Proyecto 1

October 14, 2021

1 Proyecto 1, *Prices : Advanced Regression Techniques*

[1]:
```
#Modulos

import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from pylab import rcParams
import numpy as np
from scipy.stats import skew, kurtosis, chi2
from scipy import stats
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn import linear_model
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import KFold, cross_val_score, train_test_split
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_squared_error
from sklearn.metrics import accuracy_score

from sklearn import metrics
from sklearn.metrics import mean_squared_error

from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import RobustScaler

from sklearn import tree

from sklearn.ensemble import RandomForestRegressor, GradientBoostingRegressor

from sklearn.model_selection import GridSearchCV

from sklearn.preprocessing import MinMaxScaler

from sklearn.svm import SVR

from sklearn.ensemble import StackingRegressor
```

1.1 Varibales de entrada (descripción)

Descripción de las variables de entrada: * SalePrice: el precio de venta de la propiedad en dólares. Esta es la variable objetivo que está tratando de predecir. * MSSubClass: la clase de construcción * MSZoning: la clasificación general de zonificación * LotFrontage: pies lineales de calle conectados a la propiedad * LotArea: Tamaño del lote en pies cuadrados * Calle: Tipo de acceso por carretera * Callejón: Tipo de acceso al callejón * LotShape: forma general de la propiedad * LandContour: Planitud de la propiedad * Utilidades: tipo de utilidades disponibles * LotConfig: configuración del lote * LandSlope: Pendiente de la propiedad * Vecindario: ubicaciones físicas dentro de los límites de la ciudad de Ames * Condition1: Proximidad a la carretera principal o al ferrocarril * Condición 2: Proximidad a la carretera principal o ferrocarril (si hay un segundo) * BldgType: Tipo de vivienda * HouseStyle: estilo de vivienda * OverallQual: Material general y calidad de acabado. * OverallCond: Calificación de estado general * YearBuilt: fecha de construcción original * YearRemodAdd: fecha de remodelación * RoofStyle: Tipo de techo * RoofMatl: material del techo * Exterior1st: Revestimiento exterior de la casa * Exterior2nd: Revestimiento exterior de la casa (si hay más de un material) * MasVnrType: tipo de chapa de mampostería * MasVnrArea: Área de revestimiento de mampostería en pies cuadrados * ExterQual: Calidad del material exterior * ExterCond: Estado actual del material en el exterior * Fundación: Tipo de fundación * BsmtQual: Altura del sótano * BsmtCond: Estado general del sótano * BsmtExposure: Paredes de sótano a nivel de jardín o de salida * BsmtFinType1: Calidad del área terminada del sótano * BsmtFinSF1: pies cuadrados terminados tipo 1 * BsmtFinType2: Calidad de la segunda área terminada (si está presente) * BsmtFinSF2: pies cuadrados con acabado tipo 2 * BsmtUnfSF: pies cuadrados sin terminar de área del sótano * TotalBsmtSF: Total de pies cuadrados de área del sótano * Calefacción: Tipo de calefacción * Calefacción QC: calidad y estado de la calefacción * CentralAir: aire acondicionado central * Eléctrico: sistema eléctrico * 1stFlrSF: pies cuadrados del primer piso * 2ndFlrSF: pies cuadrados del segundo piso * LowQualFinSF: pies cuadrados con acabado de baja calidad (todos los pisos) * GrLivArea: pies cuadrados de área habitable sobre el nivel (suelo) * BsmtFullBath: Baños completos en el sótano * BsmtHalfBath: Medios baños en el sótano * FullBath: baños completos sobre rasante * HalfBath: Medios baños sobre el nivel del suelo * Dormitorio: número de dormitorios sobre el nivel del sótano * Cocina: Número de cocinas * KitchenQual: calidad de la cocina * TotRmsAbvGrd: Total de habitaciones sobre rasante (no incluye baños) * Funcional: clasificación de funcionalidad del hogar * Chimeneas: Número de chimeneas * FireplaceQu: Calidad de chimenea * GarageType: Ubicación del garaje * GarageYrBlt: año en que se construyó el garaje * GarageFinish: Acabado interior del garaje * GarageCars: Tamaño del garaje en capacidad de automóvil * GarageArea: Tamaño del garaje en pies cuadrados * GarageQual: Calidad de garaje * GarageCond: Estado del garaje * PavedDrive: entrada pavimentada * WoodDeckSF: Área de la plataforma de madera en pies cuadrados * OpenPorchSF: Área de porche abierto en pies cuadrados * Porche cerrado: área de porche cerrado en pies cuadrados * 3SsnPorch: Área de porche de tres estaciones en pies cuadrados * ScreenPorch: área del porche de la pantalla en pies cuadrados * PoolArea: Área de la piscina en pies cuadrados * PoolQC: Calidad de la piscina * Valla: calidad de la valla * MiscFeature: característica miscelánea no cubierta en otras categorías * MiscVal: $ Valor de la función miscelánea * MoSold: Mes vendido * YrSold: año vendido * SaleType: Tipo de venta * SaleCondition: Condición de venta

1.2 Cargar los datos

En esté proyecto tenemos como objetivo predecir el *SalePrice* de una casa, que está en función de las variables:

[2]:
```
df_train = pd.read_csv('Data/train.csv', sep = ',')
df_test = pd.read_csv('Data/test.csv', sep = ',')
print(df_train.columns.values)
```

```
['Id' 'MSSubClass' 'MSZoning' 'LotFrontage' 'LotArea' 'Street' 'Alley'
 'LotShape' 'LandContour' 'Utilities' 'LotConfig' 'LandSlope'
 'Neighborhood' 'Condition1' 'Condition2' 'BldgType' 'HouseStyle'
 'OverallQual' 'OverallCond' 'YearBuilt' 'YearRemodAdd' 'RoofStyle'
 'RoofMatl' 'Exterior1st' 'Exterior2nd' 'MasVnrType' 'MasVnrArea'
 'ExterQual' 'ExterCond' 'Foundation' 'BsmtQual' 'BsmtCond' 'BsmtExposure'
 'BsmtFinType1' 'BsmtFinSF1' 'BsmtFinType2' 'BsmtFinSF2' 'BsmtUnfSF'
 'TotalBsmtSF' 'Heating' 'HeatingQC' 'CentralAir' 'Electrical' '1stFlrSF'
 '2ndFlrSF' 'LowQualFinSF' 'GrLivArea' 'BsmtFullBath' 'BsmtHalfBath'
 'FullBath' 'HalfBath' 'BedroomAbvGr' 'KitchenAbvGr' 'KitchenQual'
 'TotRmsAbvGrd' 'Functional' 'Fireplaces' 'FireplaceQu' 'GarageType'
 'GarageYrBlt' 'GarageFinish' 'GarageCars' 'GarageArea' 'GarageQual'
 'GarageCond' 'PavedDrive' 'WoodDeckSF' 'OpenPorchSF' 'EnclosedPorch'
 '3SsnPorch' 'ScreenPorch' 'PoolArea' 'PoolQC' 'Fence' 'MiscFeature'
 'MiscVal' 'MoSold' 'YrSold' 'SaleType' 'SaleCondition' 'SalePrice']
```

[3]:
```
print(df_test.columns.values)
```

```
['Id' 'MSSubClass' 'MSZoning' 'LotFrontage' 'LotArea' 'Street' 'Alley'
 'LotShape' 'LandContour' 'Utilities' 'LotConfig' 'LandSlope'
 'Neighborhood' 'Condition1' 'Condition2' 'BldgType' 'HouseStyle'
 'OverallQual' 'OverallCond' 'YearBuilt' 'YearRemodAdd' 'RoofStyle'
 'RoofMatl' 'Exterior1st' 'Exterior2nd' 'MasVnrType' 'MasVnrArea'
 'ExterQual' 'ExterCond' 'Foundation' 'BsmtQual' 'BsmtCond' 'BsmtExposure'
 'BsmtFinType1' 'BsmtFinSF1' 'BsmtFinType2' 'BsmtFinSF2' 'BsmtUnfSF'
 'TotalBsmtSF' 'Heating' 'HeatingQC' 'CentralAir' 'Electrical' '1stFlrSF'
 '2ndFlrSF' 'LowQualFinSF' 'GrLivArea' 'BsmtFullBath' 'BsmtHalfBath'
 'FullBath' 'HalfBath' 'BedroomAbvGr' 'KitchenAbvGr' 'KitchenQual'
 'TotRmsAbvGrd' 'Functional' 'Fireplaces' 'FireplaceQu' 'GarageType'
 'GarageYrBlt' 'GarageFinish' 'GarageCars' 'GarageArea' 'GarageQual'
 'GarageCond' 'PavedDrive' 'WoodDeckSF' 'OpenPorchSF' 'EnclosedPorch'
 '3SsnPorch' 'ScreenPorch' 'PoolArea' 'PoolQC' 'Fence' 'MiscFeature'
 'MiscVal' 'MoSold' 'YrSold' 'SaleType' 'SaleCondition']
```

Donde, cada varibale cuenta con la siguiente cantidad de registros:

[4]:
```
valores = df_train.columns.values
for i in range(80):
    print(str(valores[i]) + ": " + str(len(df_train[valores[i]])))
```

```
Id: 1460
MSSubClass: 1460
MSZoning: 1460
LotFrontage: 1460
LotArea: 1460
```

```
Street: 1460
Alley: 1460
LotShape: 1460
LandContour: 1460
Utilities: 1460
LotConfig: 1460
LandSlope: 1460
Neighborhood: 1460
Condition1: 1460
Condition2: 1460
BldgType: 1460
HouseStyle: 1460
OverallQual: 1460
OverallCond: 1460
YearBuilt: 1460
YearRemodAdd: 1460
RoofStyle: 1460
RoofMatl: 1460
Exterior1st: 1460
Exterior2nd: 1460
MasVnrType: 1460
MasVnrArea: 1460
ExterQual: 1460
ExterCond: 1460
Foundation: 1460
BsmtQual: 1460
BsmtCond: 1460
BsmtExposure: 1460
BsmtFinType1: 1460
BsmtFinSF1: 1460
BsmtFinType2: 1460
BsmtFinSF2: 1460
BsmtUnfSF: 1460
TotalBsmtSF: 1460
Heating: 1460
HeatingQC: 1460
CentralAir: 1460
Electrical: 1460
1stFlrSF: 1460
2ndFlrSF: 1460
LowQualFinSF: 1460
GrLivArea: 1460
BsmtFullBath: 1460
BsmtHalfBath: 1460
FullBath: 1460
HalfBath: 1460
BedroomAbvGr: 1460
KitchenAbvGr: 1460
```

```
KitchenQual: 1460
TotRmsAbvGrd: 1460
Functional: 1460
Fireplaces: 1460
FireplaceQu: 1460
GarageType: 1460
GarageYrBlt: 1460
GarageFinish: 1460
GarageCars: 1460
GarageArea: 1460
GarageQual: 1460
GarageCond: 1460
PavedDrive: 1460
WoodDeckSF: 1460
OpenPorchSF: 1460
EnclosedPorch: 1460
3SsnPorch: 1460
ScreenPorch: 1460
PoolArea: 1460
PoolQC: 1460
Fence: 1460
MiscFeature: 1460
MiscVal: 1460
MoSold: 1460
YrSold: 1460
SaleType: 1460
SaleCondition: 1460
```

[5]:
```
print(df_train.shape)
```

```
(1460, 81)
```

Ahora veamos nuestra tabla de entrenamiento

[6]:
```
df_train.head(10)
```

[6]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	\
0	1	60	RL	65.0	8450	Pave	NaN	Reg	
1	2	20	RL	80.0	9600	Pave	NaN	Reg	
2	3	60	RL	68.0	11250	Pave	NaN	IR1	
3	4	70	RL	60.0	9550	Pave	NaN	IR1	
4	5	60	RL	84.0	14260	Pave	NaN	IR1	
5	6	50	RL	85.0	14115	Pave	NaN	IR1	
6	7	20	RL	75.0	10084	Pave	NaN	Reg	
7	8	60	RL	NaN	10382	Pave	NaN	IR1	
8	9	50	RM	51.0	6120	Pave	NaN	Reg	
9	10	190	RL	50.0	7420	Pave	NaN	Reg	

```
  LandContour Utilities  … PoolArea PoolQC  Fence MiscFeature MiscVal  \
0         Lvl    AllPub  …        0    NaN    NaN         NaN       0
1         Lvl    AllPub  …        0    NaN    NaN         NaN       0
2         Lvl    AllPub  …        0    NaN    NaN         NaN       0
3         Lvl    AllPub  …        0    NaN    NaN         NaN       0
4         Lvl    AllPub  …        0    NaN    NaN         NaN       0
5         Lvl    AllPub  …        0    NaN  MnPrv        Shed     700
6         Lvl    AllPub  …        0    NaN    NaN         NaN       0
7         Lvl    AllPub  …        0    NaN    NaN        Shed     350
8         Lvl    AllPub  …        0    NaN    NaN         NaN       0
9         Lvl    AllPub  …        0    NaN    NaN         NaN       0

  MoSold YrSold  SaleType  SaleCondition  SalePrice
0      2   2008        WD         Normal     208500
1      5   2007        WD         Normal     181500
2      9   2008        WD         Normal     223500
3      2   2006        WD        Abnorml     140000
4     12   2008        WD         Normal     250000
5     10   2009        WD         Normal     143000
6      8   2007        WD         Normal     307000
7     11   2009        WD         Normal     200000
8      4   2008        WD        Abnorml     129900
9      1   2008        WD         Normal     118000

[10 rows x 81 columns]
```

y la tabla de prueba

[7]:
```
df_test.head(10)
```

[7]:
```
     Id  MSSubClass MSZoning  LotFrontage  LotArea Street Alley LotShape  \
0  1461          20       RH         80.0    11622   Pave   NaN      Reg
1  1462          20       RL         81.0    14267   Pave   NaN      IR1
2  1463          60       RL         74.0    13830   Pave   NaN      IR1
3  1464          60       RL         78.0     9978   Pave   NaN      IR1
4  1465         120       RL         43.0     5005   Pave   NaN      IR1
5  1466          60       RL         75.0    10000   Pave   NaN      IR1
6  1467          20       RL          NaN     7980   Pave   NaN      IR1
7  1468          60       RL         63.0     8402   Pave   NaN      IR1
8  1469          20       RL         85.0    10176   Pave   NaN      Reg
9  1470          20       RL         70.0     8400   Pave   NaN      Reg

  LandContour Utilities  … ScreenPorch PoolArea PoolQC  Fence MiscFeature  \
0         Lvl    AllPub  …         120        0    NaN  MnPrv         NaN
1         Lvl    AllPub  …           0        0    NaN    NaN        Gar2
2         Lvl    AllPub  …           0        0    NaN  MnPrv         NaN
3         Lvl    AllPub  …           0        0    NaN    NaN         NaN
4         HLS    AllPub  …         144        0    NaN    NaN         NaN
```

```
5         Lvl    AllPub  …           0        0    NaN    NaN         NaN
6         Lvl    AllPub  …           0        0    NaN  GdPrv        Shed
7         Lvl    AllPub  …           0        0    NaN    NaN         NaN
8         Lvl    AllPub  …           0        0    NaN    NaN         NaN
9         Lvl    AllPub  …           0        0    NaN  MnPrv         NaN

  MiscVal MoSold  YrSold  SaleType  SaleCondition
0       0      6    2010        WD         Normal
1   12500      6    2010        WD         Normal
2       0      3    2010        WD         Normal
3       0      6    2010        WD         Normal
4       0      1    2010        WD         Normal
5       0      4    2010        WD         Normal
6     500      3    2010        WD         Normal
7       0      5    2010        WD         Normal
8       0      2    2010        WD         Normal
9       0      4    2010        WD         Normal

[10 rows x 80 columns]
```

Mientras que la tabla de prueba cuenta con la siguiente cantidad de ejercicios:

[8]:
```
print(df_test.shape)
```

```
(1459, 80)
```

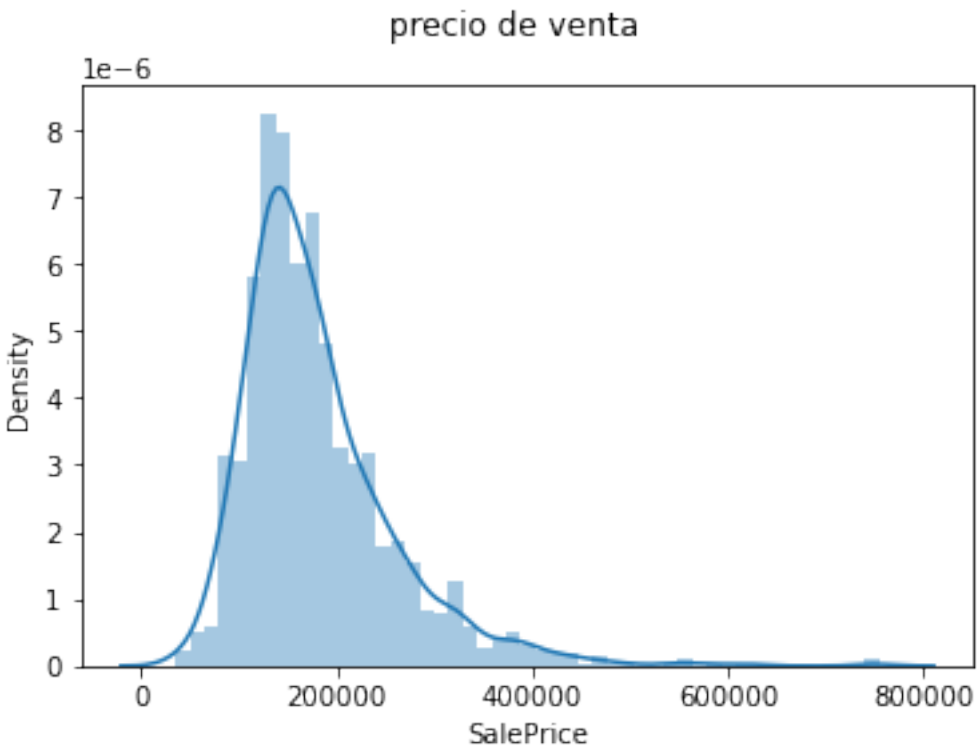
1.3 Objetivo

A partir de 79 variables independientes bucaremos predecir la variable dependiente *SalePrice*, las variables de entrada describen (casi) todos los aspectos de las viviendas residenciales en Ames y Iowa.

Visualicemos la variable objetivo

[9]:
```
sns.distplot(df_train['SalePrice'])

plt.suptitle( "precio de venta")

print("Skewness: %f" % df_train['SalePrice'].skew())
print("Kurtosis: %f" % df_train['SalePrice'].kurt())
```

```
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\seaborn\distributions.py:2557: 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)

Skewness: 1.882876
Kurtosis: 6.536282
```



Como una primer intuición uno pensaría que tiene una distribución normal, pero observemos que tiene colas pesadas, esto tambien nos hace pensar que tiene datos atipicos, lo cual se analizara mas adelante, primero veamos si es cierto que tiene una distribución normal, para esto ocuparemos el test de Jarque-Bera y Shapiro.

[10]:
```
# Jarque-Bera
# ========================================

x = df_train['SalePrice'].values
x_size = len(x)

# estadisticas
x_mean = np.mean(x)
x_std = np.std(x)
x_skew = skew(x)
x_kurt = kurtosis(x)
x_var_95 = np.percentile(x,5)
x_cvar_95 = np.mean(x[x <= x_var_95])
jb = x_size/6*(x_skew**2 + 1/4*x_kurt**2)
p_value = 1 - chi2.cdf(jb, df=2)
is_normal = (p_value > 0.05) # equivalentemente jb < 6
```

[11]:
```
is_normal
```

[11]: False

[12]:
```
# Shapiro-Wilk
# ========================================
shapiro_test = stats.shapiro(x)
shapiro_test
```

[12]: ShapiroResult(statistic=0.869671642780304, pvalue=3.206247534576162e-33)

Por lo tanto no se distribuye normal.

