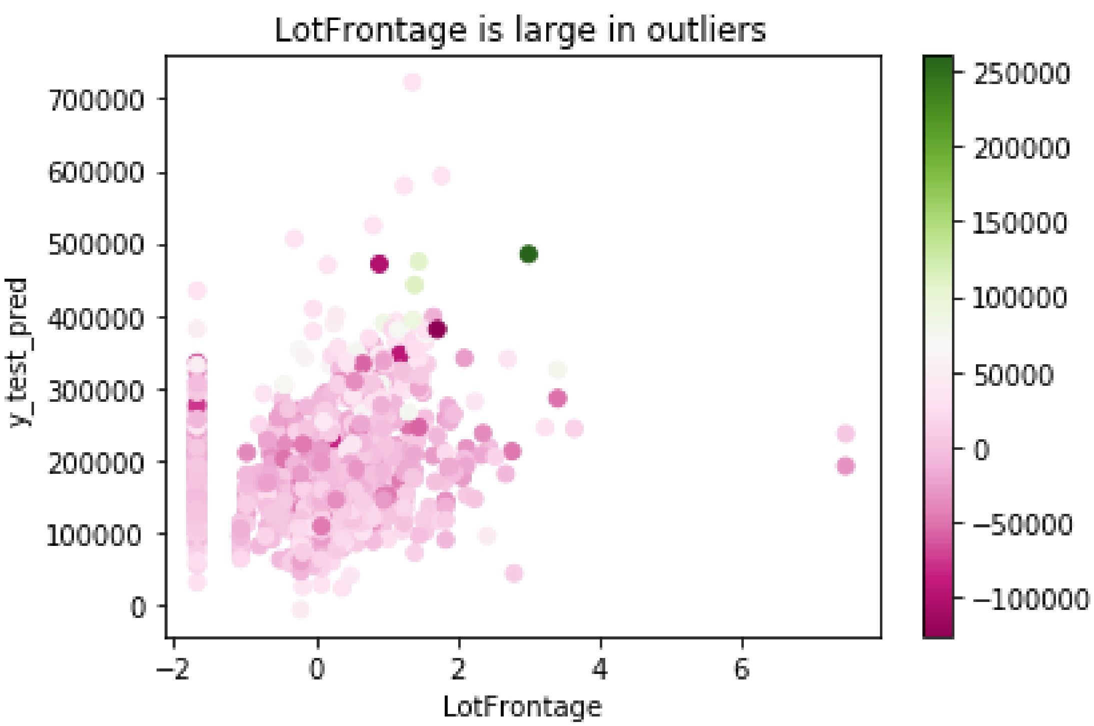
```
1299              -2.125775              3.216278

[8 rows x 532 columns]
```

In [19]:
```
strange_X = X_true_comb[error>80000]
strange_X
```

Out[19]:
```
      MSSubClass  LotFrontage   LotArea  OverallQual  OverallCond  YearBuilt  \
390    -0.881004     1.401411  0.442724      2.84441    -0.494482   1.197285
446     0.052093     1.459972  0.301082      2.11067    -0.494482   1.197285
491     0.402004     0.962207  1.134291      2.84441     3.150764  -2.623626
554    -0.881004     0.083797 -0.232562      1.37693     0.416829   1.164346
1316    0.052093     1.372131  0.266775      2.11067    -0.494482   1.197285
1379    0.052093     3.011828  0.460384      2.84441    -0.494482   0.802018

      YearRemodAdd  ExterQual  ExterCond  BsmtQual          ...             \
390       1.117407   2.756348  -0.217113  1.689151          ...
446       1.165509   2.756348  -0.217113  1.689151          ...
491       0.395884   1.031941   2.661743 -0.533302          ...
554       1.069306   1.031941  -0.217113  0.577925          ...
1316      1.165509   2.756348  -0.217113  1.689151          ...
1379      0.540189   1.031941  -0.217113  1.689151          ...

      SaleType_ConLI  SaleType_ConLw  SaleType_New  SaleType_Oth  SaleType_WD  \
390        -0.031311       -0.044302     -0.309020     -0.031311     0.393672
446        -0.031311       -0.044302      3.236033     -0.031311    -2.540188
491        -0.031311       -0.044302     -0.309020     -0.031311     0.393672
554        -0.031311       -0.044302      3.236033     -0.031311    -2.540188
1316       -0.031311       -0.044302      3.236033     -0.031311    -2.540188
1379       -0.031311       -0.044302     -0.309020     -0.031311     0.393672

      SaleCondition_AdjLand  SaleCondition_Alloca  SaleCondition_Family  \
390               -0.062715             -0.076885             -0.126176
446               -0.062715             -0.076885             -0.126176
491               -0.062715             -0.076885             -0.126176
554               -0.062715             -0.076885             -0.126176
1316              -0.062715             -0.076885             -0.126176
1379              -0.062715             -0.076885             -0.126176

      SaleCondition_Normal  SaleCondition_Partial
390               0.470417              -0.310918
446              -2.125775               3.216278
491               0.470417              -0.310918
554              -2.125775               3.216278
1316             -2.125775               3.216278
1379             -2.125775              -0.310918

[6 rows x 532 columns]
```

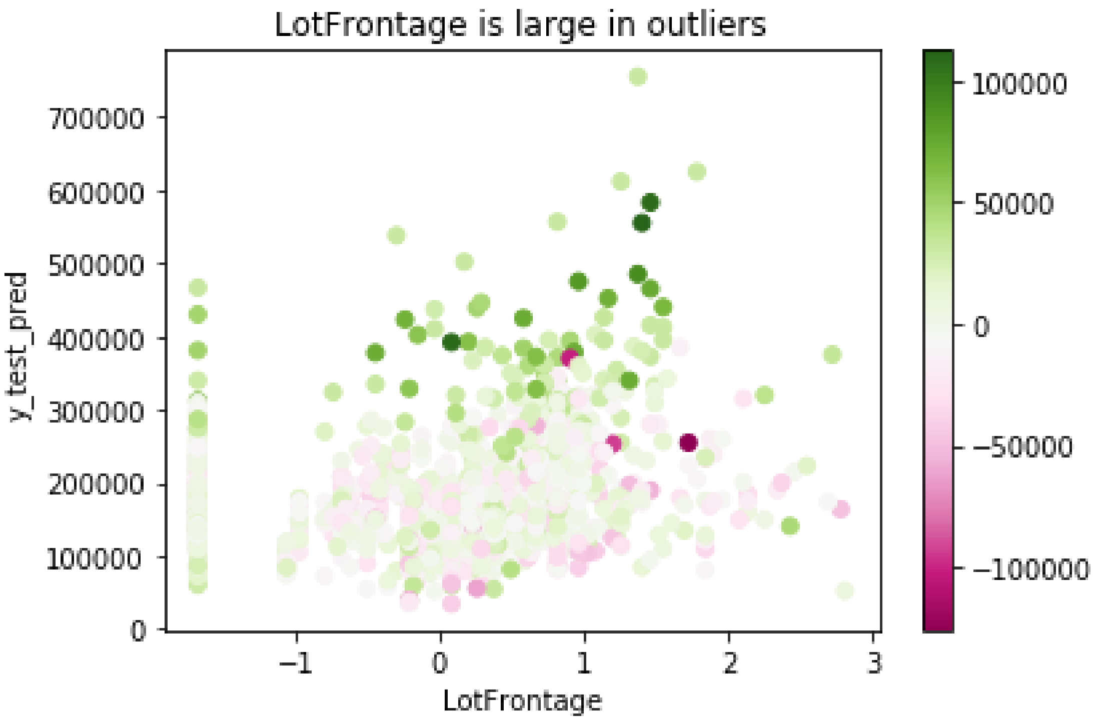
In [20]:
```
# identify outliers of X according to its feature
cm = plt.cm.get_cmap('PiYG')
sc = plt.scatter(X_true_comb.iloc[:,1],y_pred , c=error, cmap=cm) # LotFrontage:
                                                                   #Linear feet of s
plt.colorbar(sc)
plt.title('LotFrontage is large in outliers')
plt.xlabel('LotFrontage')
plt.ylabel('y_test_pred')
```

Out[20]: Text(0,0.5,'y_test_pred')



In [21]:
```
# remove according to LotFrontage.
X_filted = X_true_comb[X_true_comb['LotFrontage'] < 3]
y_filted = y_true_comb[X_true_comb['LotFrontage'] < 3]
error_filted = error[X_true_comb['LotFrontage'] < 3]
cm = plt.cm.get_cmap('PiYG')
sc = plt.scatter(X_filted.iloc[:,1],y_filted , c=error_filted, cmap=cm) # LotFrontage
                                                                   #Linear feet of s
plt.colorbar(sc)
plt.title('LotFrontage is large in outliers')
plt.xlabel('LotFrontage')
plt.ylabel('y_test_pred')
```

Out[21]: Text(0,0.5,'y_test_pred')




```
In [22]: X_train, X_test, y_train, y_test = train_test_split(X_filted, y_filted, test_size=0.3
         clf = Lasso(random_state=42)
         clf.fit(X_train,y_train)
         y_test_pred = clf.predict(X_test)
         y_train_pred = clf.predict(X_train)
         from sklearn.metrics import mean_squared_error
         mse = mean_squared_error(y_test, y_test_pred)
         sqrt(mse)
```

```
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
```

```
Out[22]: 35317.15079537594
```

```
In [23]: parameters = { 'max_iter':[1000,2000,5000],'alpha':[1, 10,100,1000,10000]}
         ls = Lasso(random_state=42)
         clf = GridSearchCV(ls, parameters, cv=5)
         clf.fit(X_train,y_train)
         y_test_pred = clf.predict(X_test)
         y_train_pred = clf.predict(X_train)
         mse = mean_squared_error(y_test, y_test_pred)
         sqrt(mse)
```

```
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
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  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
```
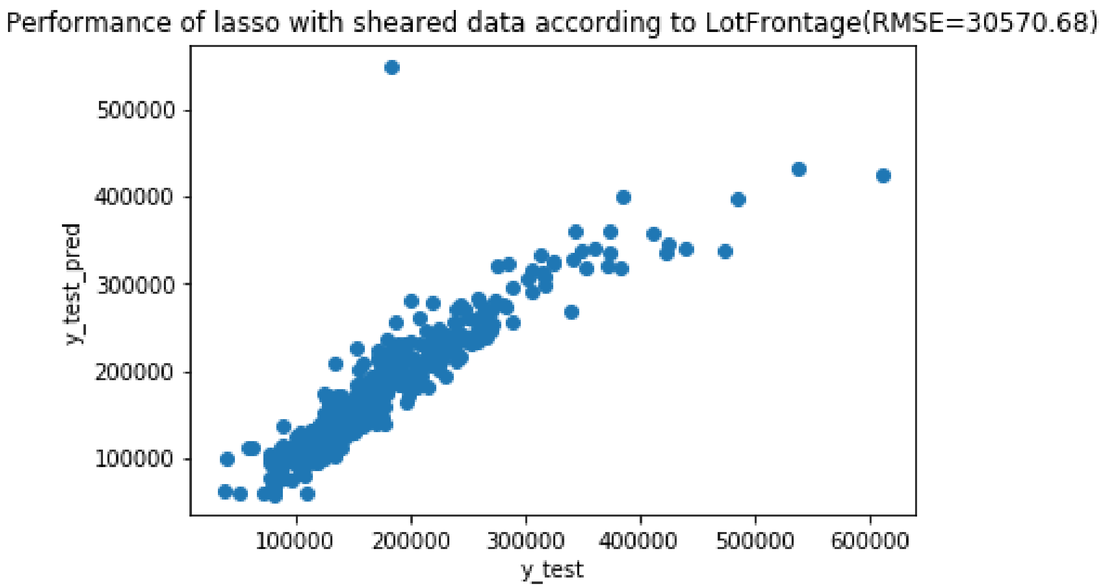