Peroooo,podemos aplicar una transformación de registro para corregir el sesgo positivo en los datos, tomar registros significa que los errores en la predicción de casas caras y baratas afectarán el resultado por igual

[13]:
```
df_train['SalePrice'] = np.log(df_train['SalePrice'])
plt.suptitle("Plot of Sale Price after log transformation")
sns.distplot(df_train['SalePrice'])
plt.show()
```

```
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\seaborn\distributions.py:2557: 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)
```

[14]:
```
x = df_train['SalePrice'].values
x_size = len(x)

# estadisticas
x_mean = np.mean(x)
x_std = np.std(x)
x_skew = skew(x)
x_kurt = kurtosis(x)
x_var_95 = np.percentile(x,5)
x_cvar_95 = np.mean(x[x <= x_var_95])
jb = x_size/6*(x_skew**2 + 1/4*x_kurt**2)
p_value = 1 - chi2.cdf(jb, df=2)
is_normal = (p_value > 0.05) # equivalentemente jb < 6
```

[15]:
```
is_normal
```

[15]:
```
False
```

1.4 Estadisticas descriptivas

A partir de esté momento solo trabajaremos con la tabla *train_df*. Primero analisemos nuestra variable objetivo

[16]:
```
df_train['SalePrice'].describe()
```

[16]:
```
count    1460.000000
mean       12.024051
std         0.399452
min        10.460242
25%        11.775097
50%        12.001505
75%        12.273731
max        13.534473
Name: SalePrice, dtype: float64
```

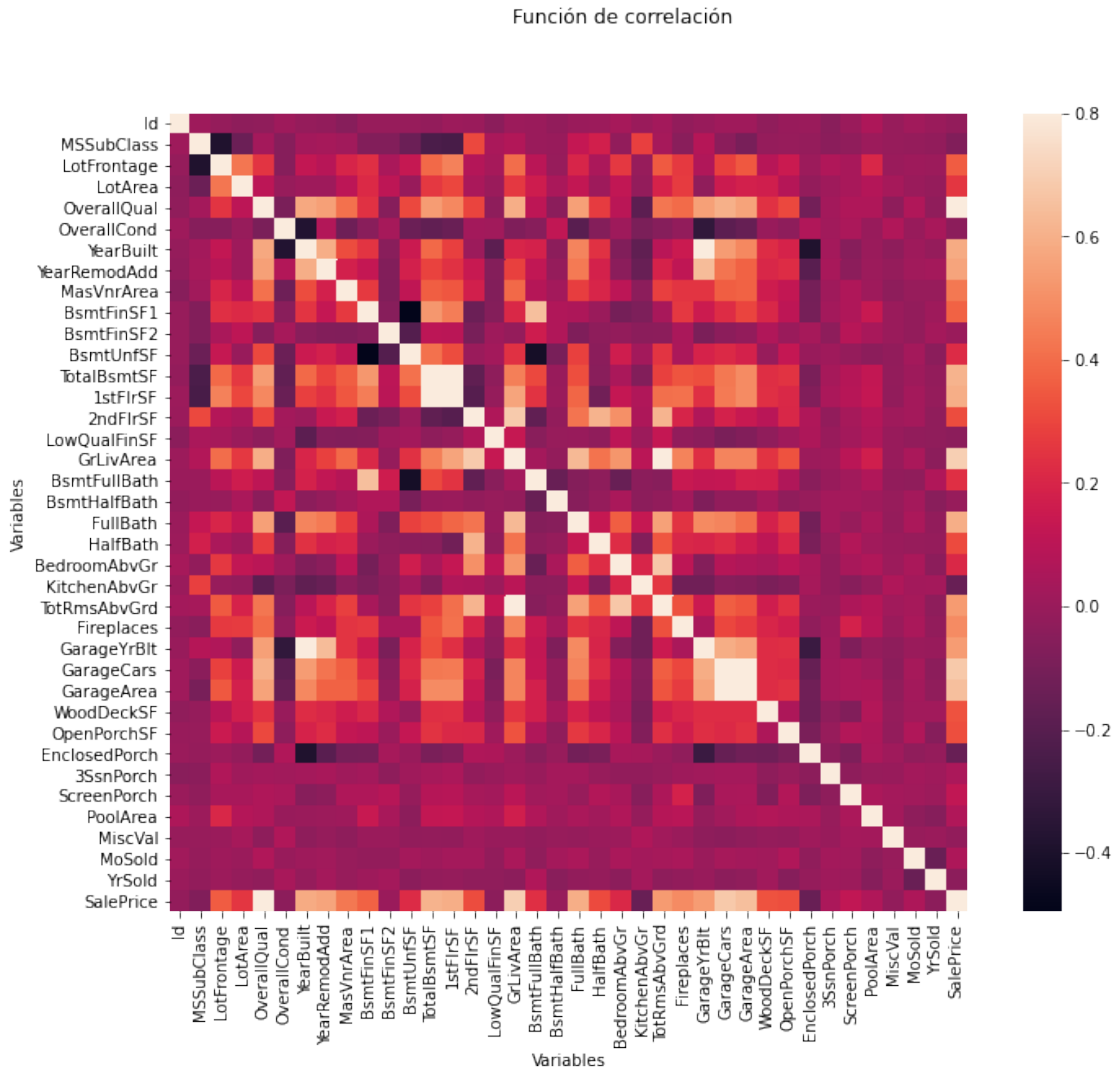
Notemos que de lo anterior, la media de *SalesPrice* es *180921.195890*, el maximo *755000* y el minimo *755000*. Lo anterior nos hace pensar que hay valores atipicos, es decir, existen algunas casas que tienen un precio demasiado elevado.

Lo siguiente es identificar las variables que tienen una mayor correlación entre ellas, esto nos permite o nos va a permitir selecciónar variables para nuestro(s) modelo(s).

[17]:
```
corr_mat = df_train.corr()
f, ax = plt.subplots(figsize=(12, 9))

sns.heatmap(corr_mat, vmax=.8,square=True)
```

```
plt.suptitle("Función de correlación")
plt.xlabel("Variables")
plt.ylabel("Variables")
```

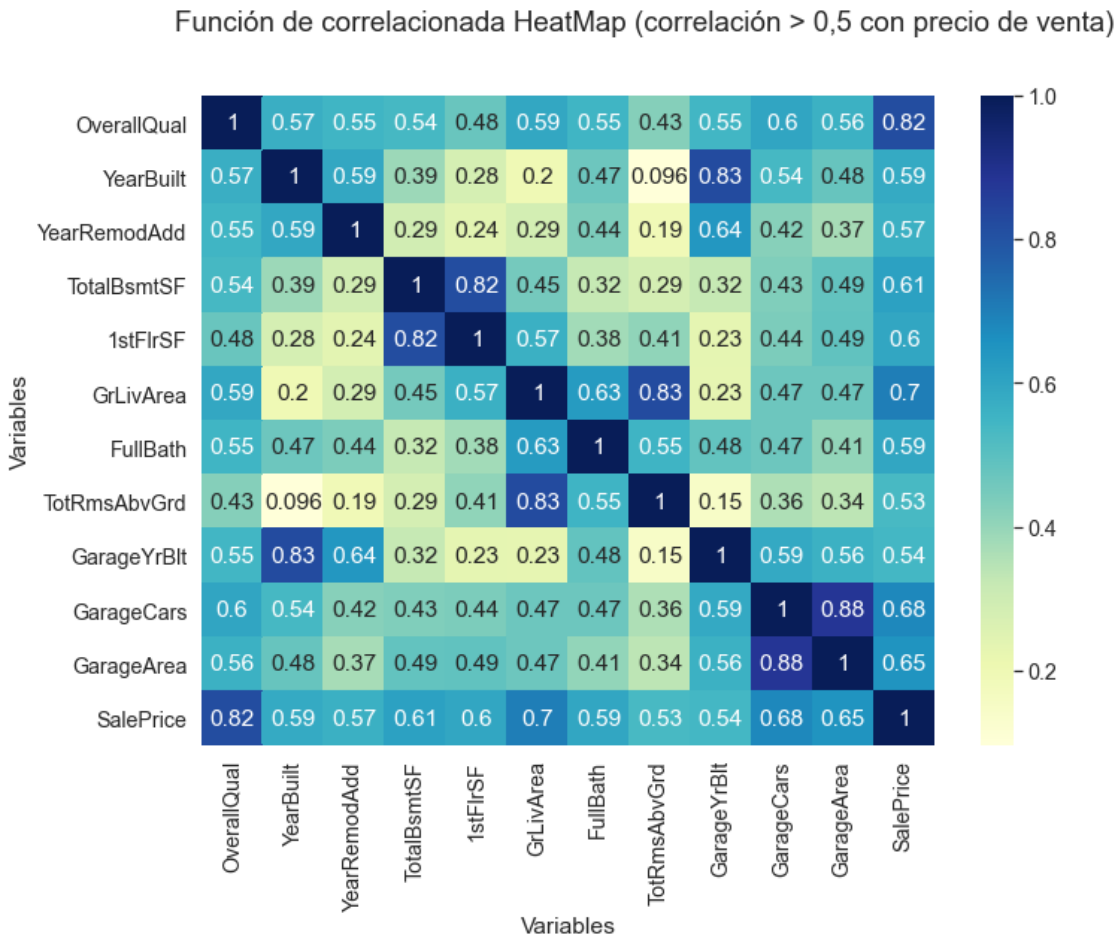
[17]: Text(133.44000000000005, 0.5, 'Variables')



[18]:
```
corr_mat = df_train.corr()

sns.set(font_scale = 1.3)
plt.figure(figsize = (11,8))

top_corr = corr_mat.index[abs(corr_mat["SalePrice"])>0.5]
g = sns.heatmap(df_train[top_corr].corr(),annot=True,cmap="YlGnBu")
```

```
plt.suptitle("Función de correlacionada HeatMap (correlación > 0,5 con precio␣
 ↪de venta)")
plt.xlabel("Variables")
plt.ylabel("Variables")
```

[18]:
```
Text(71.5, 0.5, 'Variables')
```



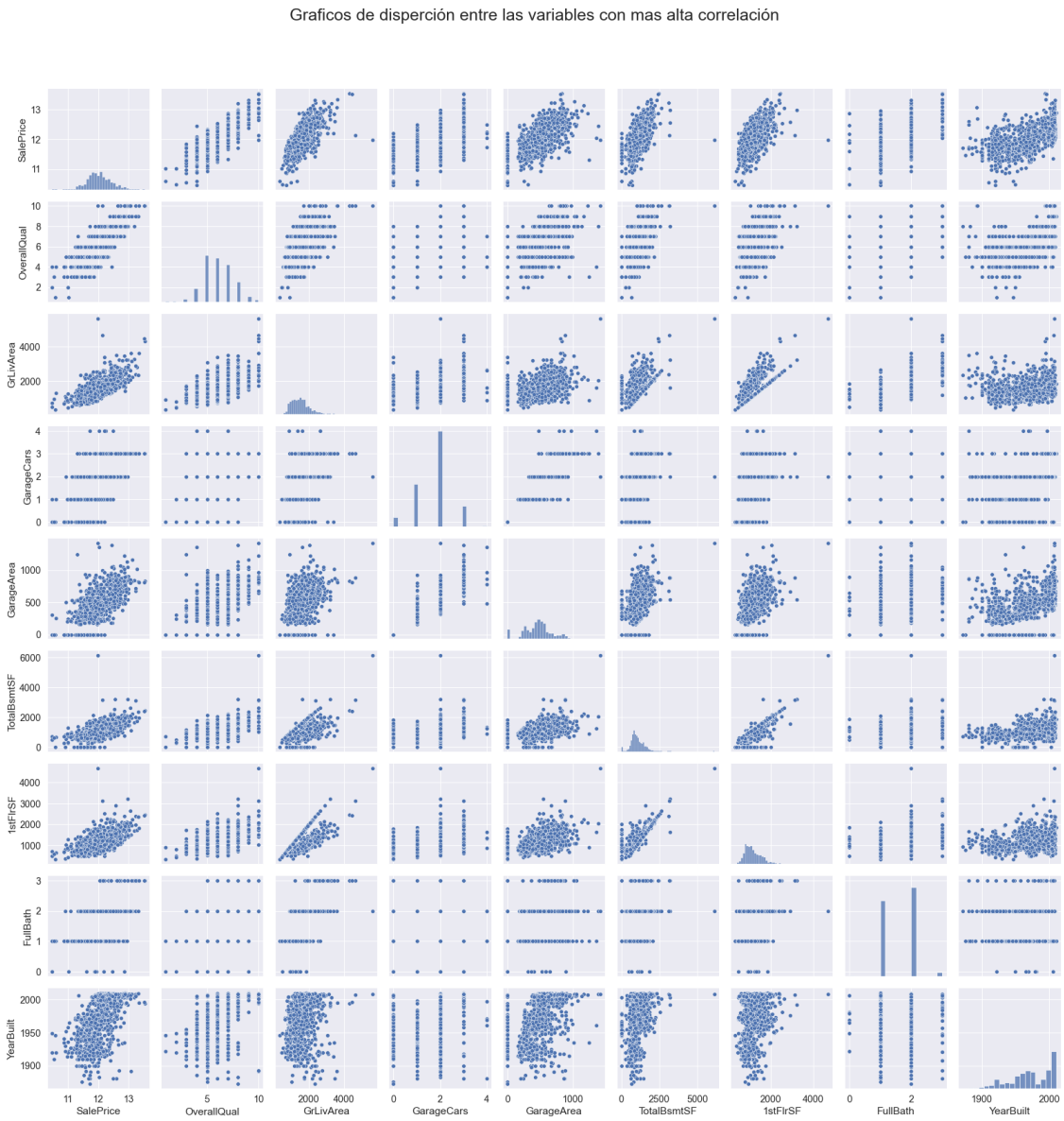
Ahora visualicemos aquellas variables que no tienen una alta correlación.

[19]:
```
print("valores de correlación")

corr = df_train.corr().drop('SalePrice')
corr.sort_values(["SalePrice"], ascending = False, inplace = True)
print(corr.SalePrice)
```

```
valores de correlación
OverallQual      0.817184
GrLivArea        0.700927
GarageCars       0.680625
```

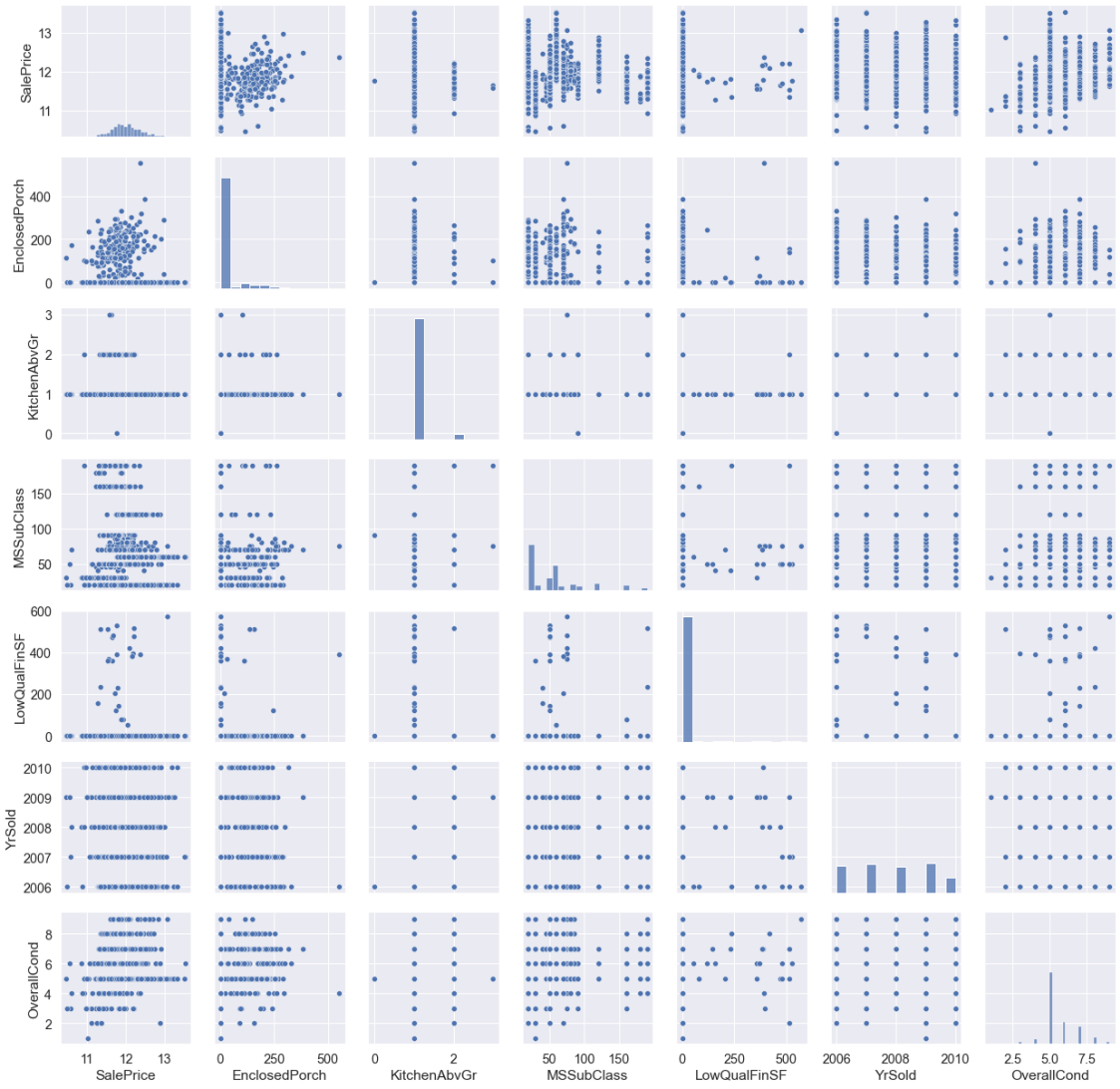
```
GarageArea       0.650888
TotalBsmtSF      0.612134
1stFlrSF         0.596981
FullBath         0.594771
YearBuilt        0.586570
YearRemodAdd     0.565608
GarageYrBlt      0.541073
TotRmsAbvGrd     0.534422
Fireplaces       0.489449
MasVnrArea       0.430809
BsmtFinSF1       0.372023
LotFrontage      0.355878
WoodDeckSF       0.334135
OpenPorchSF      0.321053
2ndFlrSF         0.319300
HalfBath         0.313982
LotArea          0.257320
BsmtFullBath     0.236224
BsmtUnfSF        0.221985
BedroomAbvGr     0.209044
ScreenPorch      0.121208
PoolArea         0.069798
MoSold           0.057329
3SsnPorch        0.054900
BsmtFinSF2       0.004832
BsmtHalfBath    -0.005149
Id              -0.017942
MiscVal         -0.020021
OverallCond     -0.036868
YrSold          -0.037263
LowQualFinSF    -0.037963
MSSubClass      -0.073959
KitchenAbvGr    -0.147548
EnclosedPorch   -0.149050
Name: SalePrice, dtype: float64
```

[20]:
```
rcParams['figure.figsize'] = 5,5
cols = ['SalePrice', 'OverallQual', 'GrLivArea', 'GarageCars','GarageArea',␣
 ↪'TotalBsmtSF','1stFlrSF','FullBath','YearBuilt']
sns_plot = sns.pairplot(df_train[cols])

plt.suptitle('Graficos de disperción entre las variables con mas alta␣
 ↪correlación', y=1.04, size=25)
plt.tight_layout()
plt.show()
```



[21]:
```
rcParams['figure.figsize'] = 5,5
cols = ['SalePrice','EnclosedPorch', 'KitchenAbvGr', 'MSSubClass',␣
 ↪'LowQualFinSF','YrSold', 'OverallCond']
sns_plot = sns.pairplot(df_train[cols])

plt.suptitle('Graficos de disperción entre las variables con baja correlación',␣
 ↪y=1.04, size=20)
plt.tight_layout()
plt.show()
```

Graficos de disperción entre las variables con baja correlación



1.5 Analisis de valores atipicos

Como se menciono anteriormente, puede ser que existan datos atipicos, ya que hay precios de casas que están por encima de la media, para esto, realizaremos el siguiente analisis. Para esto quitaremos la variable *ID* ya que no aporta información relevante.

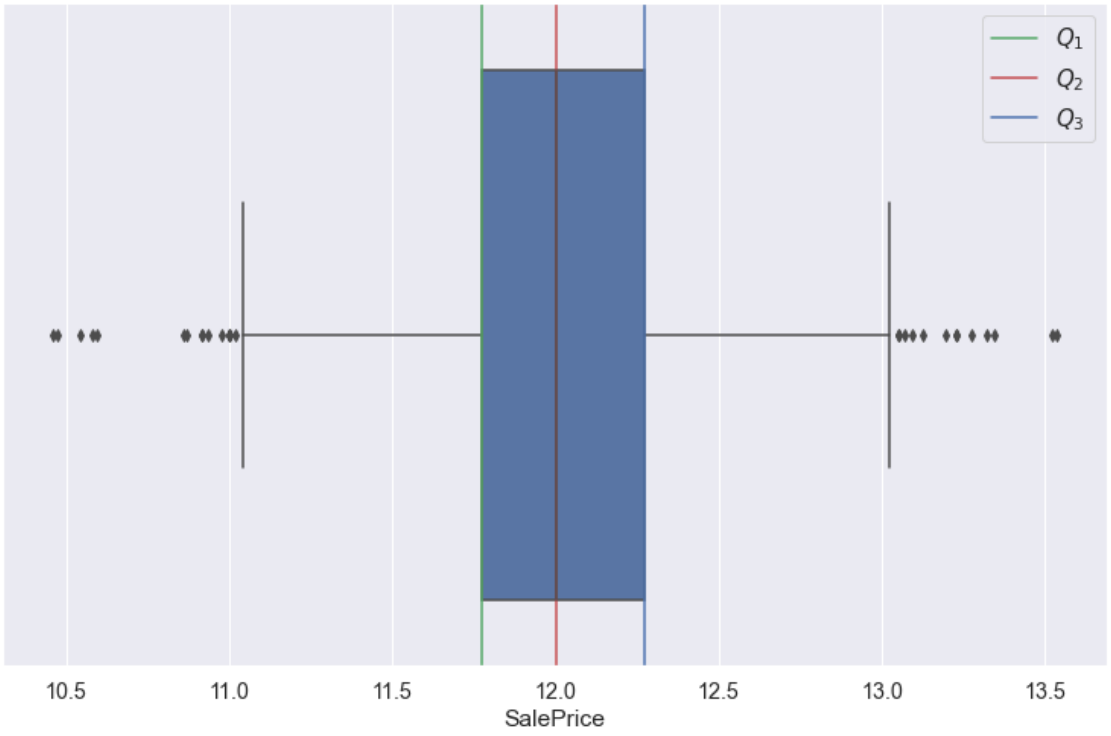
[22]:
```
#id será eliminado, ya que no es necesario para el entrenamiento o la predicción
train_ID = df_train['Id']
test_ID = df_test['Id']

df_train.drop(['Id'], axis=1, inplace=True)
```

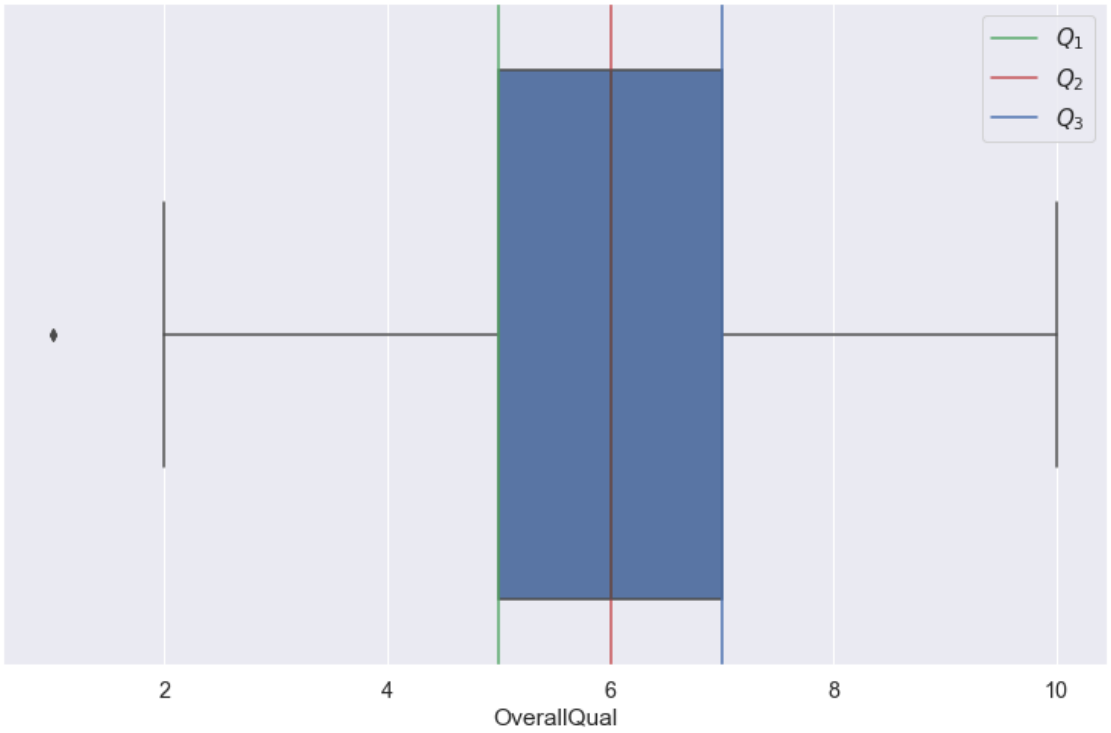
```
df_test.drop(['Id'], axis=1, inplace=True)

df_train.shape, df_test.shape
```

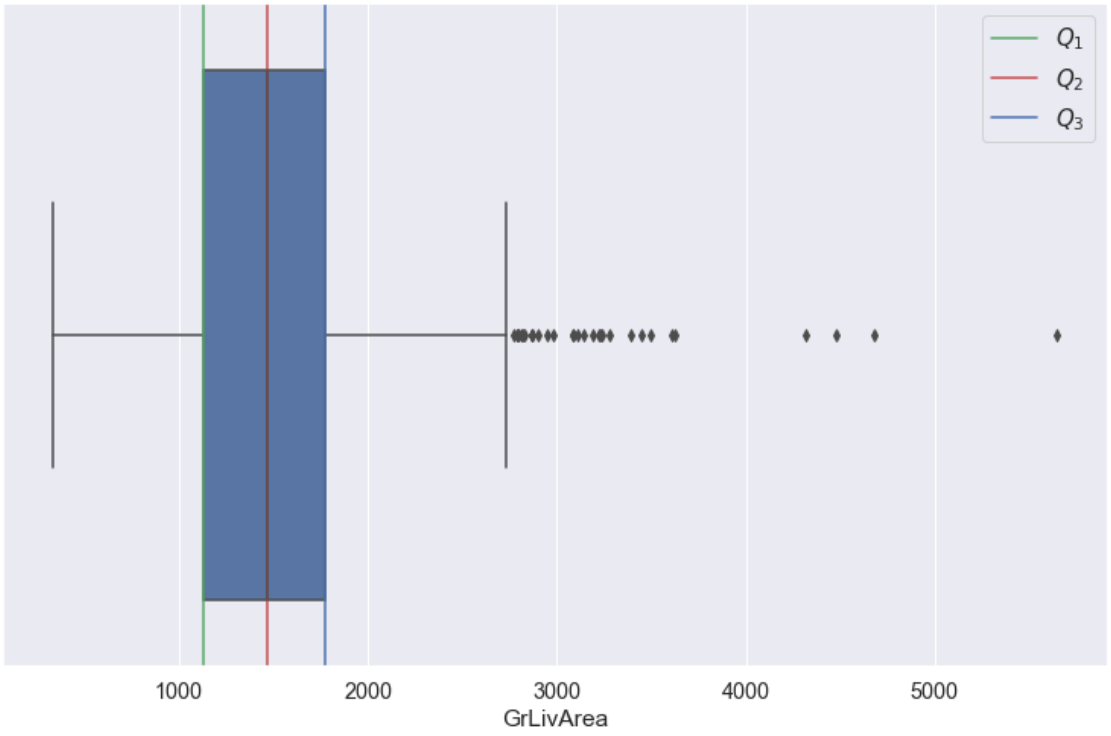
[22]: ((1460, 80), (1459, 79))

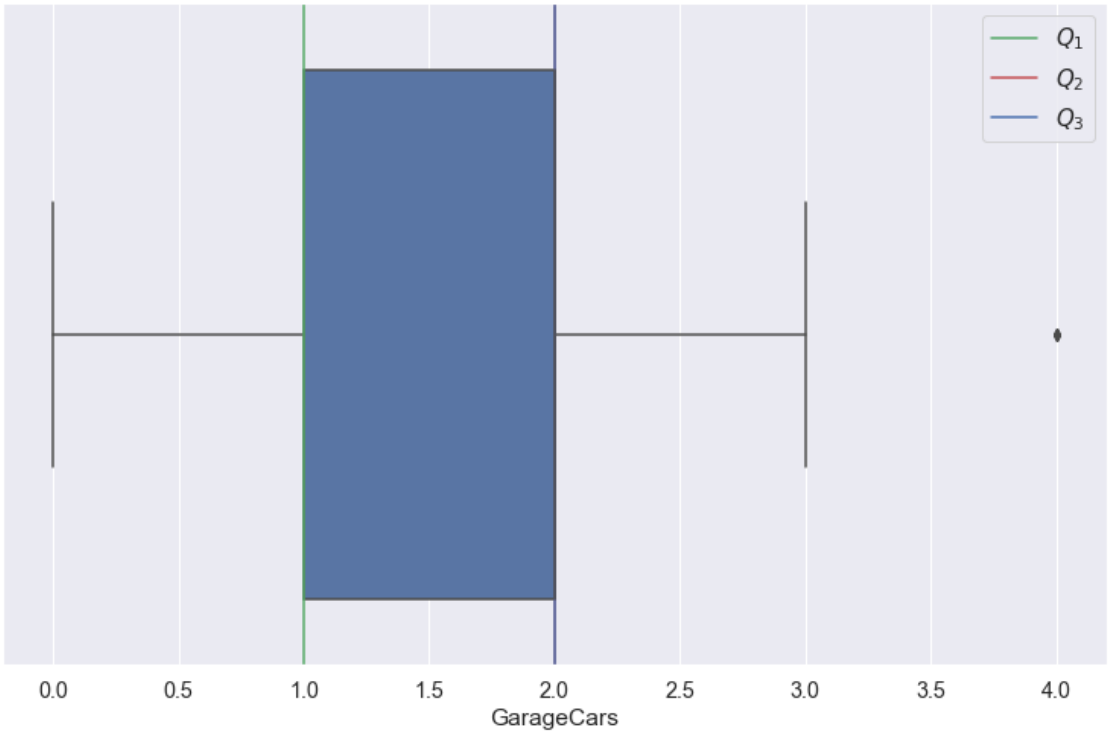
Ahora nos auxiliaremos de metodos graficos para identidicar que variables tienen datos atipicos

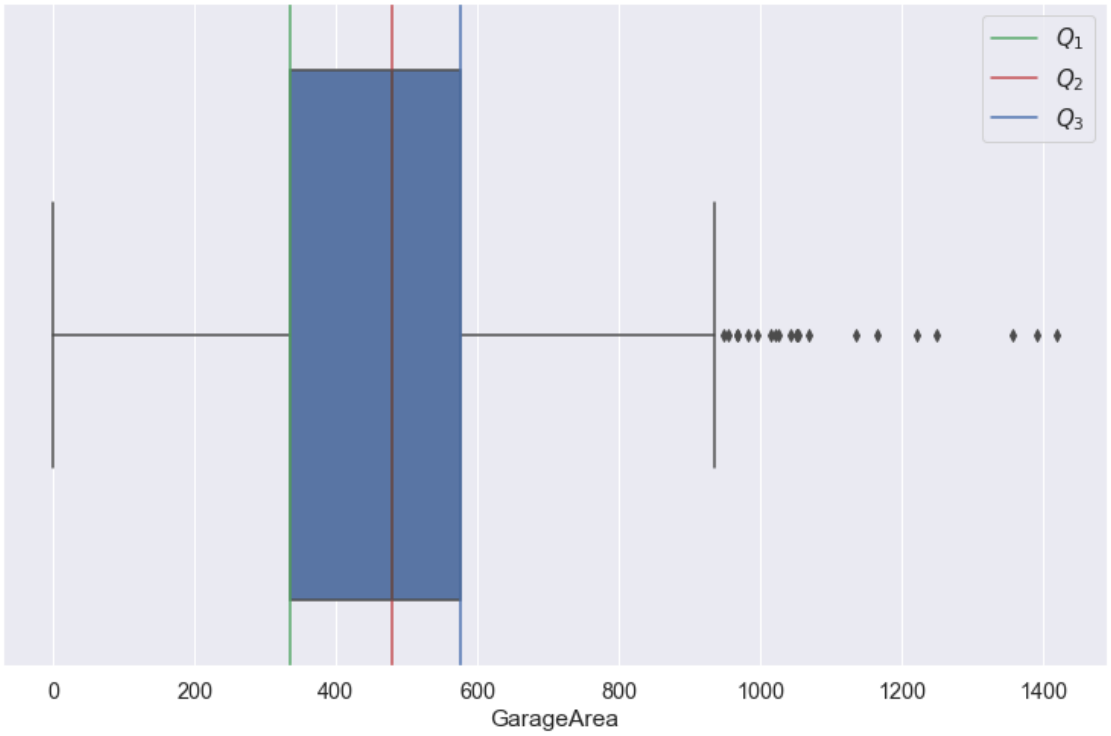
[23]:
```
cols = ['SalePrice', 'OverallQual', 'GrLivArea', 'GarageCars','GarageArea',␣
 ↪'TotalBsmtSF','1stFlrSF','FullBath','YearBuilt']

for i in cols:
    fig, ax = plt.subplots(figsize = (13, 8))

    sns.boxplot(x = df_train[i], ax = ax)
    ax.axvline(np.percentile(df_train[i], 25), color = 'g', label = '$Q_1$')
    ax.axvline(np.percentile(df_train[i], 50), color = 'r', label = '$Q_2$')
    ax.axvline(np.percentile(df_train[i], 75), color = 'b', label = '$Q_3$')
    ax.legend(prop = {'size' : 15});
```