Out[23]: 30570.689624112565

In [24]:
```
y.shape[0]-y_filted.shape[0] # 7 data points removed
```

Out[24]: 7

In [25]:
```
plt.scatter(y_test, y_test_pred)
plt.title('Performance of lasso with sheared data according to LotFrontage(RMSE=30570
plt.xlabel('y_test')
plt.ylabel('y_test_pred')
```

Out[25]: Text(0,0.5,'y_test_pred')

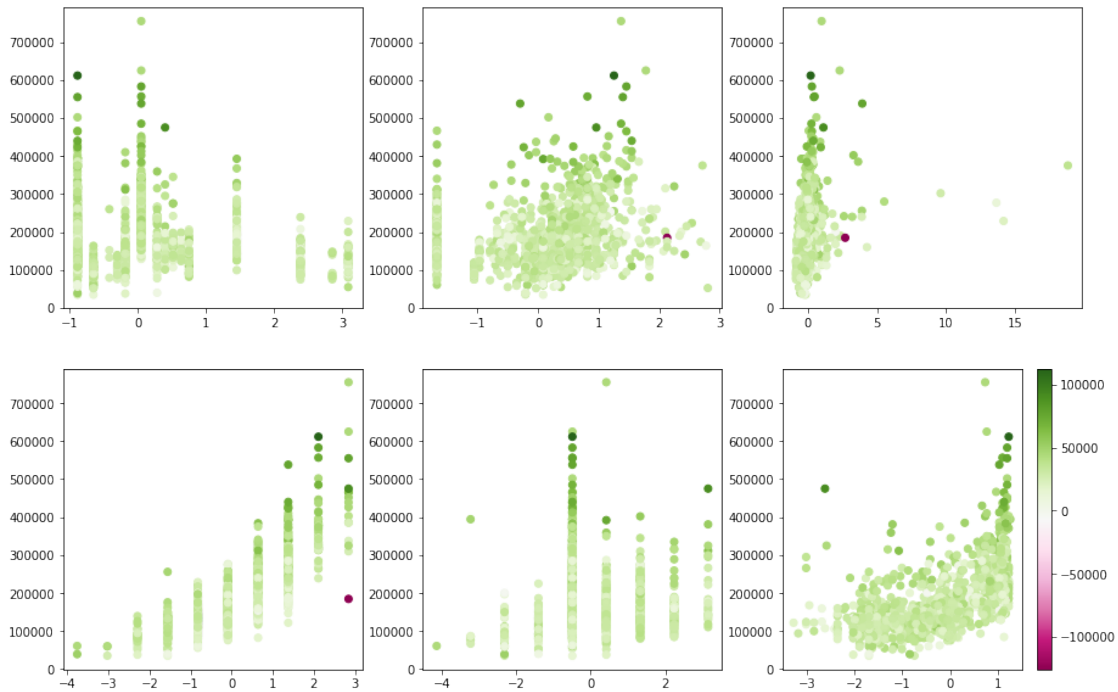



```
In [26]: # combine data for some EDA and find more outliers
         y_filted = np.hstack([y_train,y_test])
         X_true_comb = np.vstack([X_train,X_test])
         X_filted = pd.DataFrame(X_true_comb,columns=X.columns)
         y_pred = clf.predict(X_filted)
         error_filted =y_filted-y_pred
         error_filted
```