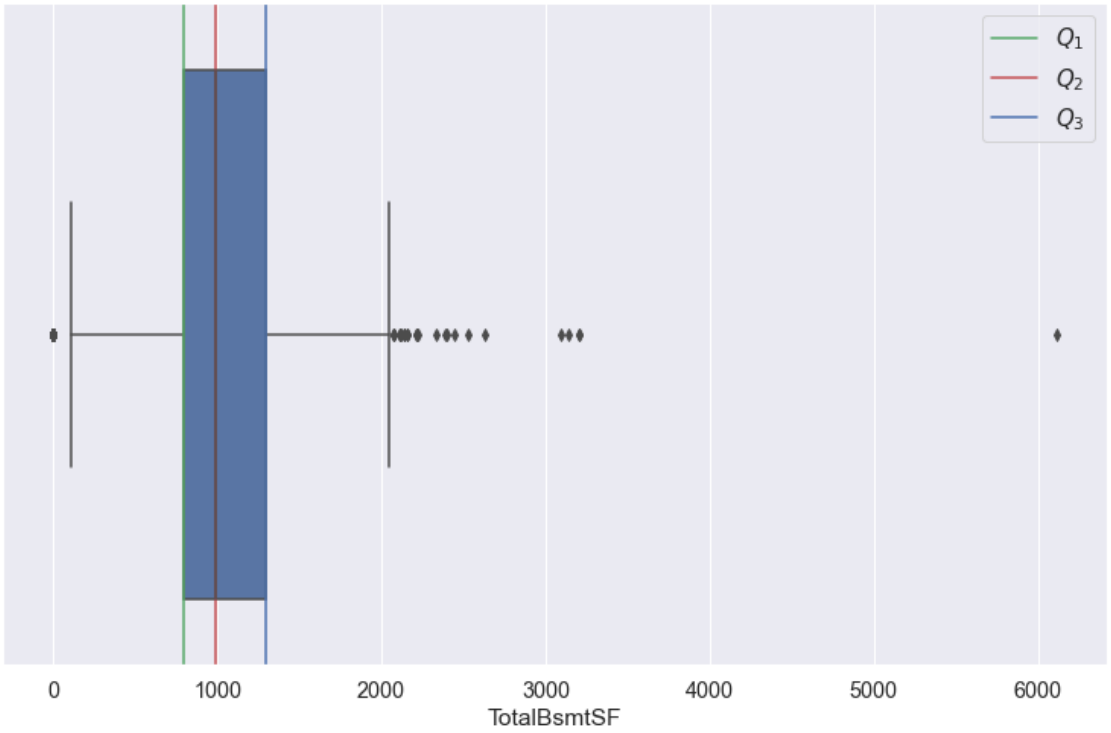


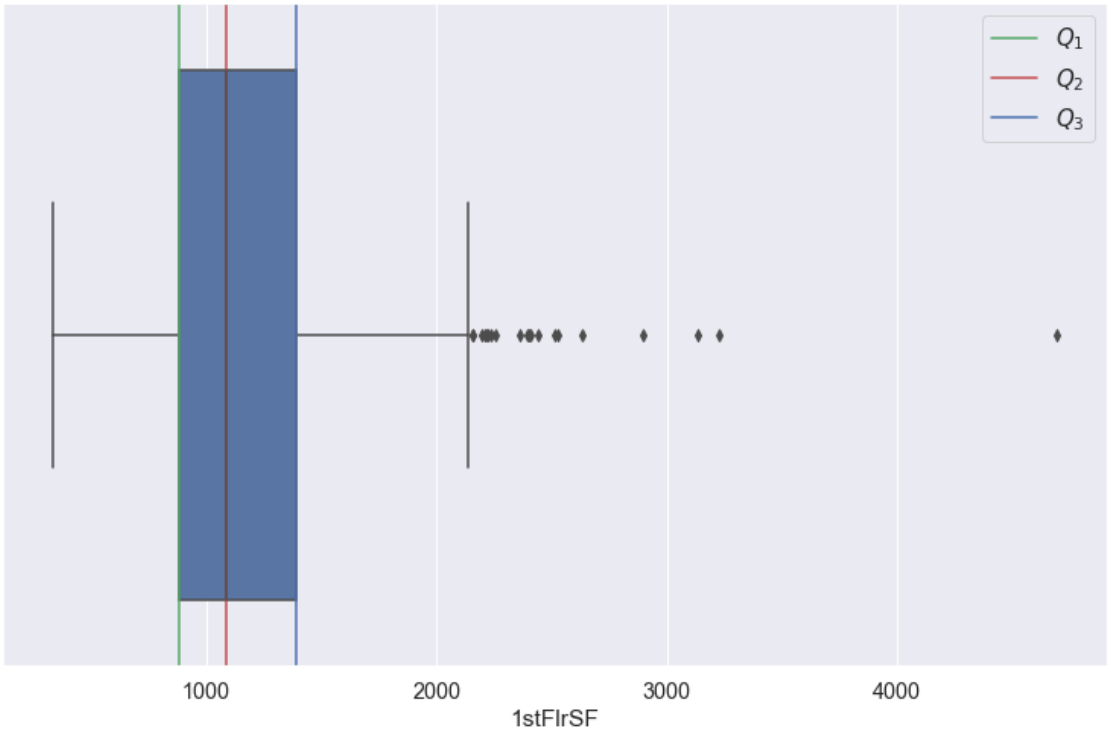

Q_1
Q_2
Q_3
2
4
6
8
10
OverallQual

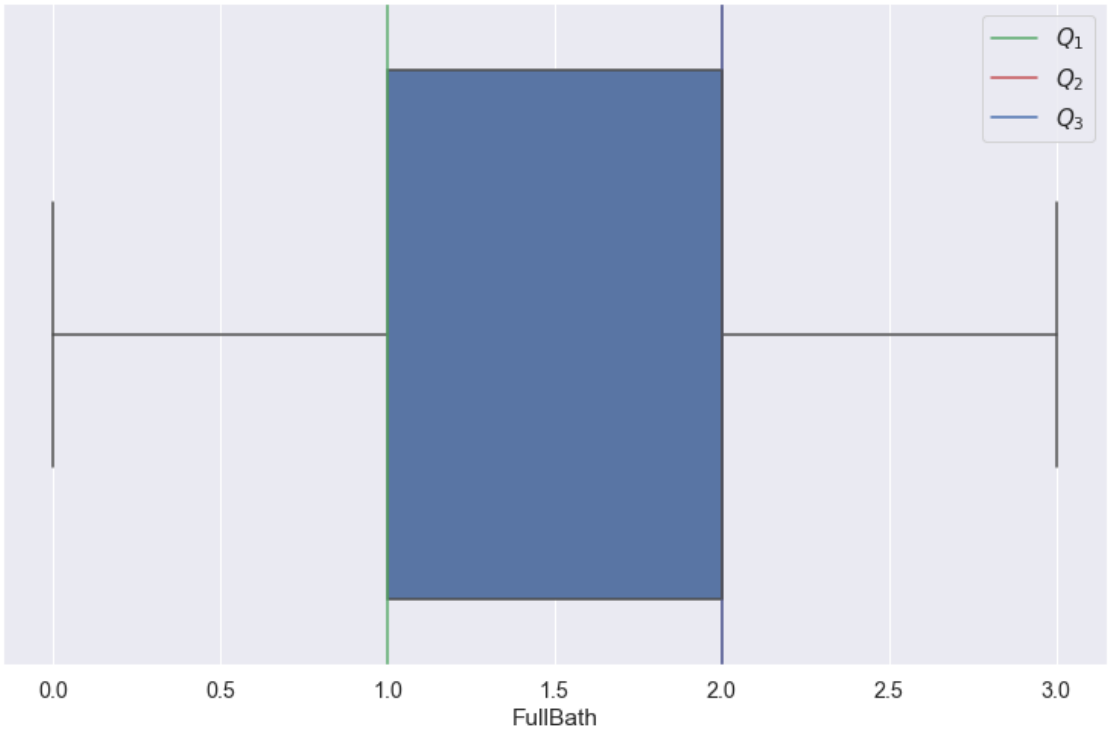

Q_1
Q_2
Q_3
1000
2000
3000
4000
5000
GrLivArea

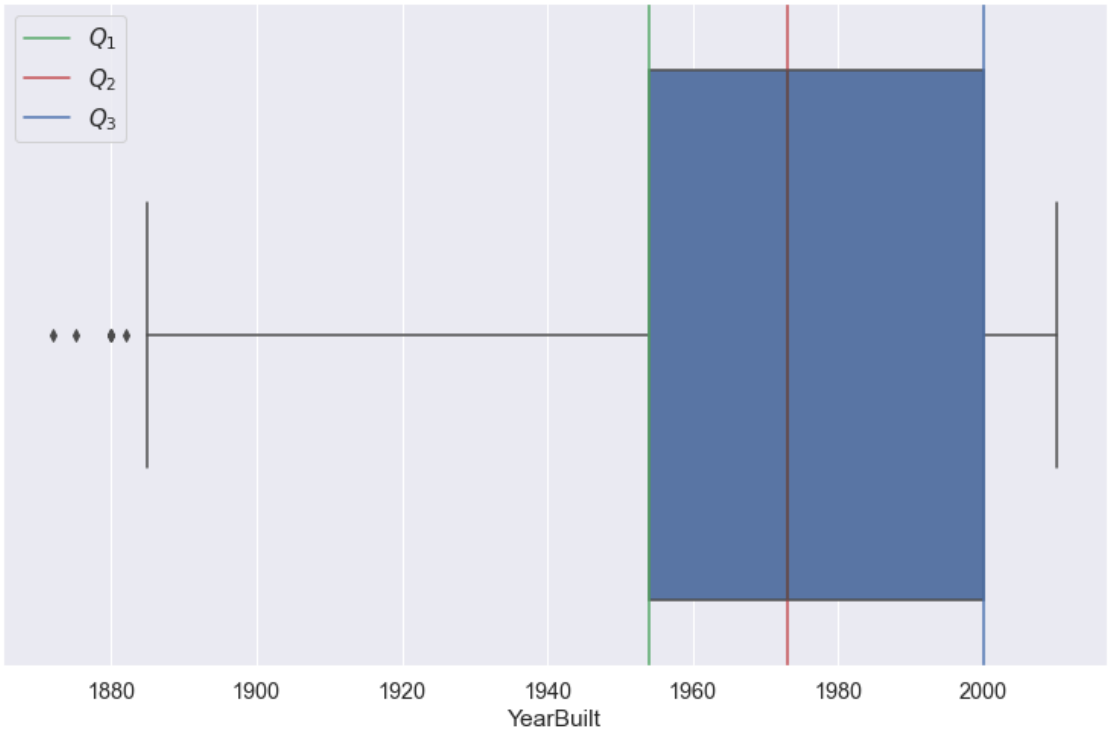

Q_1
Q_2
Q_3
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
GarageCars


Q_1
Q_2
Q_3
0
200
400
600
800
1000
1200
1400
GarageArea


Q_1
Q_2
Q_3
0
1000
2000
3000
4000
5000
6000
TotalBsmtSF


Q_1
Q_2
Q_3
1000
2000
3000
4000
1stFlrSF

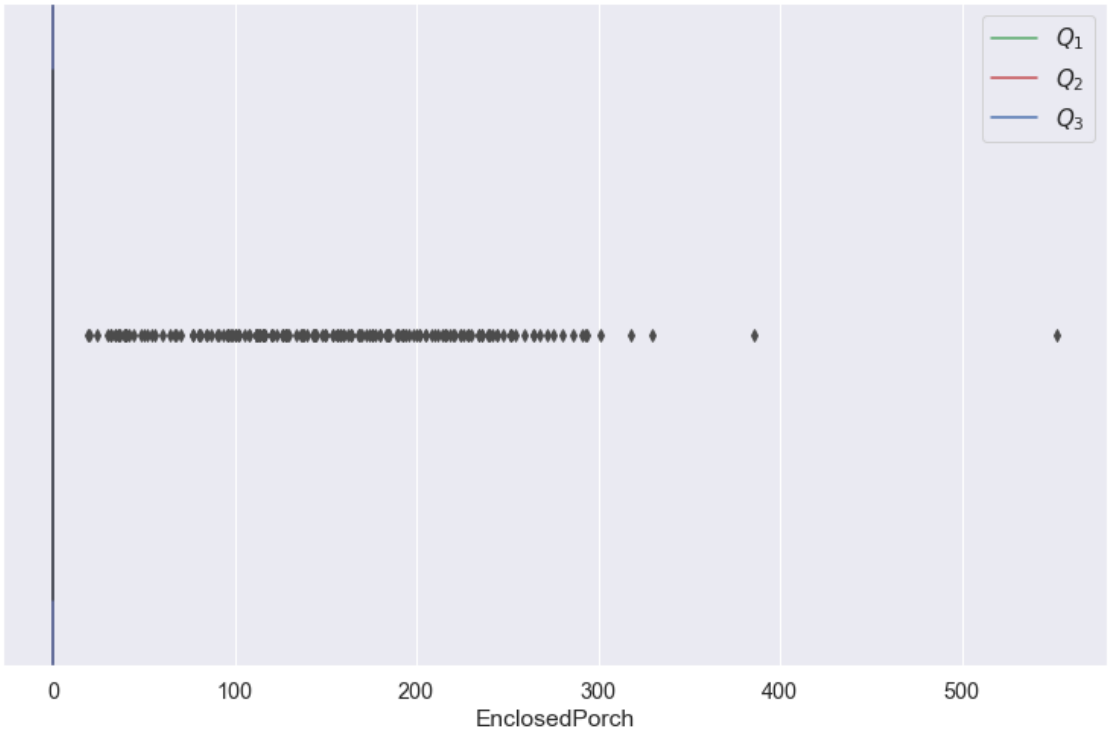

Q_1
Q_2
Q_3
0.0
0.5
1.0
1.5
2.0
2.5
3.0
FullBath

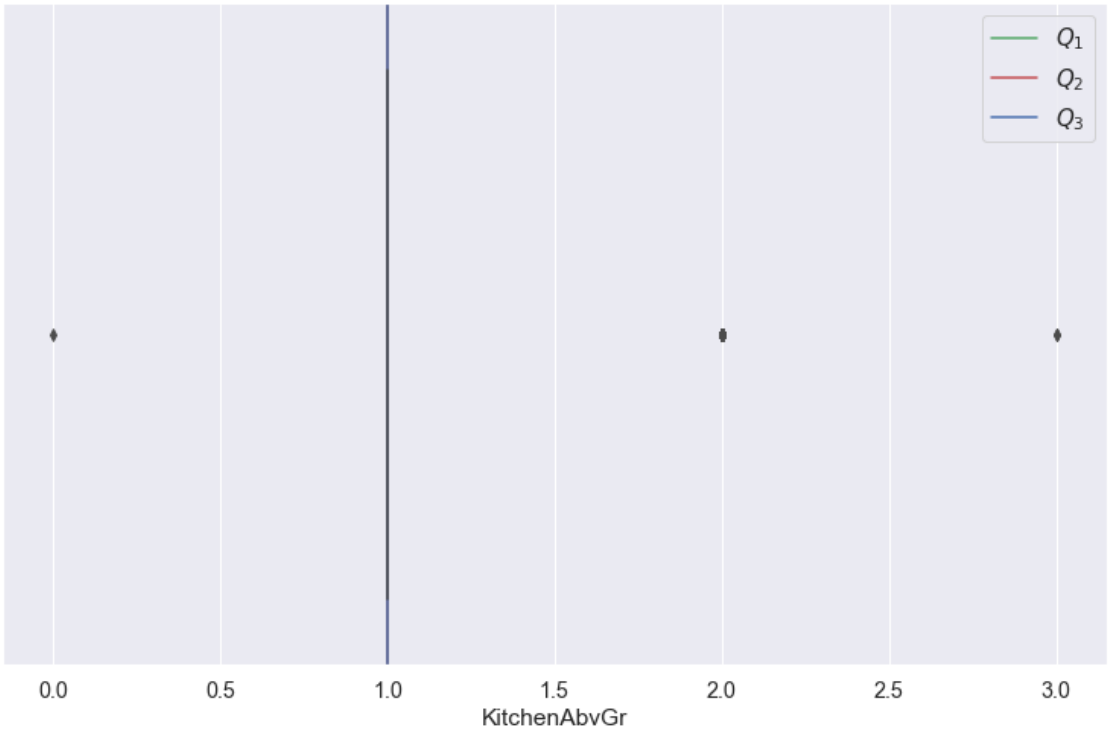

Q_1
Q_2
Q_3
1880
1900
1920
1940
1960
1980
2000
YearBuilt

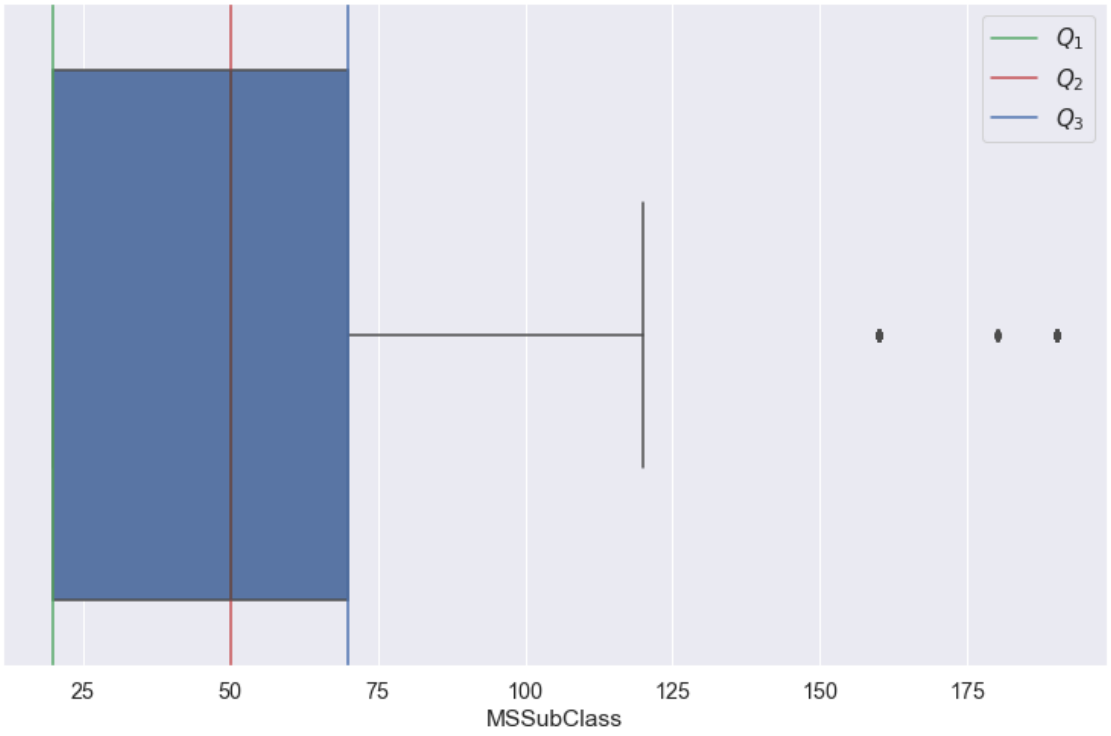
De lo anterior podemos confirmar lo antes mencionado, la variable *SalePrice* tiene datos atipicos, ademas:

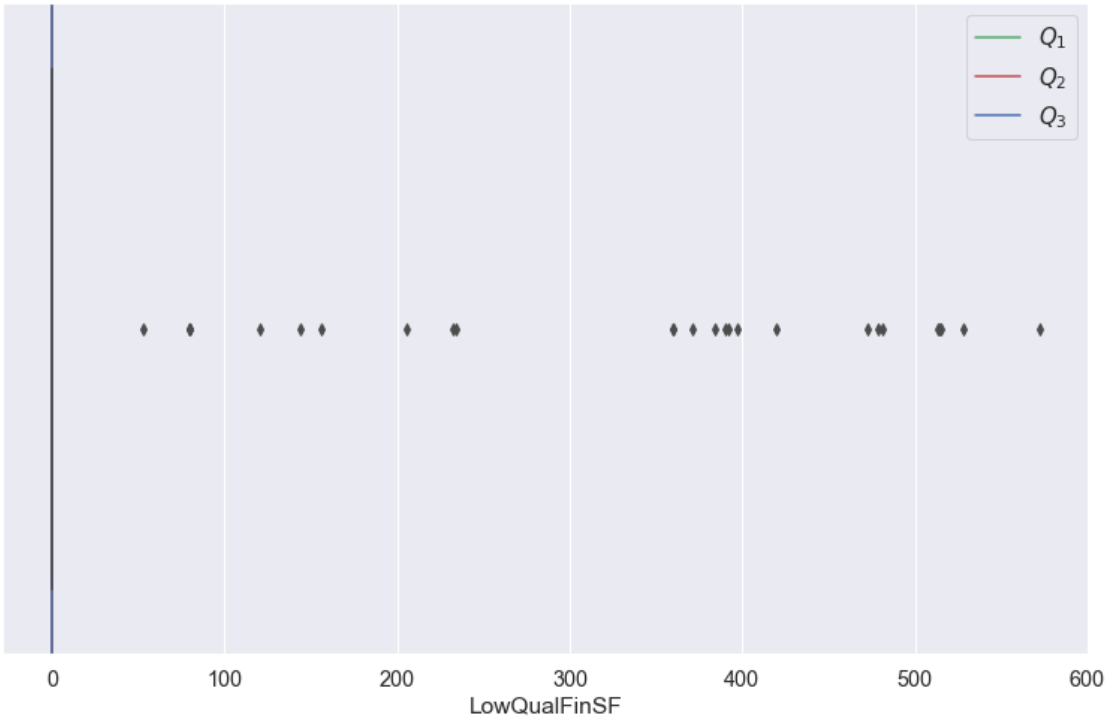
1. OveralQual
2. GrLivArea
3. GarageCars
4. Garage Area
5. TotalBsmtSF
6. 1stfirSF
7. FullBath
8. YearBuilt

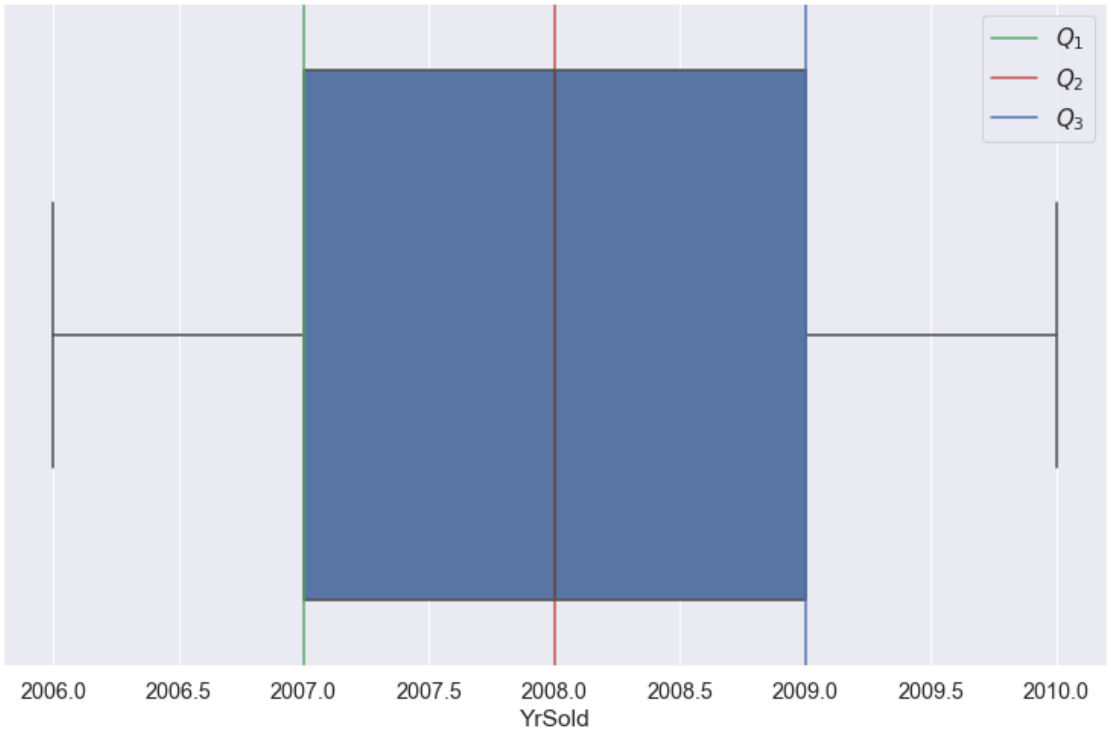
[24]:
```
cols = ['EnclosedPorch', 'KitchenAbvGr', 'MSSubClass', 'LowQualFinSF','YrSold',␣
↪'OverallCond']

for i in cols:
    fig, ax = plt.subplots(figsize = (13, 8))

    sns.boxplot(x = df_train[i], ax = ax)
    ax.axvline(np.percentile(df_train[i], 25), color = 'g', label = '$Q_1$')
    ax.axvline(np.percentile(df_train[i], 50), color = 'r', label = '$Q_2$')
    ax.axvline(np.percentile(df_train[i], 75), color = 'b', label = '$Q_3$')
    ax.legend(prop = {'size' : 15});
```

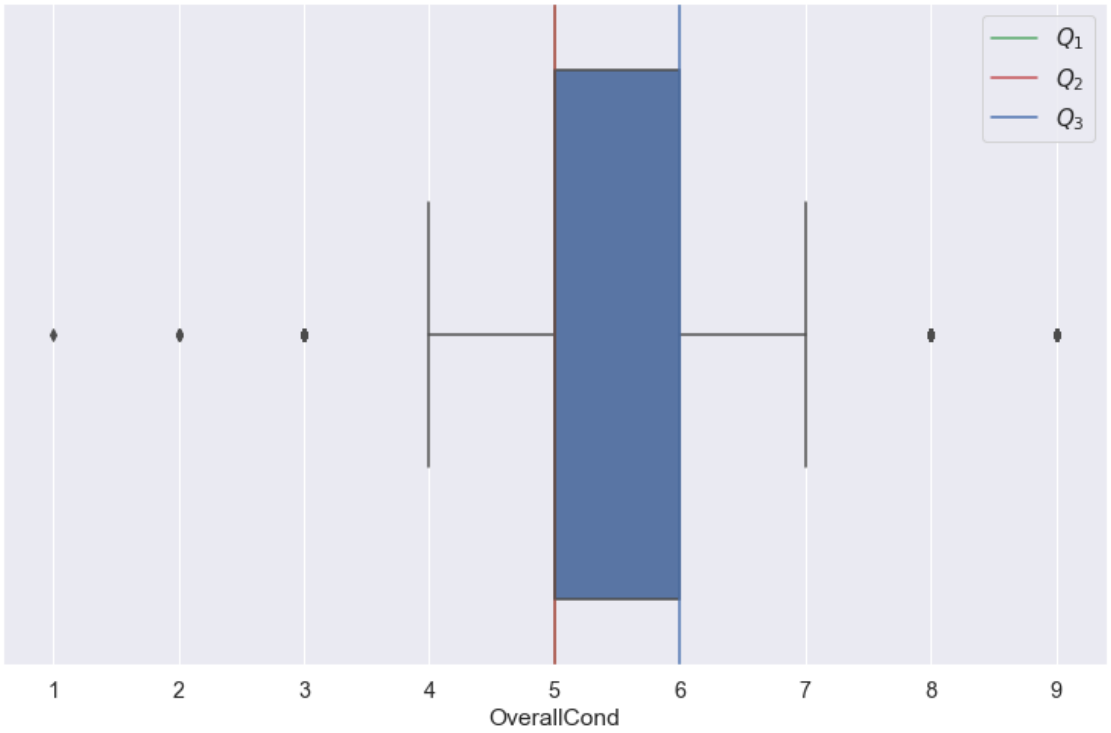



Q_1
Q_2
Q_3
0.0
0.5
1.0
1.5
2.0
2.5
3.0
KitchenAbvGr


Q_1
Q_2
Q_3
25
50
75
100
125
150
175
MSSubClass


Q_1
Q_2
Q_3
0
100
200
300
400
500
600
LowQualFinSF


Q_1
Q_2
Q_3
2006.0
2006.5
2007.0
2007.5
2008.0
2008.5
2009.0
2009.5
2010.0
YrSold



Lo siguiente, que haremos, será identificar los datos atipicos.

[25]:
```
cols_1 = ['SalePrice', 'OverallQual', 'GrLivArea', 'GarageCars','GarageArea',␣
 ↪'TotalBsmtSF','1stFlrSF','FullBath','YearBuilt']
cols_2 = ['EnclosedPorch', 'KitchenAbvGr', 'MSSubClass',␣
 ↪'LowQualFinSF','YrSold', 'OverallCond']

for i in cols_1:
    q1 = np.percentile(df_train[i], 25)
    q2 = np.percentile(df_train[i], 50)
    q3 = np.percentile(df_train[i], 75)
    iqr = q3 - q1
    globals()['outliers_'+str(i)] = np.where((df_train[i] < q1 - 1.5 * iqr) |␣
 ↪(df_train[i] > q3 + 1.5 * iqr))

for i in cols_2:
    q1 = np.percentile(df_train[i], 25)
    q2 = np.percentile(df_train[i], 50)
    q3 = np.percentile(df_train[i], 75)
    iqr = q3 - q1
    globals()['outliers_'+str(i)] = np.where((df_train[i] < q1 - 1.5 * iqr) |␣
 ↪(df_train[i] > q3 + 1.5 * iqr))
```

[26]:
```
outliers_SalePrice
```

[26]:
```
(array([  30,  178,  185,  375,  410,  440,  495,  533,  636,  691,  705,
         710,  769,  798,  803,  812,  898,  916,  968, 1046, 1100, 1169,
        1182, 1243, 1325, 1337, 1373, 1380], dtype=int64),)
```

Si quisieramos hacer un analisis por variable, se genero la siguiente función

[27]:
```
def remove_outlier(df_in, col_name):
    q1 = df_in[col_name].quantile(0.25)
    q3 = df_in[col_name].quantile(0.75)
    iqr = q3-q1 #Interquartile range
    fence_low  = q1-1.5*iqr
    fence_high = q3+1.5*iqr
    df_out = df_in.loc[(df_in[col_name] > fence_low) & (df_in[col_name] <␣
 ↪fence_high)]
    return df_out
```

[28]:
```
#df_train_0 = remove_outlier(df_train, 'SalePrice')
```

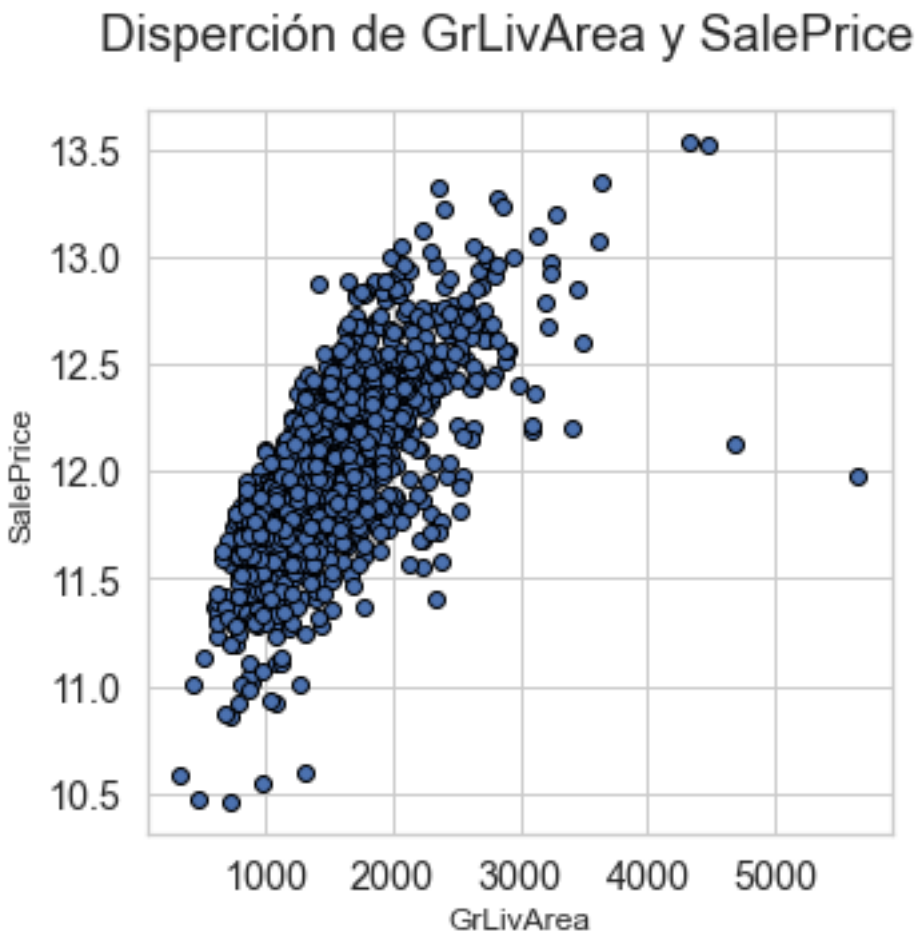
[29]:
```
#df_train_0.shape
```

Pero con el fin de hacer un analisis mas profundo, y detectaremos datos atipicos considerando dos variables

[30]:
```
sns.set_style('whitegrid')
edgecolor = 'black'

fig = plt.figure(figsize=(12,12))

#función para vizualisar el grafico de dispersión entre una función y el precio␣
 ↪de venta
def scatter_plot(a):
    fig, ax = plt.subplots()
    ax.scatter(x = df_train[a], y = df_train['SalePrice'], edgecolor=edgecolor)
    plt.ylabel('SalePrice', fontsize=12)
    plt.xlabel(a, fontsize=12)
    plt.suptitle("Disperción de "+ a + " y SalePrice")
    plt.show()
```

```
<Figure size 864x864 with 0 Axes>
```

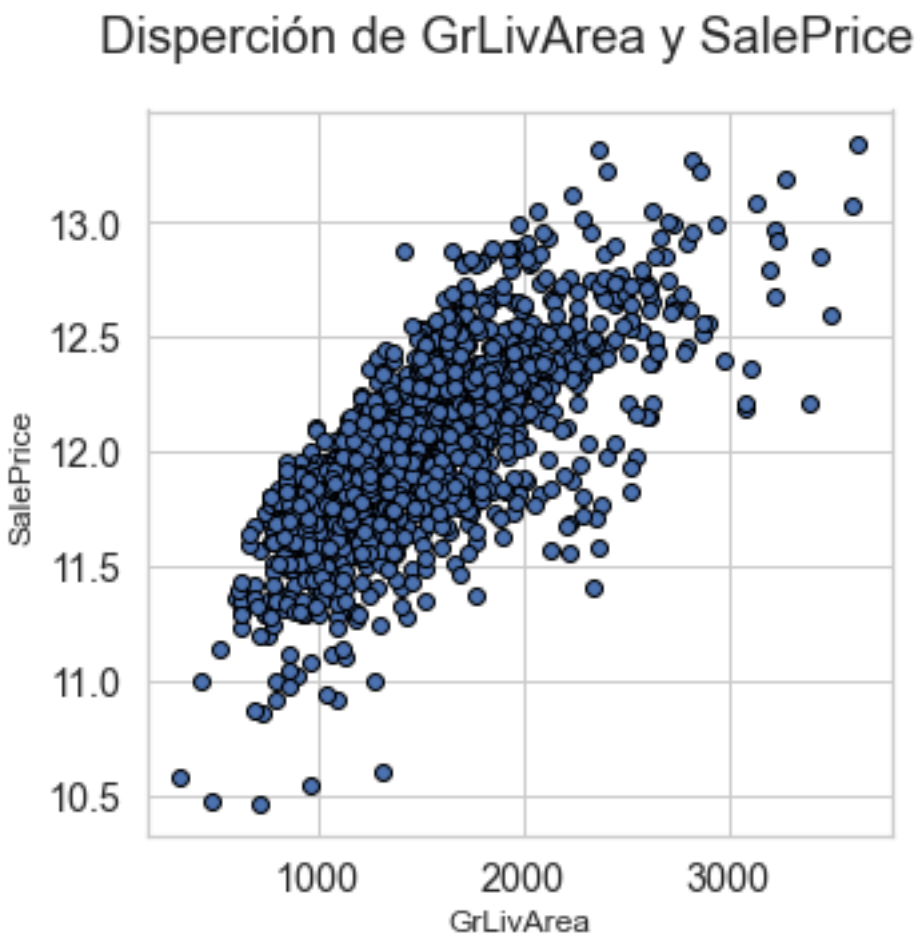
[31]:
```
scatter_plot('GrLivArea')
```



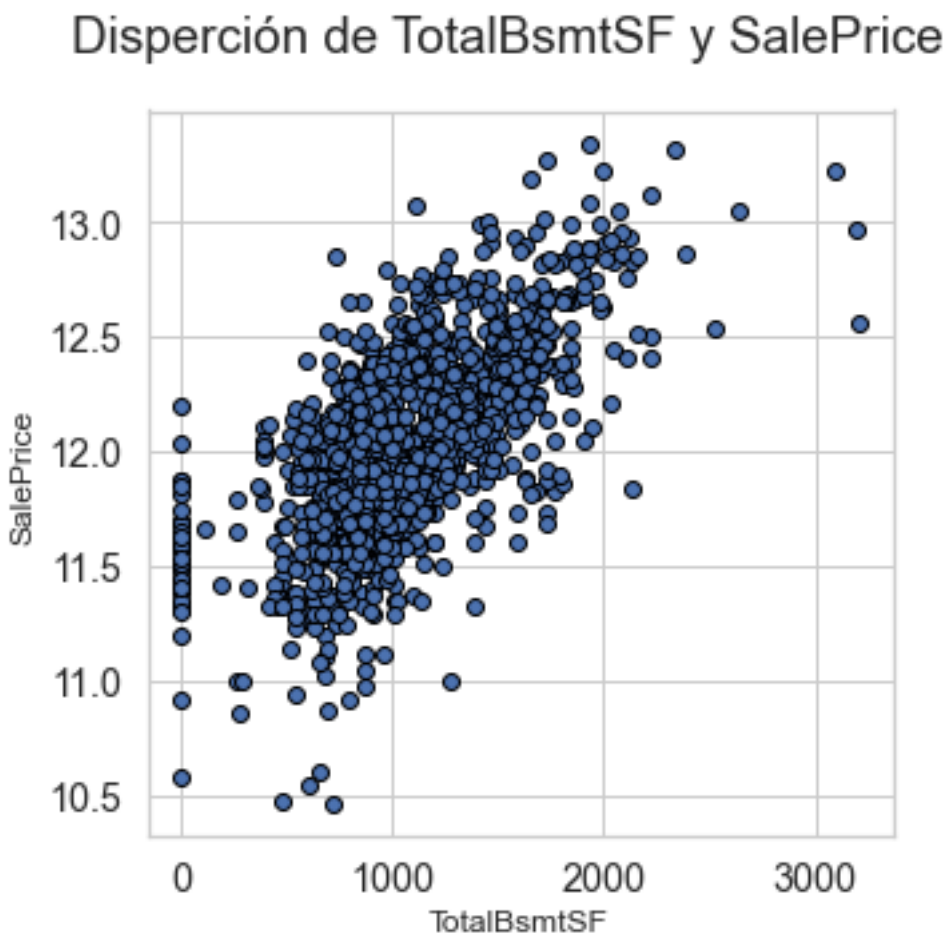
Notemos que existen datos atipicos, por lo cual serán removidos

[32]:
```
df_train =  df_train.drop( df_train[( df_train['GrLivArea'] > 4000) & (␣
↪df_train['SalePrice']<300000)].index)
```

[33]:
```
scatter_plot('GrLivArea')
```

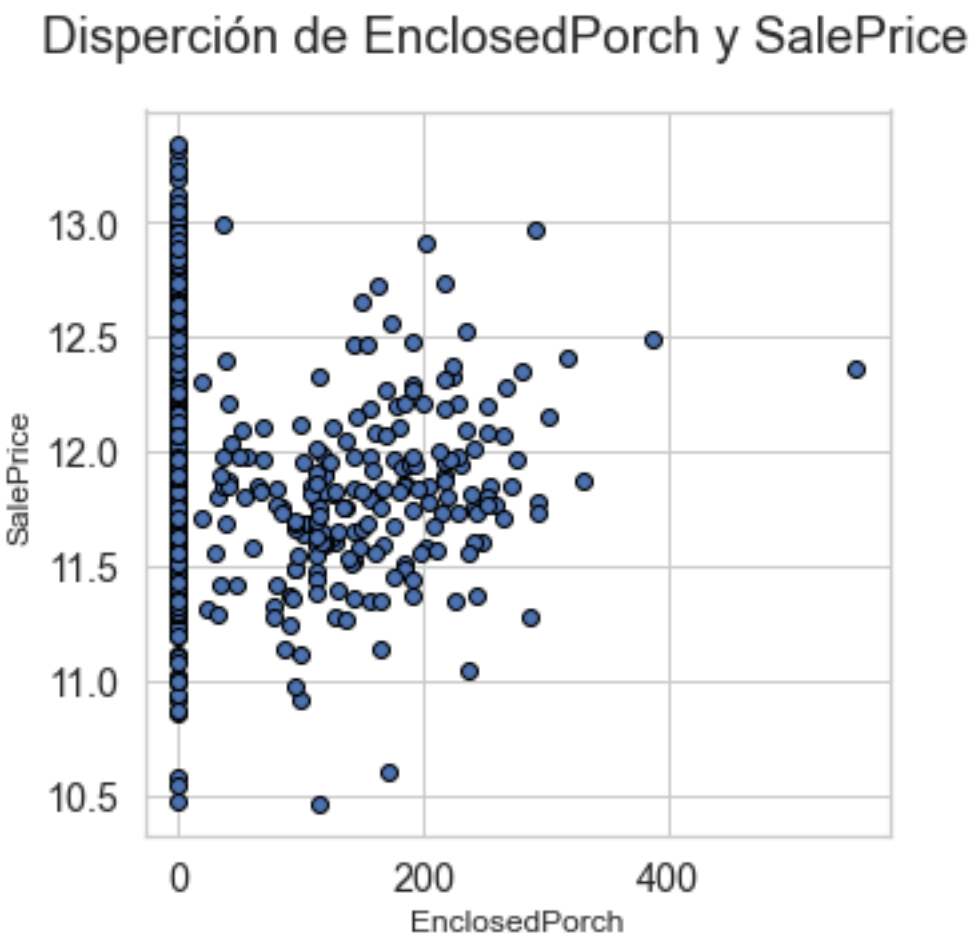


[34]:
```
scatter_plot('TotalBsmtSF')
```



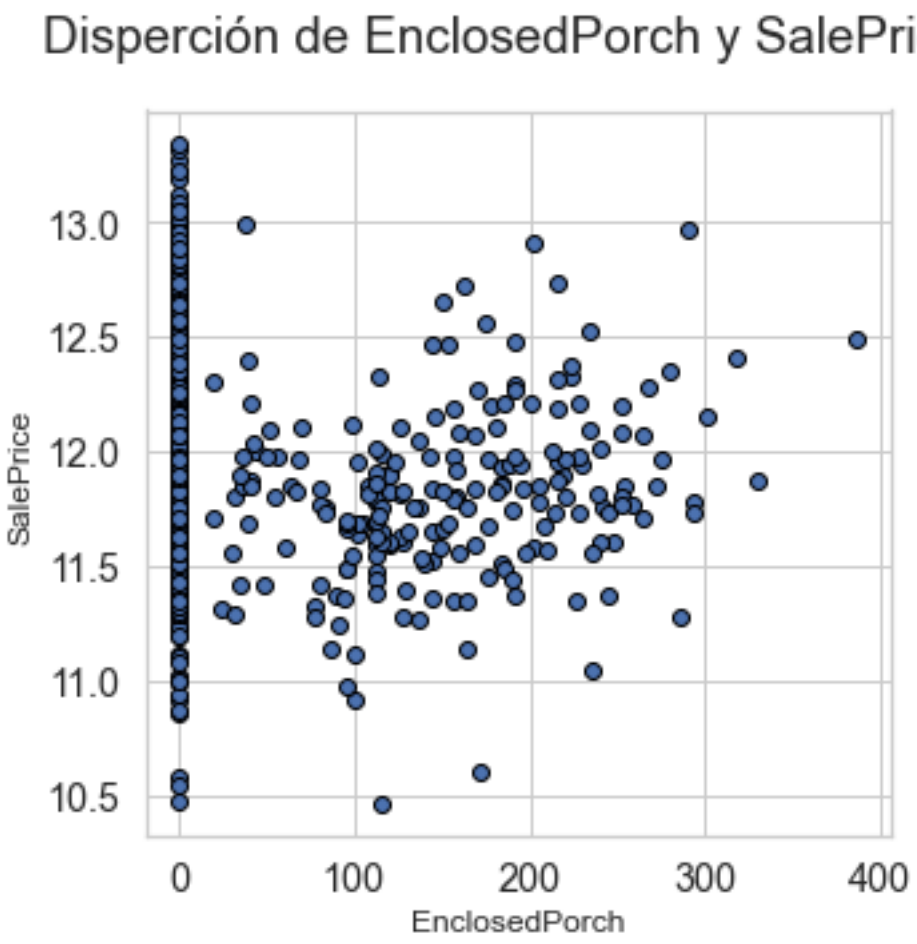
No hay valores atípicos demasiado grandes, no necesitamos eliminar ningún punto

[35]:
```
scatter_plot('EnclosedPorch')
```



Hay algunos valores atípicos que deben eliminarse para que no afectan a nuestras predicciones mucho