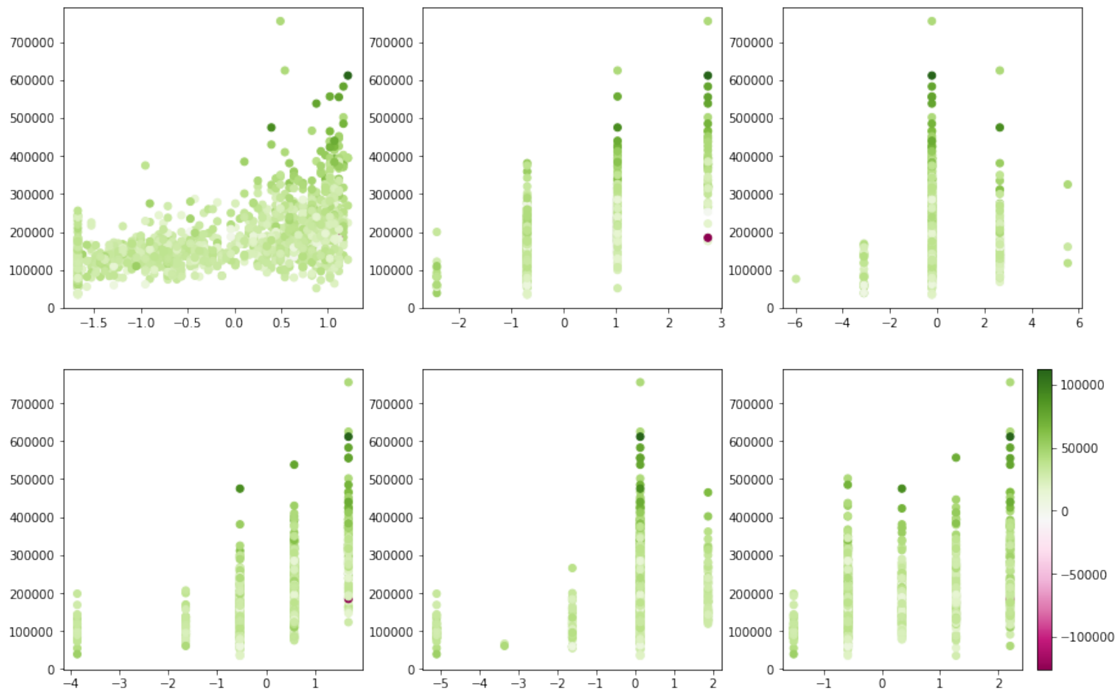
```
Out[26]: array([ 5.21606840e+03, -9.47065676e+03,  5.37606815e+03, ...,
                -1.64250998e+02, -1.62202384e+01,  1.63888821e+04])
```

```
In [27]: i = 0
         fig, axes = plt.subplots(2, 3, figsize=(15,10))
         axes[0, 0].scatter(X_filted.iloc[:,i+0],y_filted  , c=error_filted, cmap=cm)
         axes[0, 1].scatter(X_filted.iloc[:,i+1],y_filted  , c=error_filted, cmap=cm)
         axes[0, 2].scatter(X_filted.iloc[:,i+2],y_filted , c=error_filted, cmap=cm)
         axes[1, 0].scatter(X_filted.iloc[:,i+3],y_filted  , c=error_filted, cmap=cm)
         axes[1, 1].scatter(X_filted.iloc[:,i+4],y_filted  , c=error_filted, cmap=cm)
         axes[1, 2].scatter(X_filted.iloc[:,i+5],y_filted  , c=error_filted, cmap=cm)
         plt.colorbar(sc)
```

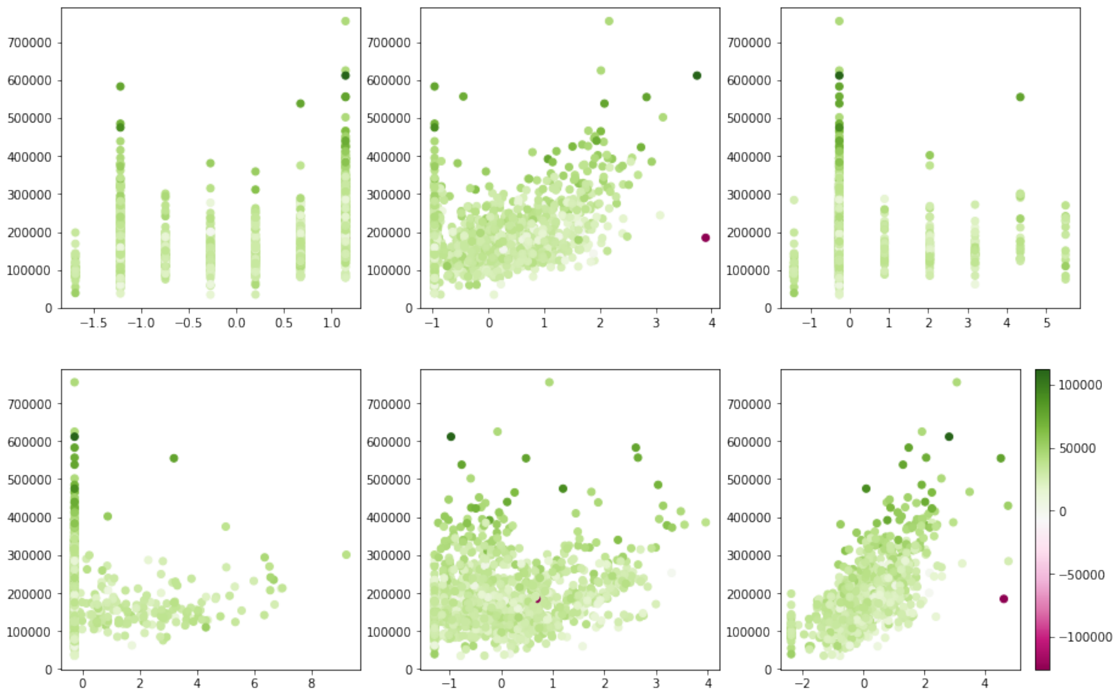
```
Out[27]: <matplotlib.colorbar.Colorbar at 0x1a257a4b00>
```