[36]:
```
df_train =  df_train.drop( df_train[( df_train['EnclosedPorch']>400)].index)
df_train =  df_train.drop( df_train[( df_train['SalePrice']>700000)].index)
scatter_plot('EnclosedPorch')
```



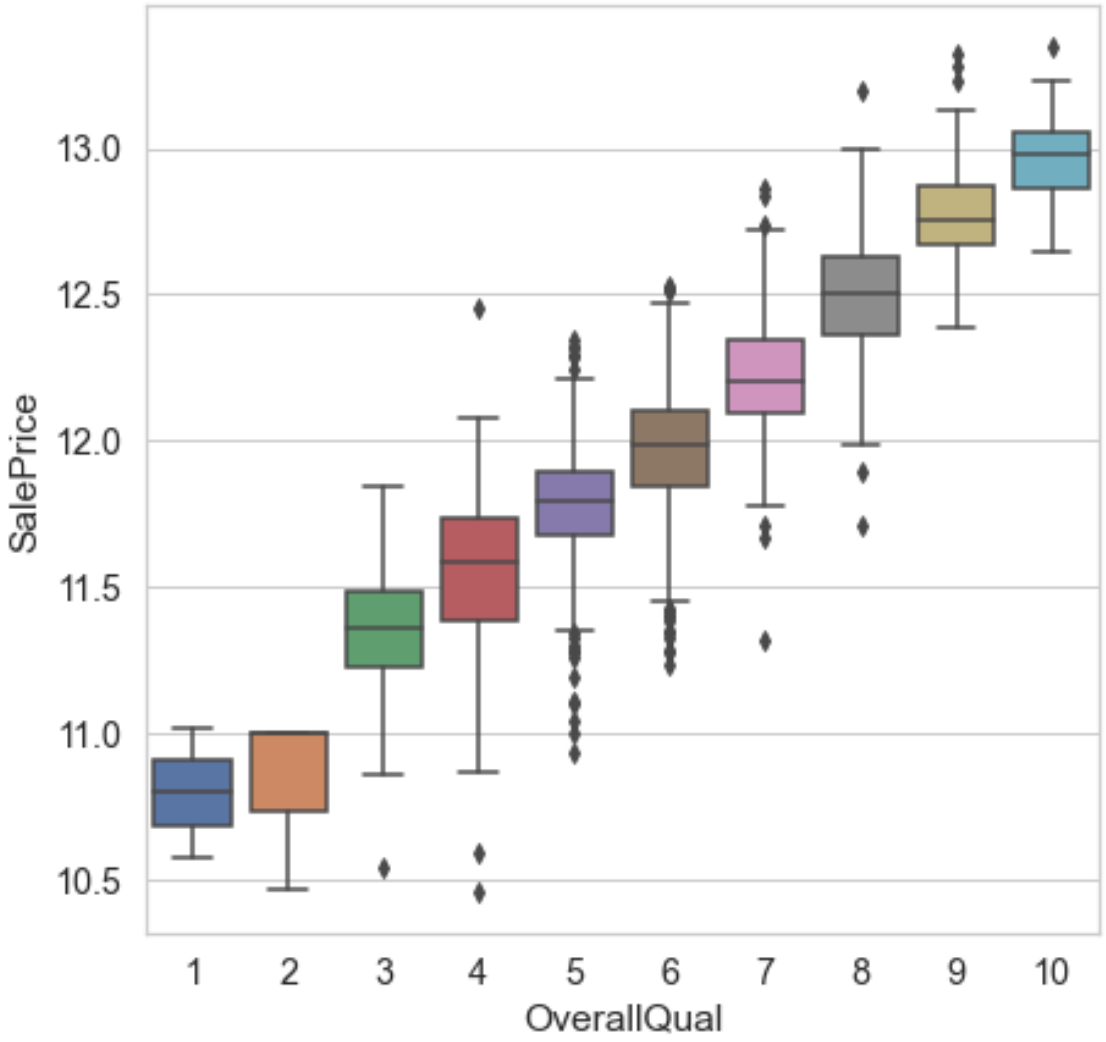
El analisis anterior lo podriamos extender a todas las variables, pero obviaremos ya que solo eliminaremos los datos atipicos de la variable objetivo.

1.6 Analisis por variable objetivo vs. variables categoricas

Por experiencia, se sabe que entre mejor sea la *calidad* y *materiales* que se ocupan en alguna obra, mayor será su valor, por lo tanto analisemos si existe dicha relación.

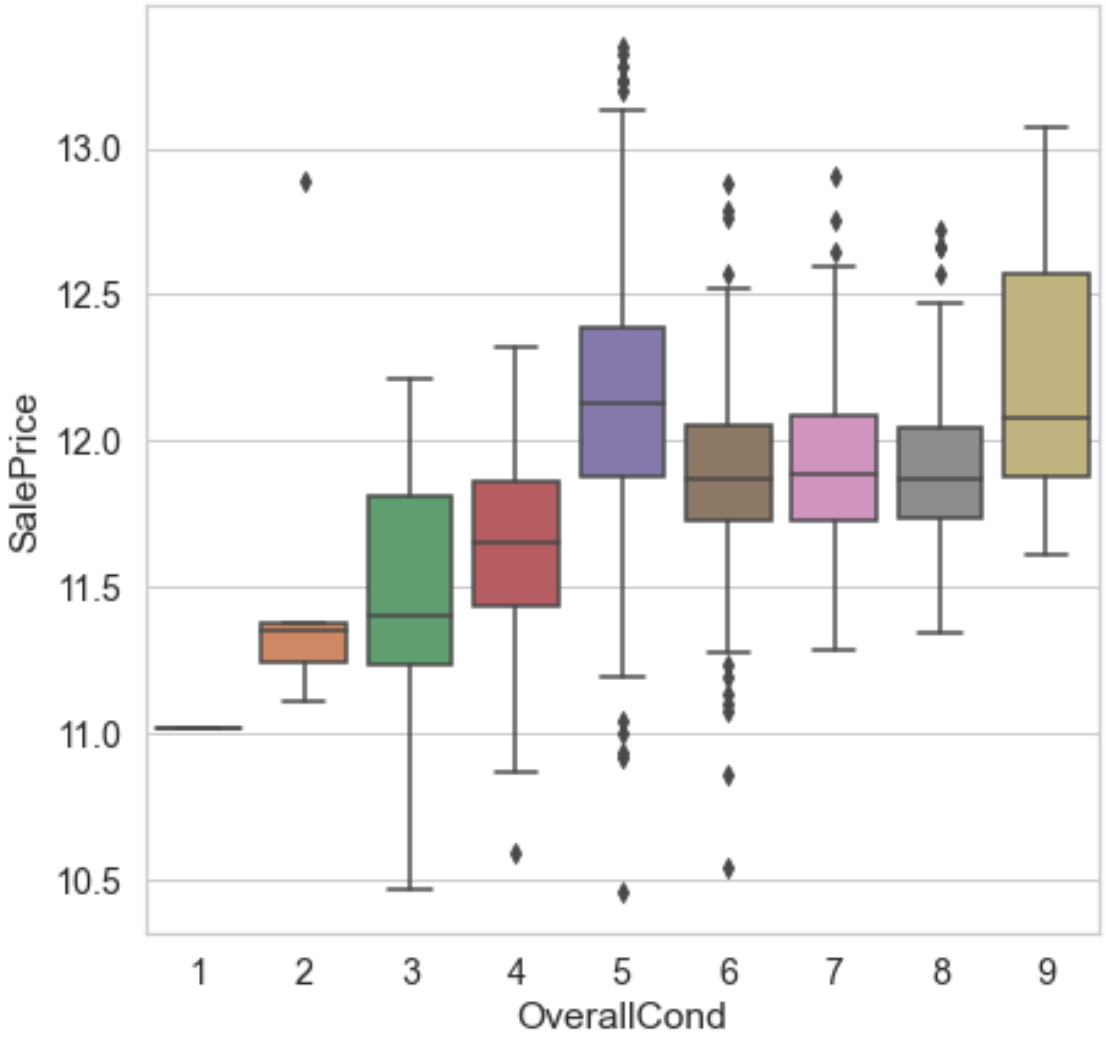
[37]:
```
# boxplot para la variable categorica : Overall Quality

fig = plt.figure(figsize=(7,7))
data = pd.concat([df_train['SalePrice'], df_train['OverallQual']], axis=1)
sns.boxplot(x = df_train['OverallQual'], y="SalePrice", data = data)
```

[37]:
```
<AxesSubplot:xlabel='OverallQual', ylabel='SalePrice'>
```



[38]:
```
# boxplot para la variable categorica : OverallCond

fig = plt.figure(figsize=(7,7))
data = pd.concat([df_train['SalePrice'], df_train['OverallCond']], axis=1)
sns.boxplot(x = df_train['OverallCond'], y="SalePrice", data = data)
```

[38]: <AxesSubplot:xlabel='OverallCond', ylabel='SalePrice'>



Note que para el primer grafico, que hace referencia a la calidad de materiales, se nota un incremento en el precio conforme aumenta dicha calidad de materiales, pero al visualizar la calificación del estado final de la vivienda, no se logra visualizar que realmente valgan ese precio.

1.7 Limpieza de datos missing

Para este apartado se diseño una función que ayuda a identificar los datos missing

[39]:
```
#función para ver los datos faltantes en un marco de datos
def missing_data(df,n):
    total = df.isnull().sum().sort_values(ascending=False)          # Total de␣
↪datos faltantes
    percentage = (df.isnull().sum() / df.isnull().count()).
↪sort_values(ascending=False)*100  # % de datos faltantes
```

```
    No_unique_val = df.nunique()                                    # datos no␣
↪unicos
    missing_data = pd.concat([total, percentage, No_unique_val], axis=1,
                             keys=['Total de datos faltantes', '% de datos␣
↪faltantes','Valores no unicos'], sort = False)

    print(missing_data.head(n))
```

[40]:
```
missing_data(df_train,20)
```

```
             Total de datos faltantes  % de datos faltantes  \
PoolQC                           1451             99.725086
MiscFeature                      1401             96.288660
Alley                            1364             93.745704
Fence                            1176             80.824742
FireplaceQu                       690             47.422680
LotFrontage                       259             17.800687
GarageYrBlt                        81              5.567010
GarageCond                         81              5.567010
GarageType                         81              5.567010
GarageFinish                       81              5.567010
GarageQual                         81              5.567010
BsmtExposure                       38              2.611684
BsmtFinType2                       38              2.611684
BsmtCond                           37              2.542955
BsmtQual                           37              2.542955
BsmtFinType1                       37              2.542955
MasVnrArea                          8              0.549828
MasVnrType                          8              0.549828
Electrical                          1              0.068729
MSSubClass                          0              0.000000

             Valores no unicos
PoolQC                       2
MiscFeature                  4
Alley                        2
Fence                        4
FireplaceQu                  5
LotFrontage                109
GarageYrBlt                 97
GarageCond                   5
GarageType                   6
GarageFinish                 3
GarageQual                   5
BsmtExposure                 4
BsmtFinType2                 6
BsmtCond                     4
BsmtQual                     4
```

```
BsmtFinType1                  6
MasVnrArea                  324
MasVnrType                    4
Electrical                    5
MSSubClass                   15
```

Lo anterior nos permite vizualizar todas las variables que tienen datos faltantes, las mas relevantes son:

- PoolQC
- MiscFeature
- Alley
- Fence
- FireplaceQu
- LotFrontage

Visualicemos los tipos de datos que contiene cada variable:

[41]:
```
var_aux = ['PoolQC', 'MiscFeature', 'Alley', 'Fence',  'FireplaceQu',␣
 ↪'LotFrontage']

for i in var_aux:
    print(df_train[i].unique())
```

```
[nan 'Fa' 'Gd']
[nan 'Shed' 'Gar2' 'Othr' 'TenC']
[nan 'Grvl' 'Pave']
[nan 'MnPrv' 'GdWo' 'GdPrv' 'MnWw']
[nan 'TA' 'Gd' 'Fa' 'Ex' 'Po']
[ 65.  80.  68.  60.  84.  85.  75.  nan  51.  50.  70.  91.  72.  66.
 101.  57.  44. 110.  98.  47. 108. 112.  74. 115.  61.  48.  33.  52.
 100.  24.  89.  63.  76.  81.  95.  69.  21.  32.  78. 121. 122.  40.
 105.  73.  77.  64.  94.  34.  90.  55.  88.  82.  71. 120. 107.  92.
 134.  62.  86. 141.  97.  54.  41.  79.  99.  67.  83.  43. 103. 174.
  93.  30. 129. 140.  35.  37. 118.  87. 116. 150. 111.  49.  96.  59.
  36.  56. 102.  58.  38. 109. 130.  53. 137.  45. 106.  42.  39. 104.
 144. 114. 128. 149. 313. 168. 182. 138. 152. 124. 153.  46.]
```

Notemos que las primeras 5 variables, corresponden a variables categoricas, pero por su alto porcentaje de datos faltantes, serán descartadas. Por otro lado, la ultima variable es una variable numerica, por lo cuál, se le aplicará un tratamiento de inputación mas adelnate.

Algo importante a resaltar de la función anterior es que nos permite identificar cuantos valores unicos tiene, esto no ayuda para ver si es una variable categorica.

[42]:
```
df_train['MasVnrArea'].unique()
```

[42]:
```
array([1.960e+02, 0.000e+00, 1.620e+02, 3.500e+02, 1.860e+02, 2.400e+02,
       2.860e+02, 3.060e+02, 2.120e+02, 1.800e+02, 3.800e+02, 2.810e+02,
       6.400e+02, 2.000e+02, 2.460e+02, 1.320e+02, 6.500e+02, 1.010e+02,
```

```
4.120e+02, 2.720e+02, 4.560e+02, 1.031e+03, 1.780e+02, 5.730e+02,
3.440e+02, 2.870e+02, 1.670e+02, 1.115e+03, 4.000e+01, 1.040e+02,
5.760e+02, 4.430e+02, 4.680e+02, 6.600e+01, 2.200e+01, 2.840e+02,
7.600e+01, 2.030e+02, 6.800e+01, 1.830e+02, 4.800e+01, 2.800e+01,
3.360e+02, 6.000e+02, 7.680e+02, 4.800e+02, 2.200e+02, 1.840e+02,
1.129e+03, 1.160e+02, 1.350e+02, 2.660e+02, 8.500e+01, 3.090e+02,
1.360e+02, 2.880e+02, 7.000e+01, 3.200e+02, 5.000e+01, 1.200e+02,
4.360e+02, 2.520e+02, 8.400e+01, 6.640e+02, 2.260e+02, 3.000e+02,
6.530e+02, 1.120e+02, 4.910e+02, 2.680e+02, 7.480e+02, 9.800e+01,
2.750e+02, 1.380e+02, 2.050e+02, 2.620e+02, 1.280e+02, 2.600e+02,
1.530e+02, 6.400e+01, 3.120e+02, 1.600e+01, 9.220e+02, 1.420e+02,
2.900e+02, 1.270e+02, 5.060e+02, 2.970e+02,       nan, 6.040e+02,
2.540e+02, 3.600e+01, 1.020e+02, 4.720e+02, 4.810e+02, 1.080e+02,
3.020e+02, 1.720e+02, 3.990e+02, 2.700e+02, 4.600e+01, 2.100e+02,
1.740e+02, 3.480e+02, 3.150e+02, 2.990e+02, 3.400e+02, 1.660e+02,
7.200e+01, 3.100e+01, 3.400e+01, 2.380e+02, 1.600e+03, 3.650e+02,
5.600e+01, 1.500e+02, 2.780e+02, 2.560e+02, 2.250e+02, 3.700e+02,
3.880e+02, 1.750e+02, 2.960e+02, 1.460e+02, 1.130e+02, 1.760e+02,
6.160e+02, 3.000e+01, 1.060e+02, 8.700e+02, 3.620e+02, 5.300e+02,
5.000e+02, 5.100e+02, 2.470e+02, 3.050e+02, 2.550e+02, 1.250e+02,
1.000e+02, 4.320e+02, 1.260e+02, 4.730e+02, 7.400e+01, 1.450e+02,
2.320e+02, 3.760e+02, 4.200e+01, 1.610e+02, 1.100e+02, 1.800e+01,
2.240e+02, 2.480e+02, 8.000e+01, 3.040e+02, 2.150e+02, 7.720e+02,
4.350e+02, 3.780e+02, 5.620e+02, 1.680e+02, 8.900e+01, 2.850e+02,
3.600e+02, 9.400e+01, 3.330e+02, 9.210e+02, 5.940e+02, 2.190e+02,
1.880e+02, 4.790e+02, 5.840e+02, 1.820e+02, 2.500e+02, 2.920e+02,
2.450e+02, 2.070e+02, 8.200e+01, 9.700e+01, 3.350e+02, 2.080e+02,
4.200e+02, 1.700e+02, 4.590e+02, 2.800e+02, 9.900e+01, 1.920e+02,
2.040e+02, 2.330e+02, 1.560e+02, 4.520e+02, 5.130e+02, 2.610e+02,
1.640e+02, 2.590e+02, 2.090e+02, 2.630e+02, 2.160e+02, 3.510e+02,
6.600e+02, 3.810e+02, 5.400e+01, 5.280e+02, 2.580e+02, 4.640e+02,
5.700e+01, 1.470e+02, 2.930e+02, 6.300e+02, 4.660e+02, 1.090e+02,
4.100e+01, 1.600e+02, 2.890e+02, 6.510e+02, 1.690e+02, 9.500e+01,
4.420e+02, 2.020e+02, 3.380e+02, 8.940e+02, 3.280e+02, 6.730e+02,
6.030e+02, 1.000e+00, 3.750e+02, 9.000e+01, 3.800e+01, 1.570e+02,
1.100e+01, 1.400e+02, 1.300e+02, 1.480e+02, 8.600e+02, 4.240e+02,
1.047e+03, 2.430e+02, 8.160e+02, 3.870e+02, 2.230e+02, 1.580e+02,
1.370e+02, 1.150e+02, 1.890e+02, 2.740e+02, 1.170e+02, 6.000e+01,
1.220e+02, 9.200e+01, 4.150e+02, 7.600e+02, 2.700e+01, 7.500e+01,
3.610e+02, 1.050e+02, 3.420e+02, 2.980e+02, 5.410e+02, 2.360e+02,
1.440e+02, 4.230e+02, 4.400e+01, 1.510e+02, 9.750e+02, 4.500e+02,
2.300e+02, 5.710e+02, 2.400e+01, 5.300e+01, 2.060e+02, 1.400e+01,
3.240e+02, 2.950e+02, 3.960e+02, 6.700e+01, 1.540e+02, 4.250e+02,
4.500e+01, 1.378e+03, 3.370e+02, 1.490e+02, 1.430e+02, 5.100e+01,
1.710e+02, 2.340e+02, 6.300e+01, 7.660e+02, 3.200e+01, 8.100e+01,
1.630e+02, 5.540e+02, 2.180e+02, 6.320e+02, 1.140e+02, 5.670e+02,
3.590e+02, 4.510e+02, 6.210e+02, 7.880e+02, 8.600e+01, 3.910e+02,
```

```
        2.280e+02, 8.800e+01, 1.650e+02, 4.280e+02, 4.100e+02, 5.640e+02,
        3.680e+02, 3.180e+02, 5.790e+02, 6.500e+01, 7.050e+02, 4.080e+02,
        2.440e+02, 1.230e+02, 3.660e+02, 7.310e+02, 4.480e+02, 2.940e+02,
        3.100e+02, 2.370e+02, 4.260e+02, 9.600e+01, 4.380e+02, 1.940e+02,
        1.190e+02])
```

[43]:
```
# Cantidad de datos faltantes en train_df
null_train = df_train.isnull().sum().sum()
print(null_train)

# Cantidad de datos faltantes en test_df
null_test = df_test.isnull().sum().sum()
print(null_test)
```

```
6950
7000
```

[44]:
```
# guardar la columna 'SalePrice' como train_label
train_label = df_train['SalePrice'].reset_index(drop=True)

# eliminar la columna 'SalePrice' de df_train
df_train = df_train.drop(['SalePrice'], axis=1)
```

[45]:
```
# Función que elimina o modifica los datos faltantes
def missing (df):

    # Elimina estas columnas debido a grandes valores nulos o muchos mismos␣
 ↪valores
    df = df.drop(['Utilities','PoolQC','MiscFeature','Alley'], axis=1)

    # Valor nulo probablemente significa No vaya así que rellene como "ninguna"
    df["Fence"] = df["Fence"].fillna("Ninguna")

    # Valor nulo probablemente significa No Chimenea para llenar como "Ninguno"
    df["FireplaceQu"] = df["FireplaceQu"].fillna("Ninguno")

    # Frente de lote es los pies de la calle conectado a la propiedad, que es␣
 ↪probablemente
    # similar a las casas del barrio, por lo que llenar por la media
    df["LotFrontage"] = df["LotFrontage"].fillna(df["LotFrontage"].median())

    # Valor nulo probablemente significa tipo
    df["Functional"] = df["Functional"].fillna("Typ")

    # Imputamos por la moda, ya que es una variable categorica
    df['KitchenQual'] = df['KitchenQual'].fillna(df['KitchenQual'].mode()[0])
```

```
    # Imputamos por la moda, ya que es una variable categorica
    df['Electrical'] = df['Electrical'].fillna(df['Electrical'].mode()[0])

    # Imputamos por la moda, ya que es una variable categorica
    df['SaleType'] = df['SaleType'].fillna(df['SaleType'].mode()[0])

    # Valor nulo probablemente significa que no hay revestimiento de mampostería
    df["MasVnrType"] = df["MasVnrType"].fillna("Ninguno") # Por lo tanto␣
↪rellenamos con ninguno
    df["MasVnrArea"] = df["MasVnrArea"].fillna(0)      #Al igual con cero

    # Imputamos por la moda
    df['Exterior1st'] = df['Exterior1st'].fillna(df['Exterior1st'].mode()[0])
    df['Exterior2nd'] = df['Exterior2nd'].fillna(df['Exterior2nd'].mode()[0])

    # MSZoning es la clasificación general de zonificación, muy poco valor nulo␣
↪por lo que llenar con el valor más frecuente (moda)
    df['MSZoning'] = df['MSZoning'].fillna(df['MSZoning'].mode()[0])

    # Valor nulo probablemente significa que no hay tipo identificado de␣
↪vivienda por lo que llenar como "Ninguno"
    df['MSSubClass'] = df['MSSubClass'].fillna("Ninguno")

    #Valor nulo probablemente significa No Garaje, así que rellene como␣
↪"Ninguno" (ya que estas son características categóricas)
    for col in ('GarageType', 'GarageFinish', 'GarageQual', 'GarageCond'):
        df[col] = df[col].fillna('Ninguno')

    # Valor nulo probablemente significa No Garaje y no hay coches en el␣
↪garaje, por lo que llenar como 0
    for col in ('GarageYrBlt', 'GarageArea', 'GarageCars'):
        df[col] = df[col].fillna(0)

    # Valor nulo probablemente significa No Sótano, por lo que llenar como 0
    for col in ('BsmtFinSF1', 'BsmtFinSF2', 'BsmtUnfSF','TotalBsmtSF',␣
↪'BsmtFullBath', 'BsmtHalfBath'):
        df[col] = df[col].fillna(0)

    # Valor nulo probablemente significa No Sótano, por lo que llenar como␣
↪"Ninguno" (ya que estas son características categóricas)
    for col in ('BsmtQual', 'BsmtCond', 'BsmtExposure', 'BsmtFinType1',␣
↪'BsmtFinType2'):
        df[col] = df[col].fillna('Ninguno')

    return df
```

Aqui recordemos, que aplicaremos el modelo tanto a la base con datos atipicos y sin ellos, por lo

tanto aplicamos la función anterior a las 3 bases de datos.

[46]:
```
df_train = missing(df_train)
df_test = missing(df_test)
```

[47]:
```
# calcular el número total de valores faltantes en df_train
null_train = df_train.isnull().sum().sum()
print(null_train)


# calcular el número total de valores faltantes en test data
null_test = df_test.isnull().sum().sum()
print(null_test)
```

```
0
0
```

[48]:
```
df_train.shape, df_test.shape
```

[48]:
```
((1455, 75), (1459, 75))
```

1.8 Creación de nuevas columnas y modificación de variables

Dada la descripción del inicio, podemos generar una columna concierando la suma de las siguientes columnas * TotalBsmtSF, 1stFlrSF y 2ndFlrSF * FullBath, HalfBath, BsmtFullBath y BsmtHalfBath * OpenPorchSF, 3SsnPorch, EnclosedPorch, ScreenPorch y WoodDeckSF * BsmtFinSF1, BsmtFinSF2, 1stFlrSF y 2ndFlrSF * OverallQual y OverallCond

[49]:
```
def add_new_cols(df):

    df['Total_SF'] = df['TotalBsmtSF'] + df['1stFlrSF'] + df['2ndFlrSF']

    df['Total_Bathrooms'] = (df['FullBath'] + (0.5 * df['HalfBath']) +␣
↪df['BsmtFullBath']
                             + (0.5 * df['BsmtHalfBath']))

    df['Total_Porch_SF'] = (df['OpenPorchSF'] + df['3SsnPorch'] +␣
↪df['EnclosedPorch'] +
                            df['ScreenPorch'] + df['WoodDeckSF'])

    df['Total_Square_Feet'] = (df['BsmtFinSF1'] + df['BsmtFinSF2'] +␣
↪df['1stFlrSF'] + df['2ndFlrSF'])

    df['Total_Quality'] = df['OverallQual'] + df['OverallCond']

    return df
```

[50]:
```
df_train = add_new_cols(df_train)
df_test = add_new_cols(df_test)
```

[51]:
```
df_train.shape, df_test.shape
```

[51]:
```
((1455, 80), (1459, 80))
```

Uno de nuestros principales objetivos es predecir el precio de una vivienda, por lo tanto, aplicaremos el concepto de variables *dummy* o variables *idicadoras*. Esto con el fin que el modelo identifique cuando entre algun nivel categerico de alguna variable categorica.

[52]:
```
#obtener valores dummy para datos categóricos
df_train = pd.get_dummies(df_train)
df_test = pd.get_dummies(df_test)

print(df_train.shape)
print(df_test.shape)
```

```
(1455, 293)
(1459, 279)
```

[53]:
```
# alinear los datos de entrenamiento y pruebas
df_train, df_test = df_train.align(df_test, join = 'inner', axis=1)
```

[54]:
```
print(df_train.shape)
print(df_test.shape)
```

```
(1455, 279)
(1459, 279)
```

[55]:
```
null_train = df_train.isnull().sum().sum()
print(null_train)

null_test = df_test.isnull().sum().sum()
print(null_test)
```

```
0
0
```

2 Modelo(s)

Ahora generemos nuestros datos de entrenamiento y validación.

[56]:
```
X_test = df_test #funciones de prueba
```

[57]:
```
df_train["SalePrice"] = train_label
```

[58]:
```
df_train.head()
```

[58]:
```
   MSSubClass  LotFrontage  LotArea  OverallQual  OverallCond  YearBuilt  \
0          60         65.0     8450            7            5       2003
1          20         80.0     9600            6            8       1976
2          60         68.0    11250            7            5       2001
3          70         60.0     9550            7            5       1915
4          60         84.0    14260            8            5       2000

   YearRemodAdd  MasVnrArea  BsmtFinSF1  BsmtFinSF2  …  SaleType_New  \
0          2003       196.0         706           0  …             0
1          1976         0.0         978           0  …             0
2          2002       162.0         486           0  …             0
3          1970         0.0         216           0  …             0
4          2000       350.0         655           0  …             0

   SaleType_Oth  SaleType_WD  SaleCondition_Abnorml  SaleCondition_AdjLand  \
0             0            1                      0                      0
1             0            1                      0                      0
2             0            1                      0                      0
3             0            1                      1                      0
4             0            1                      0                      0

   SaleCondition_Alloca  SaleCondition_Family  SaleCondition_Normal  \
0                     0                     0                     1
1                     0                     0                     1
2                     0                     0                     1
3                     0                     0                     0
4                     0                     0                     1

   SaleCondition_Partial  SalePrice
0                      0  12.247694
1                      0  12.109011
2                      0  12.317167
3                      0  11.849398
4                      0  12.429216

[5 rows x 280 columns]
```

[59]:
```
train_set, valid_set = train_test_split(df_train,train_size= 0.7, shuffle=False)

X_train = train_set.drop(["SalePrice"], axis=1)  # funciones de entrenamiento
y_train = train_set["SalePrice"].copy()             # etiqueta para la prueba

X_valid = valid_set.drop(["SalePrice"], axis=1)  # funciones de entrenamiento
y_valid = valid_set["SalePrice"].copy()                #  etiqueta para la prueba
```

[60]:
```
X_valid.head(4)
```

[60]:

	MSSubClass	LotFrontage	LotArea	OverallQual	OverallCond	YearBuilt	\
1021	20	64.0	7406	7	5	2006	
1022	50	52.0	9439	5	5	1930	
1023	120	43.0	3182	7	5	2005	
1024	20	69.0	15498	8	6	1976	

	YearRemodAdd	MasVnrArea	BsmtFinSF1	BsmtFinSF2	…	SaleType_ConLw	\
1021	2006	84.0	684	0	…	0	
1022	1950	0.0	324	0	…	0	
1023	2006	14.0	16	0	…	0	
1024	1976	0.0	1165	400	…	0	

	SaleType_New	SaleType_Oth	SaleType_WD	SaleCondition_Abnorml	\
1021	1	0	0	0	
1022	0	0	1	0	
1023	0	0	1	0	
1024	0	0	0	1	

	SaleCondition_AdjLand	SaleCondition_Alloca	SaleCondition_Family	\
1021	0	0	0	
1022	0	0	0	
1023	0	0	0	
1024	0	0	0	

	SaleCondition_Normal	SaleCondition_Partial
1021	0	1
1022	1	0
1023	1	0
1024	0	0

[4 rows x 279 columns]

[61]:
```
print("X_train shape: {}".format(X_train.shape))
print("y_train shape: {}".format(y_train.shape))
print()
print("X_valid shape: {}".format(X_valid.shape))
print("y_valid shape: {}".format(y_valid.shape))
print()
print("X_test shape: {}".format(X_test.shape))
```

```
X_train shape: (1018, 279)
y_train shape: (1018,)

X_valid shape: (437, 279)
y_valid shape: (437,)

X_test shape: (1459, 279)
```

[62]:
```
y_train
```

[62]:
```
0       12.247694
1       12.109011
2       12.317167
3       11.849398
4       12.429216
          …
1016    12.271345
1017    12.078239
1018    12.175613
1019    11.373663
1020    12.160029
Name: SalePrice, Length: 1018, dtype: float64
```

[63]:
```
y_valid
```

[63]:
```
1021    12.567237
1022    11.630709
1023    12.028739
1024    12.588191
1025    11.561716
          …
1455          NaN
1456          NaN
1457          NaN
1458          NaN
1459          NaN
Name: SalePrice, Length: 437, dtype: float64
```

[64]:
```
null_t_x = X_train.isnull().sum().sum()
print(null_t_x)

null_t_y = y_train.isnull().sum().sum()
print(null_t_y)
```

```
0
0
```

[65]:
```
null_v_x = X_valid.isnull().sum().sum()
print(null_v_x)

null_v_y = y_valid.isnull().sum().sum()
print(null_v_y)
```

```
0
5
```

[66]:
```
np.where(np.isnan(y_valid))
```

[66]:
```
(array([432, 433, 434, 435, 436], dtype=int64),)
```

[67]:
```
# replace null values by mean value of y_valid column
mean = np.nanmean(y_valid)
y_valid = np.nan_to_num(y_valid,nan = mean)
```

[68]:
```
#check again
np.where(np.isnan(y_valid))
```

[68]:
```
(array([], dtype=int64),)
```

[69]:
```
print("Valid data shape:")
print(X_valid.shape, y_valid.shape)
print()
```

```
Valid data shape:
(437, 279) (437,)
```

2.1 Validación cruzada

Para esté analices aplicaremos em metodo de validación cruzada con el fin de evaluar los resultados de nuestro analisis y garantizar que son independientes de la partición entre datos de entrenamiento y prueba.

[70]:
```
# Cálculo de la puntuación de validación cruzada
#con puntuación ajustada a error absoluto medio negativo

def cross_validation(model):

    scores = np.sqrt(-cross_val_score(model, X_train, y_train, cv = 12, scoring␣
 ↪= "neg_mean_squared_error"))
    mean = np.mean(scores)
    print("Mean CV score: ",mean)
```

2.2 Error cuadratico medio

Además aplicaremos la función del error cuadratico medio.

[71]:
```
def rmse(y_pred, y_train):

    rmse_ = np.sqrt(metrics.mean_squared_error(y_pred,y_train))
    print("rmse: ", rmse_)
```

[72]:
```
# function to plot actual vs predicited label
def actual_vs_pred_plot(y_train,y_pred):
```

```
    fig = plt.figure(figsize=(12,12))
    fig, ax = plt.subplots()

    ax.scatter(y_train, y_pred,color = "teal",edgecolor = 'lightblue')
    ax.plot([y_train.min(),y_train.max()], [y_train.min(), y_train.max()],␣
↪'k--',lw=0.2)
    ax.set_xlabel('Actual')
    ax.set_ylabel('Predicted')
    plt.suptitle("Actual vs Predicted Scatter Plot",size=14)
    plt.show()
```

2.3 Modelos con datos atipicos

2.3.1 Regresión lineal

[73]:
```
reg = linear_model.LinearRegression()
```

[74]:
```
cross_validation(reg)
```

```
Mean CV score:  0.4746902467763583
```

[75]:
```
#Entenamos el modelo
model_reg = reg.fit(X_train, y_train)

#Valores que predice el modelo para entrenamiento
y1_pred = reg.predict(X_train)

# calcilo del error cuadratico medio
rmse(y1_pred,y_train)
```

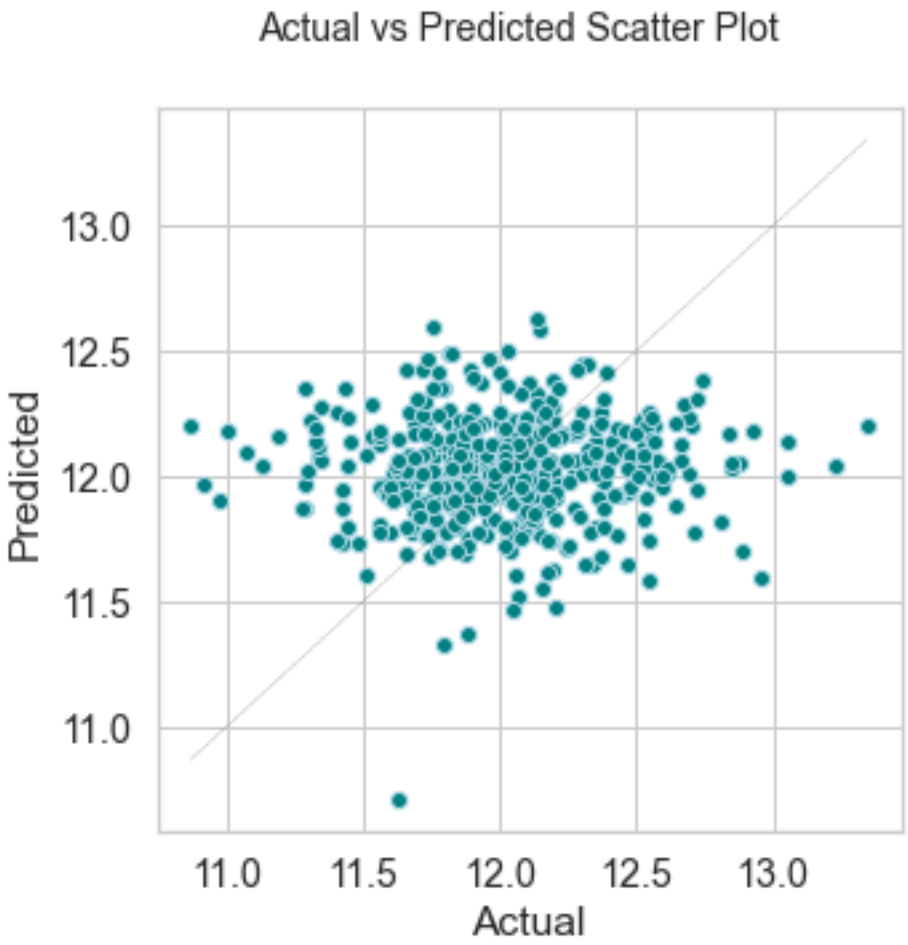
```
rmse:  0.3438610544722426
```

[76]:
```
#Valores que predice el modelo para validación
y1_pred_v = reg.predict(X_valid)

#calcilo del error cuadratico medio
rmse(y1_pred_v, y_valid)
```

```
rmse:  0.42725618696108586
```

[77]:
```
#grafico
actual_vs_pred_plot(y_valid,y1_pred_v)
```

```
<Figure size 864x864 with 0 Axes>
```



2.3.2 MODELO Lasoo

[78]:
```
# para encontrar el mejor valor de alphas de esta lista, usaré LassoCV
# está lista puede ser aleatoria,
alpha2 = [0.0001, 0.0002, 0.0004, 0.0005, 0.0006, 0.0007, 0.0008]

#utilizar un escalador robusto para que las predicciones no se vean influidas␣
 ↪por un pequeño
#número de valores atípicos marginales muy grandes

lasso = make_pipeline(RobustScaler(), linear_model.LassoCV(alphas = alpha2,␣
 ↪random_state=42,cv=12,max_iter=2000))
```

[79]:
```
cross_validation(lasso)
```

```
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
```

```
Duality gap: 21.59280923080454, tolerance: 0.014062005916392917
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.73814181681166, tolerance: 0.01388682924653013
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 38.01741114402399, tolerance: 0.014074783611391048
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.73024910796892, tolerance: 0.013641632636133466
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 45.161296383190034, tolerance: 0.013867601255958597
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.86680414998588, tolerance: 0.01398203379828378
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.56697424977421, tolerance: 0.01343266438665632
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 42.65421182451132, tolerance: 0.014123457216722002
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 46.276238893383145, tolerance: 0.014245077315842255
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 45.08406856979287, tolerance: 0.013871240498036671
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
```

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packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.250825142733724, tolerance: 0.014003757971204503
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 31.970589730139643, tolerance: 0.014144090071961648
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.3665631549501, tolerance: 0.013857576575166352
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 39.03992347217756, tolerance: 0.014083396081368514
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 17.464969584207346, tolerance: 0.01419767179067312
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 23.00253535092253, tolerance: 0.013648506564403386
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 0.865337454937773, tolerance: 0.014338722637059974
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 28.12770960381379, tolerance: 0.014460714071915126
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 39.959089011436525, tolerance: 0.01408716910659155
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 28.507305942175215, tolerance: 0.014219998851852694
```