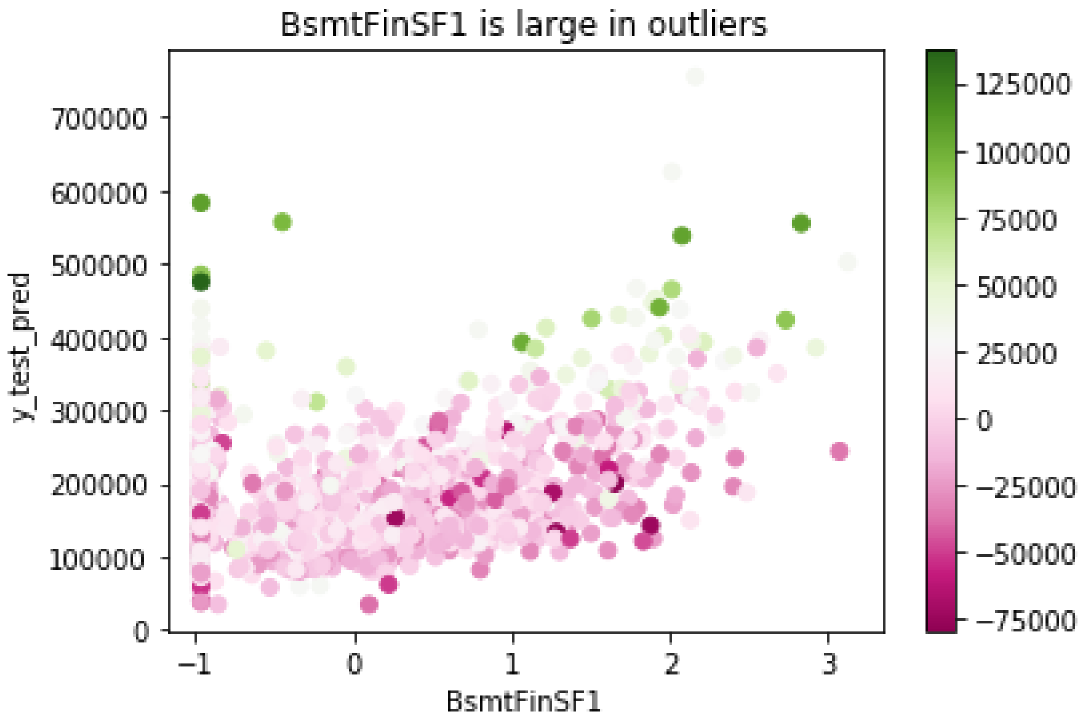
```
In [28]: i = 6
         fig, axes = plt.subplots(2, 3, figsize=(15,10))
         axes[0, 0].scatter(X_filted.iloc[:,i+0],y_filted  , c=error_filted, cmap=cm)
         axes[0, 1].scatter(X_filted.iloc[:,i+1],y_filted  , c=error_filted, cmap=cm)
         axes[0, 2].scatter(X_filted.iloc[:,i+2],y_filted , c=error_filted, cmap=cm)
         axes[1, 0].scatter(X_filted.iloc[:,i+3],y_filted  , c=error_filted, cmap=cm)
         axes[1, 1].scatter(X_filted.iloc[:,i+4],y_filted  , c=error_filted, cmap=cm)
         axes[1, 2].scatter(X_filted.iloc[:,i+5],y_filted  , c=error_filted, cmap=cm)
         plt.colorbar(sc)

Out[28]: <matplotlib.colorbar.Colorbar at 0x1a13b234e0>
```




```
In [29]: i = 12
         fig, axes = plt.subplots(2, 3, figsize=(15,10))
         axes[0, 0].scatter(X_filted.iloc[:,i+0],y_filted  , c=error_filted, cmap=cm)
         axes[0, 1].scatter(X_filted.iloc[:,i+1],y_filted  , c=error_filted, cmap=cm)
         axes[0, 2].scatter(X_filted.iloc[:,i+2],y_filted , c=error_filted, cmap=cm)
         axes[1, 0].scatter(X_filted.iloc[:,i+3],y_filted  , c=error_filted, cmap=cm)
         axes[1, 1].scatter(X_filted.iloc[:,i+4],y_filted  , c=error_filted, cmap=cm)
         axes[1, 2].scatter(X_filted.iloc[:,i+5],y_filted  , c=error_filted, cmap=cm)
         plt.colorbar(sc)

Out[29]: <matplotlib.colorbar.Colorbar at 0x1a13df9198>
```



```
In [30]: # find some outliers in feature BsmtFinSF1
         import heapq
         print(heapq.nlargest(3, X_filted.iloc[:,13]))

[3.8974066763514945, 3.7424466786490984, 3.131215576600758]


In [31]: X_filted.columns[13]

Out[31]: 'BsmtFinSF1'

In [33]: # remove according to BsmtFinSF1.
         X_filted2 = X_filted[X_filted['BsmtFinSF1'] < 3.6]
         y_filted2 = y_filted[X_filted['BsmtFinSF1'] < 3.6]
         error_filted2 = error_filted[X_filted['BsmtFinSF1'] < 3.6]
         cm = plt.cm.get_cmap('PiYG')
         sc = plt.scatter(X_filted2.iloc[:,13],y_filted2 , c=error_filted2, cmap=cm) # LotFron
                                                                                     #Linear feet of s
         plt.colorbar(sc)
         plt.title('BsmtFinSF1 is large in outliers')
         plt.xlabel('BsmtFinSF1')
         plt.ylabel('y_test_pred')

Out[33]: Text(0,0.5,'y_test_pred')
```




```
In [45]: X_train, X_test, y_train, y_test = train_test_split(X_filted2, y_filted2, test_size=0

         parameters = { 'max_iter':[1000,2000,5000],'alpha':[1, 10,100,1000,10000]}

         ls = Lasso(random_state=42)

         clf = GridSearchCV(ls, parameters, cv=5)

         clf.fit(X_train,y_train)

         y_test_pred = clf.predict(X_test)

         y_train_pred = clf.predict(X_train)

         mse = mean_squared_error(y_test, y_test_pred)

         sqrt(mse)
```

```
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
```

```
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
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  ConvergenceWarning)
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  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
```

```
Out[45]: 25183.600856565372
```

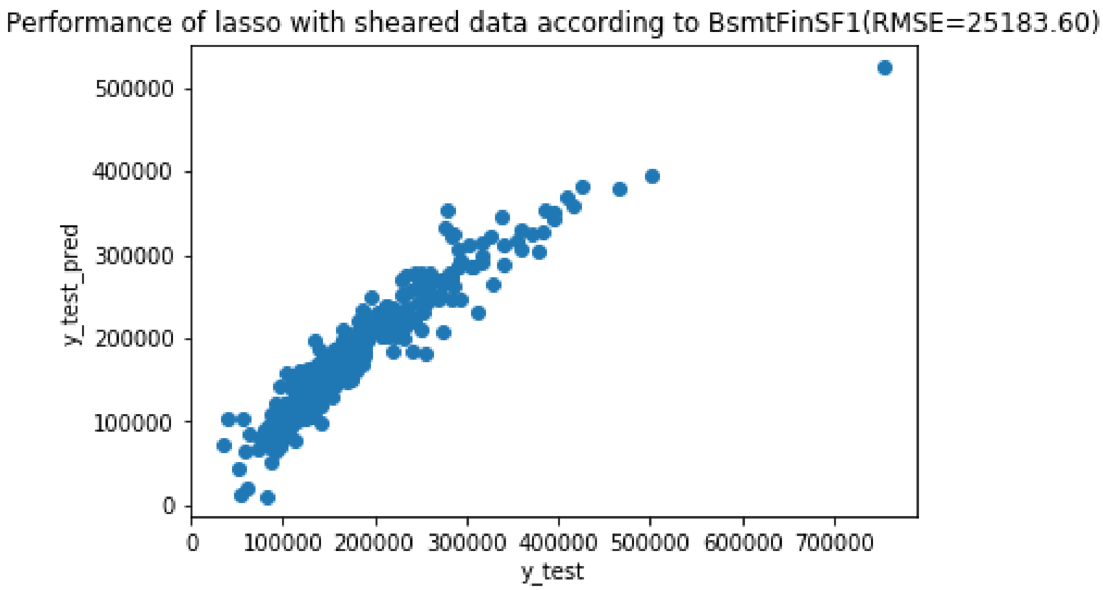
0.2 After remove the outliers in X , the root mean squared error droped to 25183.60

```
In [46]: y_filted.shape[0]-y_filted2.shape[0] # 2 data points removed
```

```
Out[46]: 2
```

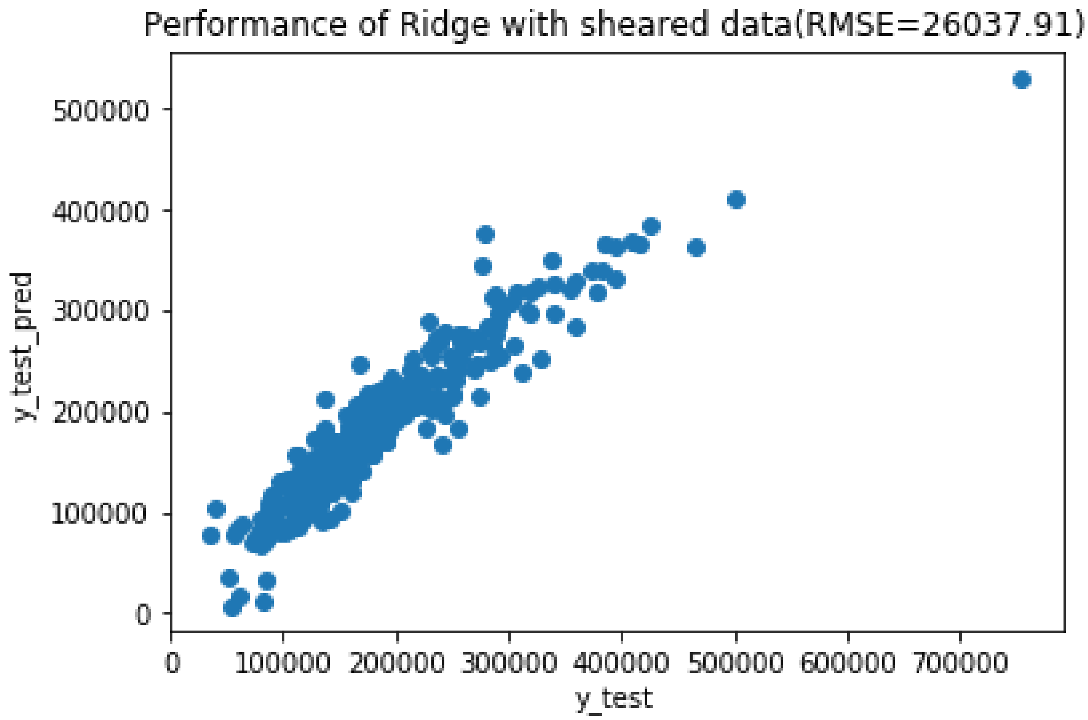
```
In [47]: plt.scatter(y_test, y_test_pred)
         plt.title('Performance of lasso with sheared data according to BsmtFinSF1(RMSE=25183.6
         plt.xlabel('y_test')
         plt.ylabel('y_test_pred')
```

```
Out[47]: Text(0,0.5,'y_test_pred')
```



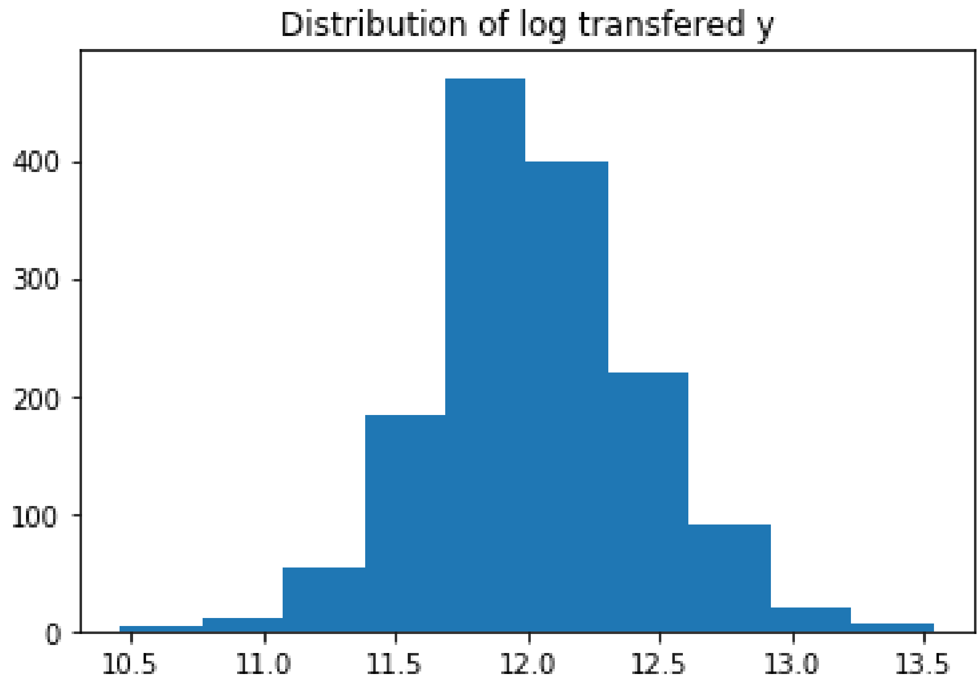
0.3 fit into Ridge

```
In [48]: parameters = { 'max_iter':[1000,2000,5000],'alpha':[1, 10,100,1000,10000]}
         from sklearn.linear_model import Ridge
         ls = Ridge(random_state=42)
         clf = GridSearchCV(ls, parameters, cv=5)
         clf.fit(X_train,y_train)
         y_test_pred = clf.predict(X_test)
         y_train_pred = clf.predict(X_train)

In [49]: mse_test = mean_squared_error(y_test, y_test_pred)
         sqrt(mse_test)

Out[49]: 26037.908039527552

In [50]: clf.best_score_

Out[50]: 0.8699814937005034

In [51]: plt.scatter(y_test, y_test_pred)
         plt.title('Performance of Ridge with sheared data(RMSE=26037.91)')
         plt.xlabel('y_test')
         plt.ylabel('y_test_pred')

Out[51]: Text(0,0.5,'y_test_pred')
```



0.4 log transfered y

```
In [52]: # log transfered y
         y_log = np.log(y)
         plt.hist(y_log)
         plt.title('Distribution of log transfered y')

Out[52]: Text(0.5,1,'Distribution of log transfered y')
```



0.5 fit into lasso

In [58]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y_log, test_size=0.3, random_s

clf = Lasso(random_state=42)
clf.fit(X_train,y_train)
y_test_pred = clf.predict(X_test)
y_train_pred = clf.predict(X_train)

mse = mean_squared_error(y_test, y_test_pred)
sqrt(mse)
```

Out[58]: 0.18036476431273618

In [63]:
```
parameters = { 'max_iter':[100,500,1000],'alpha':[0.001,0.01,0.1,1, 10,100,1000]}
ls = Lasso(random_state=42)
clf = GridSearchCV(ls, parameters, cv=5)
clf.fit(X_train,y_train)
y_test_pred = clf.predict(X_test)
y_train_pred = clf.predict(X_train)
```

```
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
```

```
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
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  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
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  ConvergenceWarning)
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  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
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  ConvergenceWarning)
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  ConvergenceWarning)
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  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/linear_model/coordinate_descent.p
  ConvergenceWarning)
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/model_selection/_search.py:841: I
  DeprecationWarning)
```
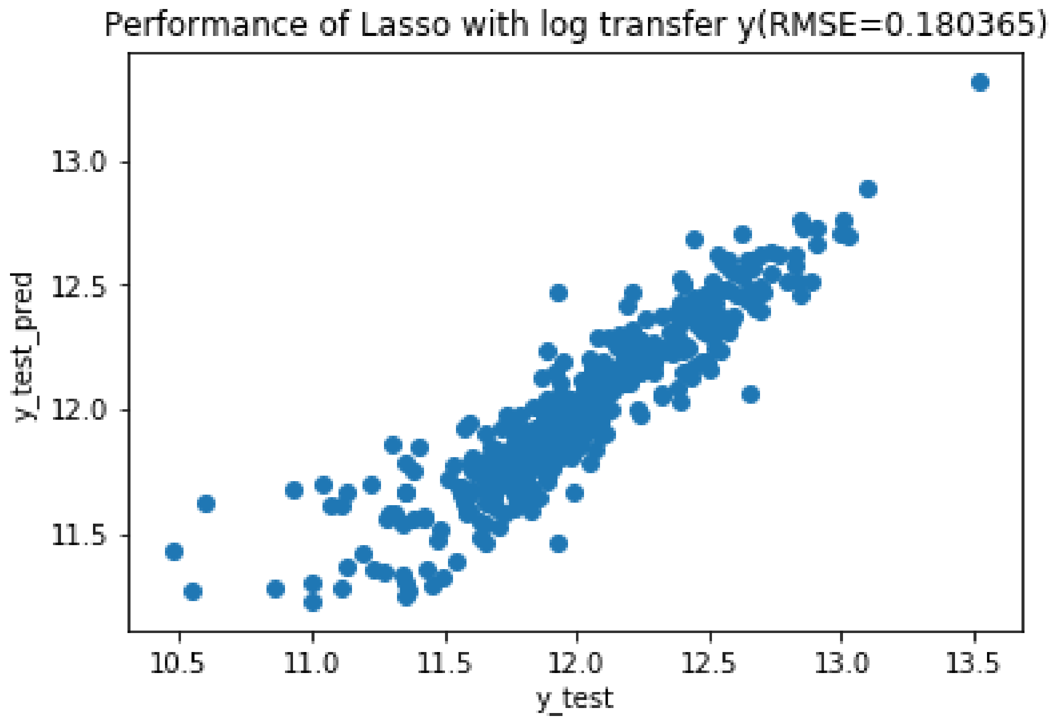

```
In [64]: mse_test = mean_squared_error(y_test, y_test_pred)
         sqrt(mse_test)

Out[64]: 0.18036476431273618

In [65]: clf.best_params_

Out[65]: {'alpha': 1, 'max_iter': 500}

In [66]: clf.best_score_

Out[66]: 0.6492490027698465

In [68]: plt.scatter(y_test, y_test_pred)
         plt.title('Performance of Lasso with log transfer y(RMSE=0.180365)')
         plt.xlabel('y_test')
         plt.ylabel('y_test_pred')

Out[68]: Text(0,0.5,'y_test_pred')
```



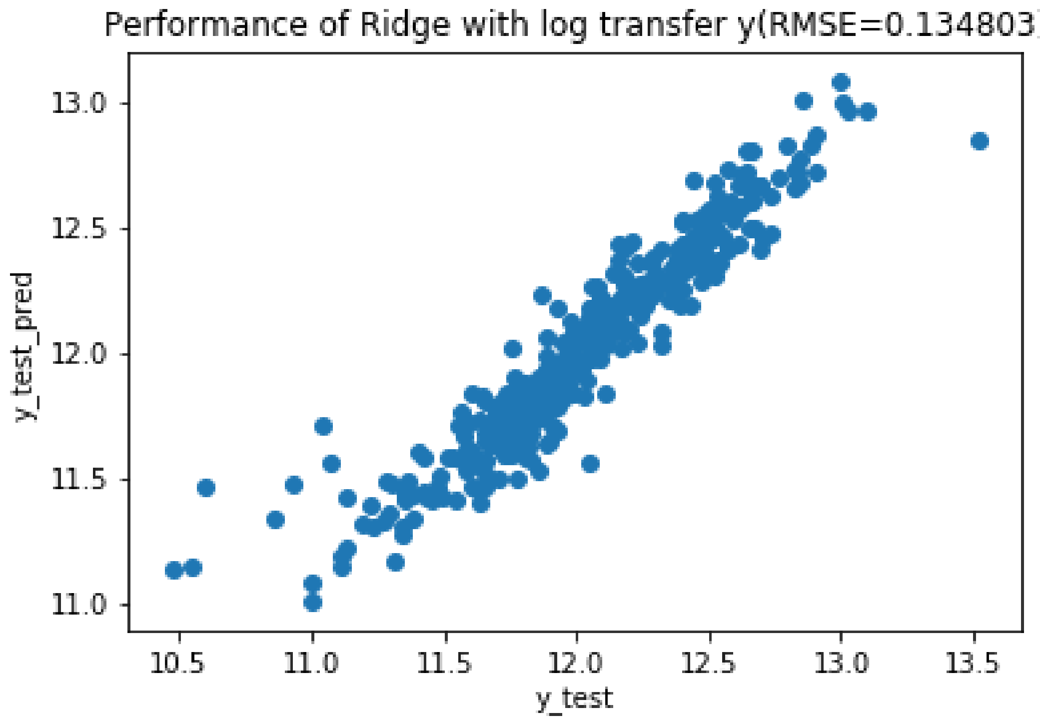
0.6 fit into Ridge

```
In [69]: parameters = { 'max_iter':[10,50,100,500],'alpha':[0.001,0.01,0.1,1, 10,100,1000]}
         rg = Ridge(random_state=42)
         clf = GridSearchCV(rg, parameters, cv=5)
         clf.fit(X_train,y_train)
         y_test_pred = clf.predict(X_test)
         y_train_pred = clf.predict(X_train)
```

```
/Users/fanwenyu/anaconda3/lib/python3.6/site-packages/sklearn/model_selection/_search.py:841: I
  DeprecationWarning)
```

```
In [70]: plt.scatter(y_test, y_test_pred)
         plt.title('Performance of Ridge with log transfer y(RMSE=0.134803)')
         plt.xlabel('y_test')
         plt.ylabel('y_test_pred')
```

```
Out[70]: Text(0,0.5,'y_test_pred')
```




```
In [71]: mse_test = mean_squared_error(y_test, y_test_pred)
         sqrt(mse_test)

Out[71]: 0.1375474209000953

In [72]: clf.best_score_

Out[72]: 0.6234102765983629
```