```
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.306537647053375, tolerance: 0.013869513751085373
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 38.43685007369391, tolerance: 0.014271391363214017
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 35.636307749991104, tolerance: 0.01399915959633298
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 40.01738897947998, tolerance: 0.013707584223022018
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.26955901296641, tolerance: 0.013932102904575652
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 0.01826761160270962, tolerance: 0.013525788400155336
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 18.46729605999934, tolerance: 0.013525788400155336
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 40.40676368858856, tolerance: 0.014045010447412219
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.69096384643538, tolerance: 0.01349762647587234
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
```

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Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.31012929493392, tolerance: 0.014182811081658054
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.398241214968785, tolerance: 0.014308044538793639
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.93758601401714, tolerance: 0.013937045611147662
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.2150324234521, tolerance: 0.014072599528942138
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 0.018341079087434764, tolerance: 0.01384242420987892
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 4.321832437467634, tolerance: 0.01384242420987892
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 31.260624295667185, tolerance: 0.013876446474780958
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 17.273586468473695, tolerance: 0.013442425862961384
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 29.91887704792144, tolerance: 0.01425087479092477
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 30.63152944141042, tolerance: 0.013882685255525742
  model = cd_fast.enet_coordinate_descent_gram(
```

```
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.33531690929575, tolerance: 0.013722652355119453
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 39.92175304895234, tolerance: 0.014119977466120207
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.683808116304476, tolerance: 0.013768178404593573
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 36.762988268572066, tolerance: 0.01396029363376195
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 0.06319392342996366, tolerance: 0.013634669073809572
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.74819410290116, tolerance: 0.013634669073809572
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 20.516233583927963, tolerance: 0.013378198504056454
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 42.802248700428365, tolerance: 0.013900198260009773
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 0.037676069755121944, tolerance: 0.013350060591992716
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
```

```
Duality gap: 40.965357160523595, tolerance: 0.013350060591992716
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 37.32708516135178, tolerance: 0.014043023497178923
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.71757297194407, tolerance: 0.014163246977531574
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 0.07313771759851306, tolerance: 0.01378831205192525
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.40478688799859, tolerance: 0.01378831205192525
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.4055262637188, tolerance: 0.013919654587606599
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 37.62539899370158, tolerance: 0.013532427064856805
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 31.843806221469613, tolerance: 0.013929599102321001
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 34.454542739835674, tolerance: 0.013578284929557842
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 0.02030127615230981, tolerance: 0.013770288377981974
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
```

```
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 24.812201694437295, tolerance: 0.013770288377981974
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 35.04115664253128, tolerance: 0.013417906932012455
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 35.2320525371352, tolerance: 0.013404245477335385
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 35.44761026226004, tolerance: 0.01371004187244328
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 35.86693094104656, tolerance: 0.013159811613991528
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 34.36493817085478, tolerance: 0.01385303605712451
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.289927510993174, tolerance: 0.013973091275160382
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.169309457694226, tolerance: 0.013598024005352321
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 34.99409036841364, tolerance: 0.013729224937300737
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 16.96191669160524, tolerance: 0.0136777199070858
```

```
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 30.364079890692956, tolerance: 0.013717816460828832
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.08503075836525, tolerance: 0.013703819487876268
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 33.49607317621345, tolerance: 0.01330551574665131
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 33.73483390026513, tolerance: 0.0141171776496551
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 33.78533513944524, tolerance: 0.013744408273487455
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 14.680344920676085, tolerance: 0.013878067872404868
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.028234630308205, tolerance: 0.013646251128345386
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 38.35746843923065, tolerance: 0.01404492579209056
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.608642494006475, tolerance: 0.013688851772421717
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
```

```
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 39.90080252599576, tolerance: 0.013881952501850588
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.5614768714227, tolerance: 0.013529836086047357
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 7.323148826087859, tolerance: 0.013670641764035776
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.87225340392318, tolerance: 0.013670641764035776
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 33.25353856890722, tolerance: 0.013274768016506627
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 39.53512586314956, tolerance: 0.013554451504562406
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.50097195210985, tolerance: 0.013964525295261461
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.29876001212372, tolerance: 0.014086232782743643
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.4296546213889, tolerance: 0.013712464652421971
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 42.00314294820294, tolerance: 0.013845055618829401
  model = cd_fast.enet_coordinate_descent_gram(
```

```
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 13.356360669486087, tolerance: 0.013685067387109945
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 42.62091296455165, tolerance: 0.013685067387109945
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 12.492495664824474, tolerance: 0.014087626694964838
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 32.27245102393414, tolerance: 0.014087626694964838
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 12.471775847096026, tolerance: 0.013719247345967347
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 37.04415810584757, tolerance: 0.013719247345967347
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 11.814297974053666, tolerance: 0.013915184806156035
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 29.74742169576797, tolerance: 0.013915184806156035
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 11.172993166453935, tolerance: 0.013563753555977423
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
```

```
Duality gap: 36.35828072971578, tolerance: 0.013563753555977423
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 12.178129807556346, tolerance: 0.013715204815778544
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.270840881076296, tolerance: 0.013715204815778544
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 12.396935302740808, tolerance: 0.013830893331015535
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 35.97961565767729, tolerance: 0.013830893331015535
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 40.565481966943906, tolerance: 0.013725216724905493
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 42.21705330588992, tolerance: 0.014123290092369482
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 11.36247357726419, tolerance: 0.013752880544695674
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.91262857682644, tolerance: 0.013752880544695674
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 12.843710073720871, tolerance: 0.013889065078739877
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
```

```
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 36.46541249210879, tolerance: 0.013889065078739877
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 42.160668942932176, tolerance: 0.014158251392731108
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 35.9648977155617, tolerance: 0.01455725816168879
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 42.70606007197756, tolerance: 0.014200132137281211
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 34.593617622289514, tolerance: 0.014393475383925358
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 39.02699406077424, tolerance: 0.014041417544163829
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.31982955861802, tolerance: 0.01418313333209035
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 5.990156625778674, tolerance: 0.013786578962971075
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 37.07866695689543, tolerance: 0.014306489435414193
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.59672396925007, tolerance: 0.013904361486610521
```

```
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.722334098988696, tolerance: 0.014418480448371478
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.06520782105574, tolerance: 0.014224601355564914
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.89806794110898, tolerance: 0.014357499542533613
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 0.0395808470535286, tolerance: 0.013859093480151831
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.206954018521742, tolerance: 0.013859093480151831
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.955617622695371, tolerance: 0.013859093480151831
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 45.33688297760353, tolerance: 0.013859093480151831
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.1458372478466288, tolerance: 0.014258058927726155
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.0836795784087343, tolerance: 0.014258058927726155
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
```

```
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.8310828882451347, tolerance: 0.014258058927726155
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.85000690789457, tolerance: 0.014258058927726155
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.8122990907070147, tolerance: 0.01390107252164853
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.963140272494805, tolerance: 0.01390107252164853
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 40.96790673434178, tolerance: 0.014094381320551649
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.8586066962646868, tolerance: 0.01374231536369735
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.8575876198644607, tolerance: 0.01374231536369735
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.7412667307055472, tolerance: 0.01374231536369735
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.5304351845073967, tolerance: 0.01374231536369735
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 39.04795672969291, tolerance: 0.01374231536369735
  model = cd_fast.enet_coordinate_descent_gram(
```

```
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.13634662420219, tolerance: 0.013883915191350321
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.1389757115159256, tolerance: 0.013883915191350321
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.1499704920687606, tolerance: 0.013883915191350321
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.122827819976834, tolerance: 0.013883915191350321
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.0737180009502936, tolerance: 0.013883915191350321
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.8147215802831198, tolerance: 0.013883915191350321
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.648728598808894, tolerance: 0.013883915191350321
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.7596576789787974, tolerance: 0.0134874457430947
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 28.79876945842775, tolerance: 0.0134874457430947
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
```

```
Duality gap: 40.99372144069134, tolerance: 0.014007361027747377
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.164417392997393, tolerance: 0.013605211982889606
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.141725772899889, tolerance: 0.013605211982889606
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.1157531482959513, tolerance: 0.013605211982889606
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.7878805843198933, tolerance: 0.013605211982889606
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.25353367662191, tolerance: 0.013605211982889606
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.789482710518456, tolerance: 0.014046231127915153
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.350989759016144, tolerance: 0.014046231127915153
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.776419718694271, tolerance: 0.01429885076424951
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.76894002713427, tolerance: 0.01429885076424951
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
```

```
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 1.9467273157515592, tolerance: 0.014058286995831615
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.72196901309716, tolerance: 0.014058286995831615
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.0894611357605, tolerance: 0.014024783417259264
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 36.23745479529802, tolerance: 0.014420250216884206
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 42.42600245733687, tolerance: 0.014074346425843166
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 31.187673435876867, tolerance: 0.014265100364641873
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.628664829727299, tolerance: 0.01391241732338039
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 40.13695172967019, tolerance: 0.01391241732338039
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.972787903079123, tolerance: 0.014044429363342392
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.858520448725145, tolerance: 0.014044429363342392
```

```
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 15.001635839627092, tolerance: 0.013655130098633712
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 34.89806701761249, tolerance: 0.014175426472818496
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 2.9530689240234267, tolerance: 0.013771588629217556
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 40.775181044996714, tolerance: 0.013771588629217556
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 37.70362164591594, tolerance: 0.01421446978773399
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 43.51970400909724, tolerance: 0.014463830254971615
  model = cd_fast.enet_coordinate_descent_gram(

Mean CV score:  0.42984976903749605

C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.9607630291156, tolerance: 0.014059197139630457
  model = cd_fast.enet_coordinate_descent_gram(
```

[80]:
```
model_lasso = lasso.fit(X_train, y_train)

y3_pred = lasso.predict(X_train)

rmse(y3_pred,y_train)
```

```
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
```

```
Duality gap: 49.044290547216114, tolerance: 0.015151270252779393
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 30.418225750854077, tolerance: 0.015366965177081287
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 48.21187319249469, tolerance: 0.015214986226185617
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 0.892105576375684, tolerance: 0.015158959845744491
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 15.456298642542308, tolerance: 0.015069259741237932
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 47.335612810347946, tolerance: 0.015069259741237932
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 41.33391005026678, tolerance: 0.01487908645188081
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 26.937049405369265, tolerance: 0.015023604319544939
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 48.209048392315836, tolerance: 0.014992439021043876
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 14.614632672995228, tolerance: 0.015030438481461334
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
```

```
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 44.51847722156104, tolerance: 0.015030438481461334
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 46.83645273813144, tolerance: 0.015504346785604396
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 13.47749608010239, tolerance: 0.01520520059432298
  model = cd_fast.enet_coordinate_descent_gram(
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 49.55299834033617, tolerance: 0.01520520059432298
  model = cd_fast.enet_coordinate_descent_gram(
```

```
rmse:  0.36260550408847053
```

```
C:\Users\fjza9\.conda\envs\spyder5\lib\site-
packages\sklearn\linear_model\_coordinate_descent.py:526: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations.
Duality gap: 46.32993782750746, tolerance: 0.015372083714337646
  model = cd_fast.enet_coordinate_descent_gram(
```

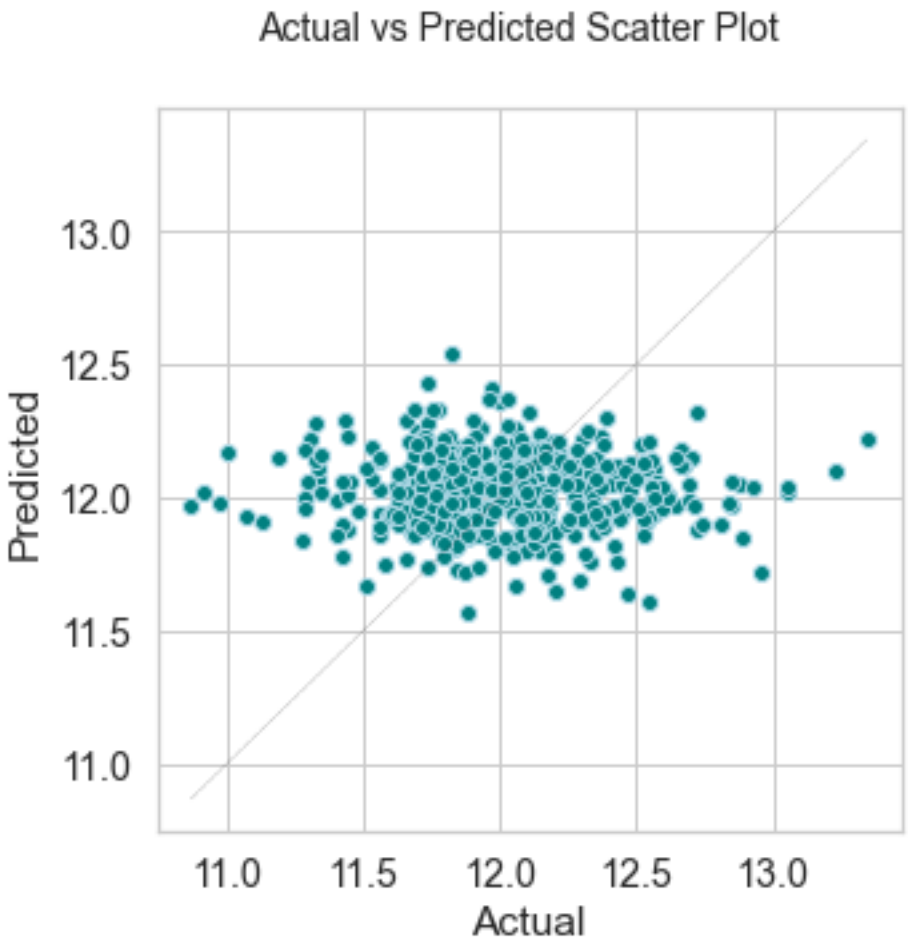
[81]:
```
y3_pred_v = lasso.predict(X_valid)

rmse(y3_pred_v, y_valid)
```

```
rmse:  0.4058586832817921
```

[82]:
```
actual_vs_pred_plot(y_valid,y3_pred_v)
```

```
<Figure size 864x864 with 0 Axes>
```



2.3.3 Arbol de decisión

[83]:
```
# ajustar la profundidad máxima a 5
tree_regr1 = tree.DecisionTreeRegressor(max_depth = 7,␣
 ↪min_samples_leaf=5,random_state=42)

# ajustar la profundidad máxima a 9
tree_regr2 = tree.DecisionTreeRegressor(max_depth =␣
 ↪9,min_samples_leaf=9,random_state=42)


tree_regr11 = tree_regr1.fit(X_train,y_train)
tree_regr12 = tree_regr2.fit(X_train,y_train)

y1 = tree_regr1.predict(X_train)
y2 = tree_regr2.predict(X_train)
```

[84]:
```
cross_validation(tree_regr1)
cross_validation(tree_regr2)
```

```
Mean CV score:  0.44351431440248495
Mean CV score:  0.4584291945505277
```

[85]:
```
rmse(y1,y_train)
```

```
rmse:  0.3238501847516405
```

[86]:
```
rmse(y2,y_train)
```

```
rmse:  0.319434991726199
```

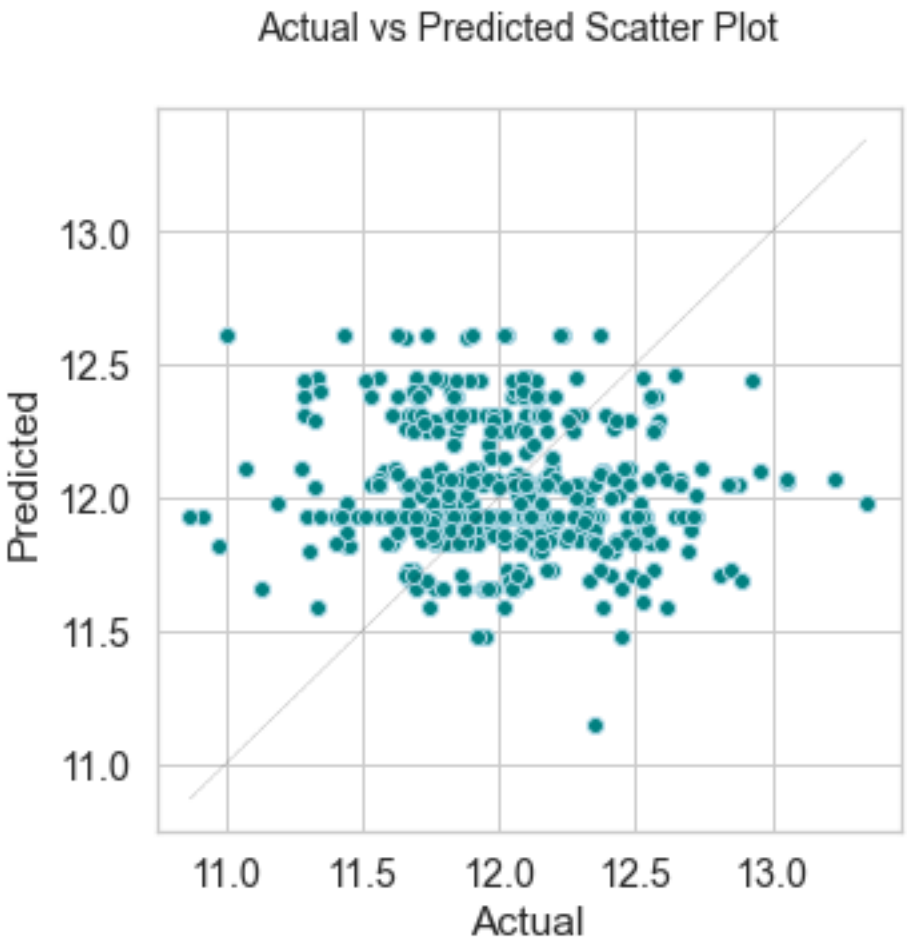
[87]:
```
y5_pred_v = tree_regr2.predict(X_valid)


rmse(y5_pred_v, y_valid)
```

```
rmse:  0.45816527813069785
```

[88]:
```
actual_vs_pred_plot(y_valid,y5_pred_v)
```

```
<Figure size 864x864 with 0 Axes>
```



2.3.4 Bosque aleatorio

Mi compu no lo corrio

[89]:
```
#rforest = RandomForestRegressor(n_estimators=200,max_depth=13,random_state=42)
```

[90]:
```
#param_grid  = {'n_estimators': [100,150,200,250,300,350,400],
               #'max_depth': [5,7,9,11,13,15,17],
               #'min_samples_leaf': [3,5,7,9,11,13,15]}


#clf = GridSearchCV(rforest, param_grid, cv = 5, n_jobs = -2)
#clf.fit(X_train,y_train)
```

[91]:
```
#clf.best_params_
```

[92]:
```
#rforest = RandomForestRegressor(n_estimators=, max_depth=5,␣
↪min_samples_leaf=3, random_state=42)
```

[93]:
```
#cross_validation(rforest)
```

[94]:
```
#model_rforest = rforest.fit(X_train, y_train)

#y6_pred = rforest.predict(X_train)

#rmse(y6_pred,y_train)
```

[95]:
```
#y6_pred_v = rforest.predict(X_valid)


#rmse(y6_pred_v, y_valid)
```

[96]:
```
#actual_vs_pred_plot(y_valid, y6_pred_v)
```

2.4 Conclusiónes

2.4.1 Comparar errores

Errores cuadraticos medios

Modelo

ERM entrenamiento

ERM validación

Regresión lineal

0.0.3438610544722426

0.42725618696108586

Modelo Lasso

0.36260550408847053

0.4058586832817921

Arbol de desición

0.3238501847516405, 0.319434991726199

0.45816527813069785

3 Modelos aplicados a los datos de sample_submission

[97]:
```
df_sub = pd.read_csv('Data/sample_submission.csv', sep = ',')
```

[98]:
```
df_sub.shape
```

[98]: (1459, 2)

[99]:
```
df_sub.head()
```

[99]:

	Id	SalePrice
0	1461	169277.052498
1	1462	187758.393989
2	1463	183583.683570
3	1464	179317.477511
4	1465	150730.079977

[100]:
```
X_test.shape
```

[100]: (1459, 279)

[101]:
```
y_final_pred = lasso.predict(X_test)

y_final_pred
```

[101]:
```
array([11.93709865, 12.26468829, 11.8807385 , …, 12.03871925,
       11.86699596, 12.165125  ])
```

[102]:
```
#deshacer la tranformación de log para obtener predicciones en términos de␣
↪etiqueta original
predictions = np.expm1(y_final_pred)
print(predictions)
```

```
[152831.62539928 212072.52032178 144456.19316714 … 169179.12401442
 142484.5629697  191974.87741837]
```

[103]:
```
submit = pd.DataFrame()
submit['Id'] = test_ID
submit['SalePrice'] = predictions
submit.to_csv('submission.csv',index=False)
```

[104]:
```
submit
```

[104]:

	Id	SalePrice
0	1461	152831.625399
1	1462	212072.520322
2	1463	144456.193167
3	1464	160281.258825
4	1465	176756.341919
…	…	…
1454	2915	136252.885374
1455	2916	146670.130852
1456	2917	169179.124014
1457	2918	142484.562970

```
1458  2919  191974.877418

[1459 rows x 2 columns]
```

[ ]: