In [1]:
```
df = pd.read_csv('data_assignment2.csv')

df = df.rename(columns = {'Selling_price':'Selling price (SEK)', 'Land_size':'Land size (m²)', 'Living_area':'Living area (m²)'})

df_readable = df.copy()
df_readable['Selling price (SEK)'] = df_readable.apply(lambda x: "{:,}".format(x['Selling price (SEK)']), axis=1)

df_readable.head()
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
C:\Users\MC22E~1.SUL\AppData\Local\Temp/ipykernel_16724/2908613453.py in <module>
----> 1 df = pd.read_csv('data_assignment2.csv')
      2
      3 df = df.rename(columns = {'Selling_price':'Selling price (SEK)', 'Land_size':'Land size (m²)', 'Living_area':'Living are
a (m²)'})
      4
      5 df_readable = df.copy()

NameError: name 'pd' is not defined
```

In [2]:
```
# Data Manipulation
import pandas as pd
import numpy as np

# DataViz
import seaborn as sns
import matplotlib.pyplot as plt

# Modeling
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.neighbors import KNeighborsRegressor
```

In [3]:
```
# Load and view dataset
df = sns.load_dataset('diamonds')
df.head()
```

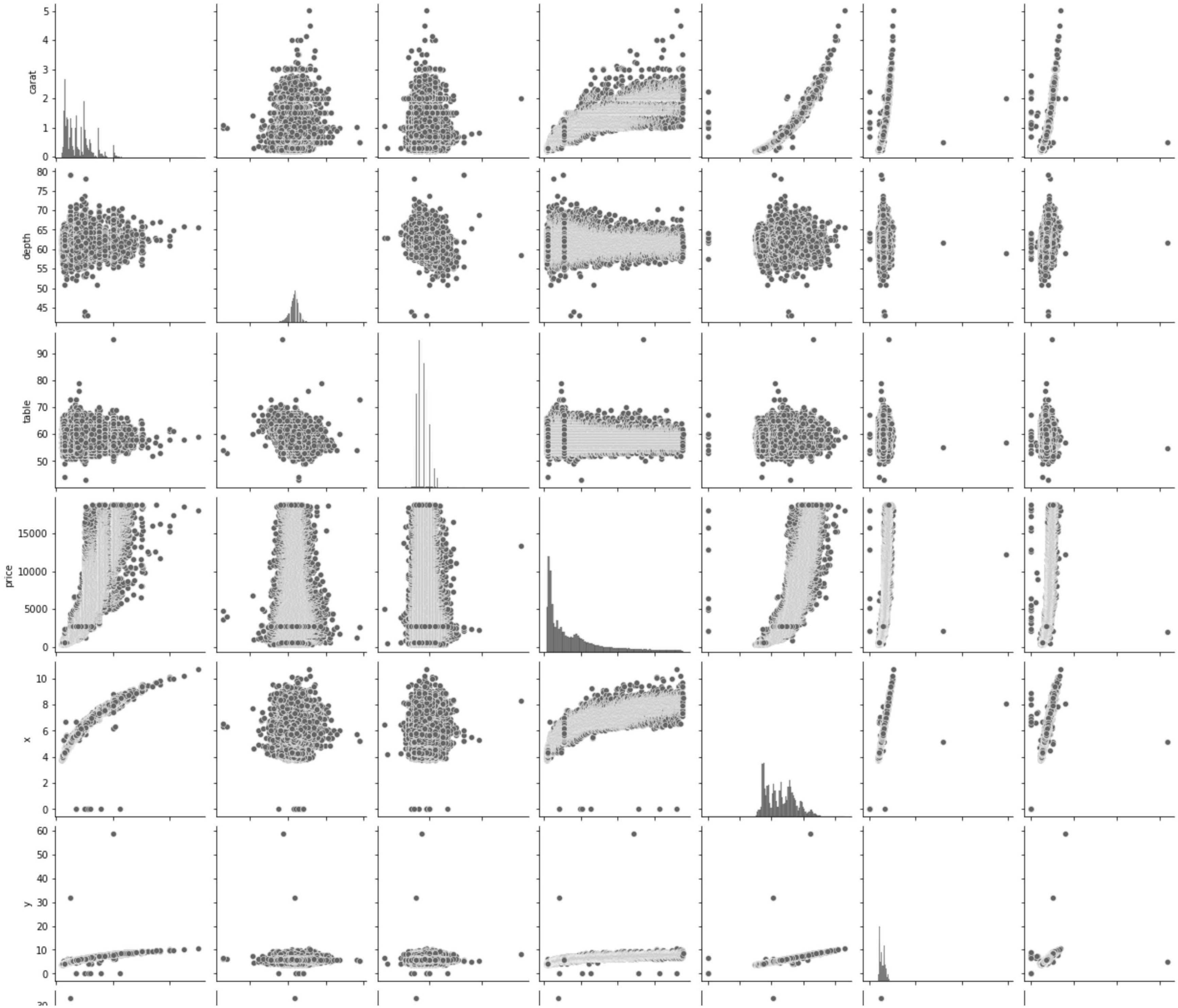
Out[3]:

	carat	cut	color	clarity	depth	table	price	x	y	z
0	0.23	Ideal	E	SI2	61.5	55.0	326	3.95	3.98	2.43
1	0.21	Premium	E	SI1	59.8	61.0	326	3.89	3.84	2.31
2	0.23	Good	E	VS1	56.9	65.0	327	4.05	4.07	2.31
3	0.29	Premium	I	VS2	62.4	58.0	334	4.20	4.23	2.63
4	0.31	Good	J	SI2	63.3	58.0	335	4.34	4.35	2.75

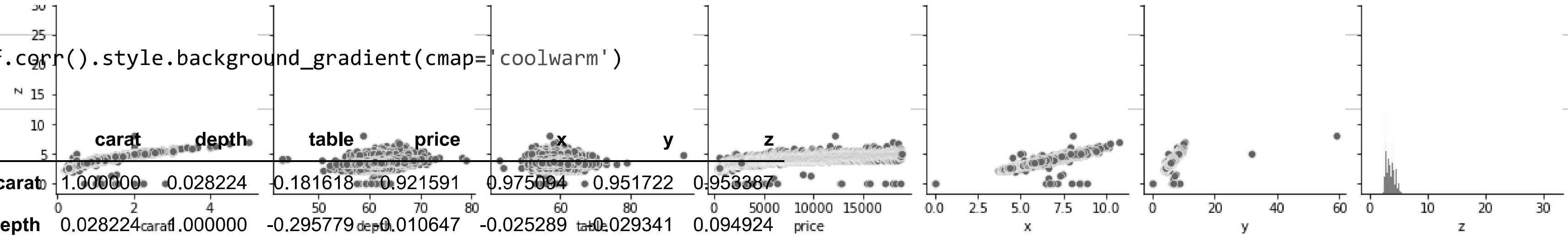
In [4]:
```
# Data shape
print(f'Number of rows: {df.shape[0]} | Columns (variables): {df.shape[1]}')
```

```
Number of rows: 53940 | Columns (variables): 10
```

In [5]:
```
# Let's see the possible best variables for modeling the carat
sns.pairplot(df);
```



carat
depth
table
price
x
y



In [6]:
```python
df.corr().style.background_gradient(cmap='coolwarm')
```

Out[6]:

	carat	depth	table	price	x	y	z
carat	1.000000	0.028224	0.181618	0.921591	0.975094	0.951722	0.953387
depth	0.028224	1.000000	-0.295779	-0.010647	-0.025289	-0.029341	0.094924
table	0.181618	-0.295779	1.000000	0.127134	0.195344	0.183760	0.150929
price	0.921591	-0.010647	0.127134	1.000000	0.884435	0.865421	0.861249
x	0.975094	-0.025289	0.195344	0.884435	1.000000	0.974701	0.970772
y	0.951722	-0.029341	0.183760	0.865421	0.974701	1.000000	0.952006
z	0.953387	0.094924	0.150929	0.861249	0.970772	0.952006	1.000000

In [7]:
```python
# Checking for missing values
df.isna().sum()
```

Out[7]:
```
carat      0
cut        0
color      0
clarity    0
depth      0
table      0
price      0
x          0
y          0
z          0
dtype: int64
```

In [8]:
```python
X = df[['x', 'y', 'z']]
y = df.carat
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size= 0.2, random_state=12)
```

In [10]:
```python
print(f'Train: {X_train.shape, y_train.shape}  \nTest: {X_test.shape, y_test.shape}')
```

```
Train: ((43152, 3), (43152,))
Test: ((10788, 3), (10788,))
```

In [11]:

```
# Extract the descriptive statistics for the explanatory variables for IQR calculation
X_train.describe().T
```

Out[11]:

	count	mean	std	min	25%	50%	75%	max
x	43152.0	5.731283	1.122783	0.0	4.71	5.69	6.54	10.74
y	43152.0	5.734739	1.150275	0.0	4.72	5.71	6.54	58.90
z	43152.0	3.538536	0.708813	0.0	2.91	3.53	4.03	31.80

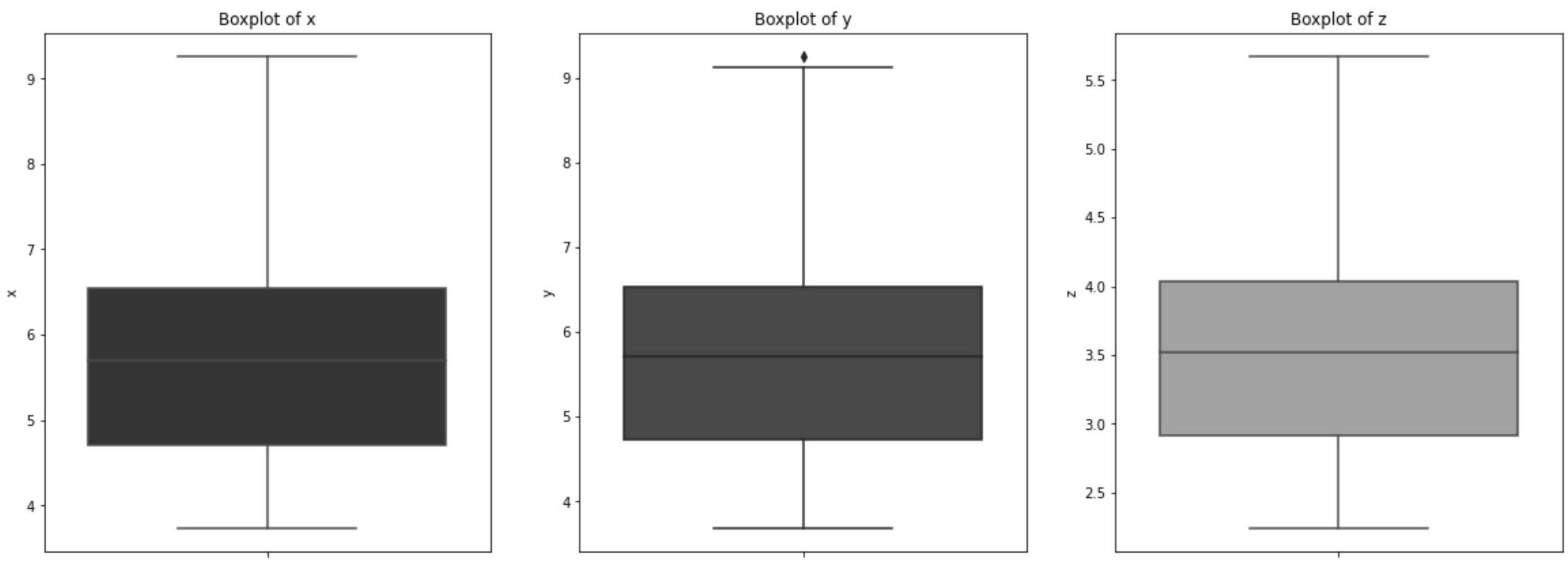
In [12]:

```
# Extracting the quantiles
x_25 = X_train.describe().T.loc['x', '25%']
x_75 = X_train.describe().T.loc['x', '75%']
y_25 = X_train.describe().T.loc['y', '25%']
y_75 = X_train.describe().T.loc['y', '75%']
z_25 = X_train.describe().T.loc['z', '25%']
z_75 = X_train.describe().T.loc['z', '75%']

# Calculate IQRs
IQR_x = 1.5 * (x_75 - x_25)
IQR_y = 1.5 * (y_75 - y_25)
IQR_z = 1.5 * (z_75 - z_25)
```

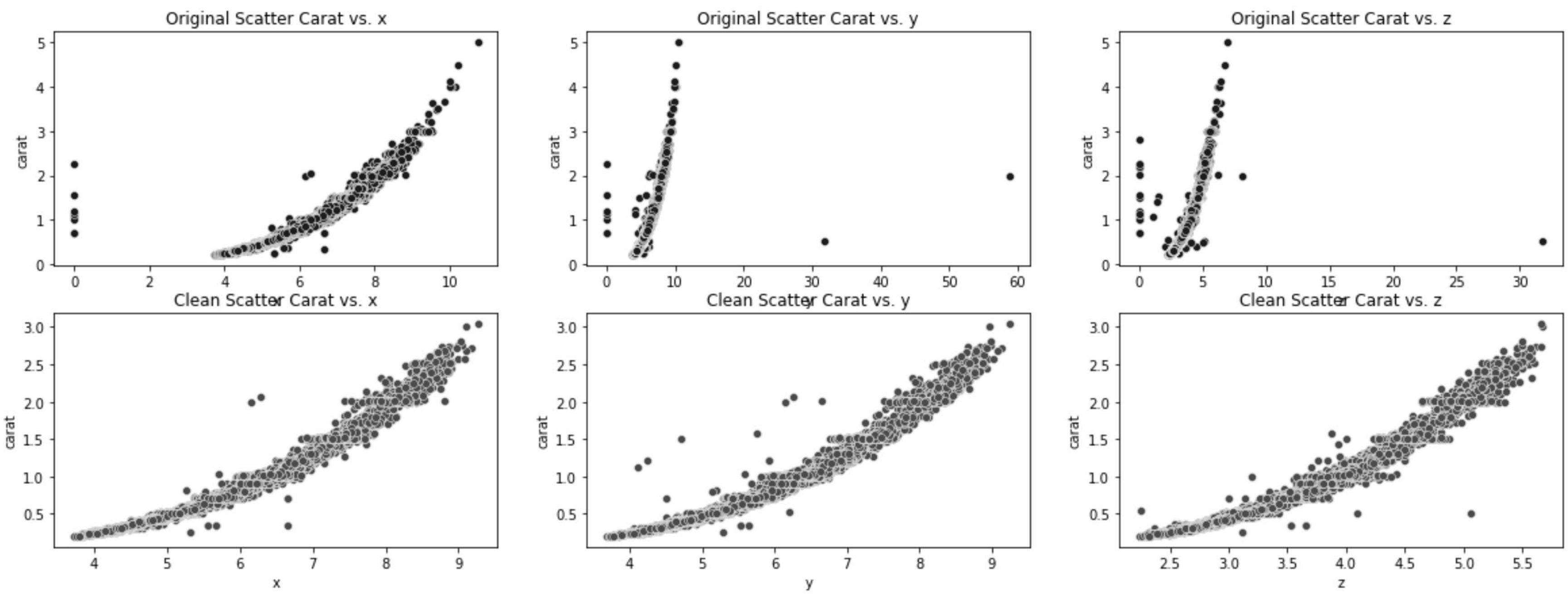
In [13]:

```
# Remove outliers from the variable 'x'
X_train = X_train.query(' x >= (@x_25 - @IQR_x) & x <= (@x_75 + @IQR_x) ')
y_train = y_train[X_train.index]

# Remove outliers from the variable 'y'
X_train = X_train.query(' z >= (@y_25 - @IQR_y) & y <= (@y_75 + @IQR_y) ')
y_train = y_train[X_train.index]

# Remove outliers from the variable 'z'
X_train = X_train.query(' x >= (@z_25 - @IQR_z) & z <= (@z_75 + @IQR_z) ')
y_train = y_train[X_train.index]
```

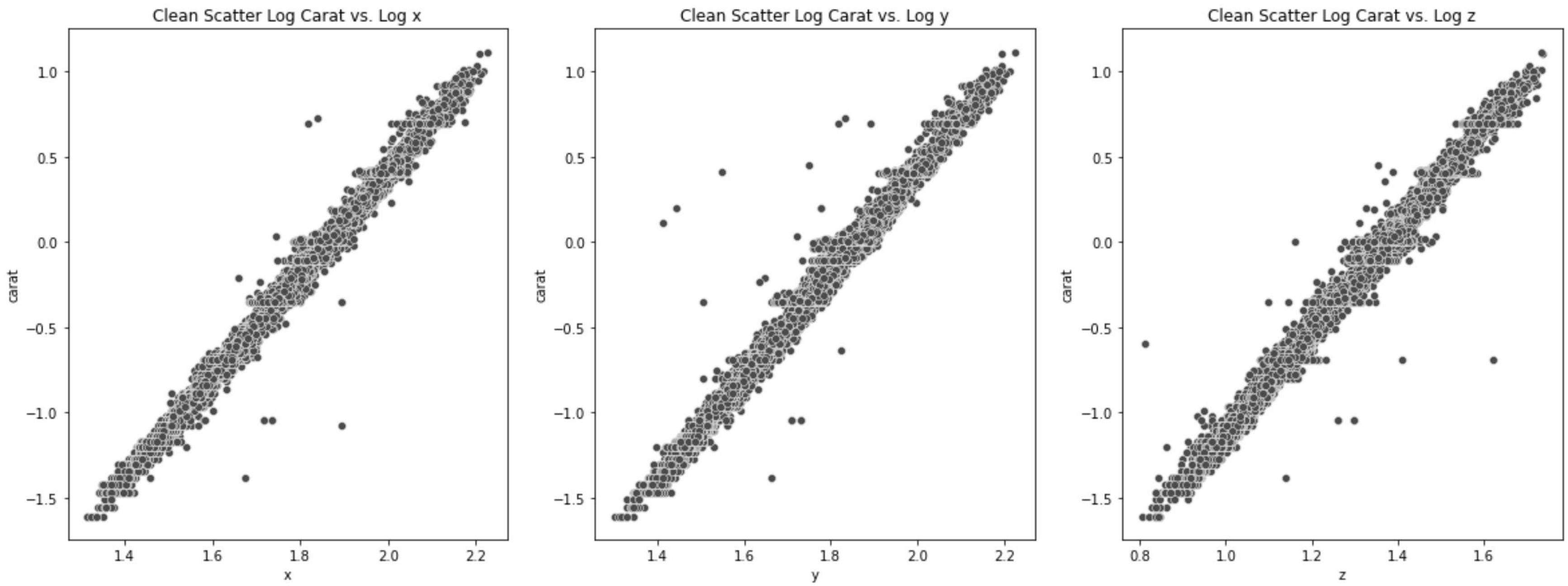
In [14]:
```
# setup figure
fig, ax = plt.subplots(1,3, figsize=(20,7))

# plot1
g1 = sns.boxplot(y=X_train.x, color='blue', ax=ax[0])
g1.set_title('Boxplot of x')

# plot2
g2 = sns.boxplot(y=X_train.y, color='green', ax=ax[1])
g2.set_title('Boxplot of y')

# plot3
g3 = sns.boxplot(y=X_train.z, color='orange', ax=ax[2])
g3.set_title('Boxplot of z');
```



In [16]:
```python
# setup figure
fig, ax = plt.subplots(2,3, figsize=(20,7))

for i, var in enumerate(['x', 'y', 'z']):
  # Original data plots
  g= sns.scatterplot(data= df, x=var, y='carat', color='blue', ax=ax[0][i])
  g.set_title(f'Original Scatter Carat vs. {var}')


df_clean = pd.concat([X_train, y_train], axis=1)

for i, var in enumerate(['x', 'y', 'z']):
  # Cleaned data plots
  g= sns.scatterplot(data= df_clean, x=var, y='carat', color='green', ax=ax[1][i])
  g.set_title(f'Clean Scatter Carat vs. {var}')
```



In [17]:
```
# setup figure
fig, ax = plt.subplots(1,3, figsize=(20,7))

for i, var in enumerate(['x', 'y', 'z']):
  log_var = np.log(df_clean[var])
  # Cleaned data plots
  g= sns.scatterplot(x=log_var, y= np.log(df_clean.carat), color='green', ax=ax[i]);
  g.set_title(f'Clean Scatter Log Carat vs. Log {var}');
```



In [18]:
```
# Log transformation
X_log = np.log(X_train)
y_log = np.log(y_train)
```

In [19]:
```
# Instance and fit
lr_model = LinearRegression().fit(X_train, y_train)

# Score
score_lr = lr_model.score(X_test, y_test)
score_lr
```

Out[19]:
```
0.9534250731184013
```

In [20]:
```
# Instance and fit
lrLog_model = LinearRegression().fit(X_log, y_log)

# Remove zeroes
X_test_log = X_test[(X_test.x > 0) & (X_test.y > 0) & (X_test.z > 0) ]
y_test_log = y_test[X_test_log.index]

# Log Transform X_test and y test
X_test_log = np.log(X_test_log)
y_test_log = np.log(y_test_log)

# Score
score_log = lrLog_model.score(X_test_log, y_test_log)
score_log
```

Out[20]: 0.9988479198247474

In [21]:
```
# Predictions
preds = lrLog_model.predict(X_test_log)

# Performance
pd.DataFrame({ 'True Value': np.exp(y_test_log),
               'Prediction': np.exp(preds)}).head(5)
```

Out[21]:

	True Value	Prediction
45936	0.51	0.517710
23023	0.35	0.348205
34325	0.39	0.391145
38578	0.40	0.403460
15979	1.20	1.225848

In [22]:
```
# Instance and fit
knn_model = KNeighborsRegressor(n_neighbors=5).fit(X_train, y_train)

# Score
score_knn = knn_model.score(X_test, y_test)
score_knn
```

Out[22]: 0.99785313406391

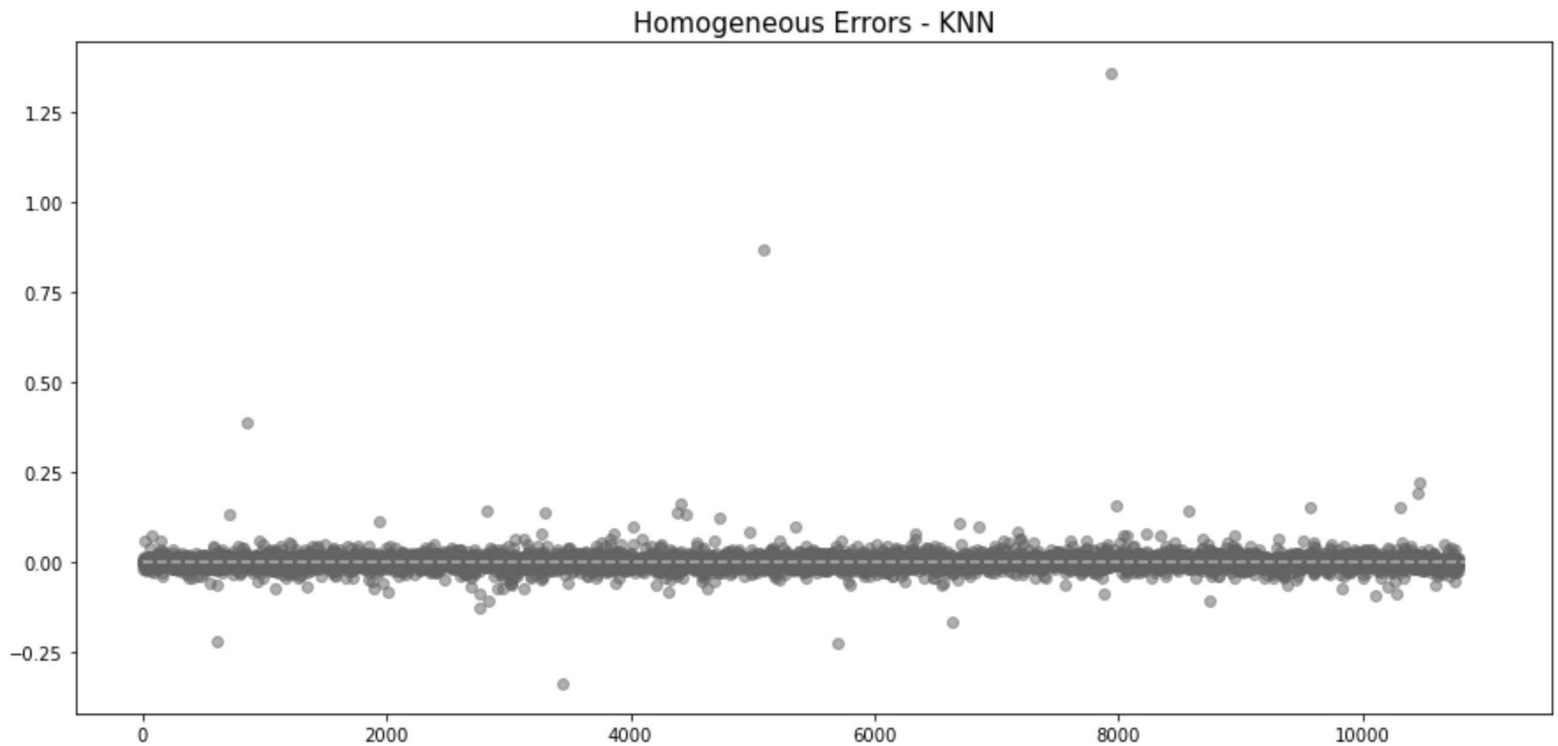
In [23]:
```
# Predictions
preds = knn_model.predict(X_test)

# Performance
performance = pd.DataFrame({ 'True Value': y_test,
                             'Prediction': preds,
                             'Error': y_test - preds})
# View
performance
```

Out[23]:

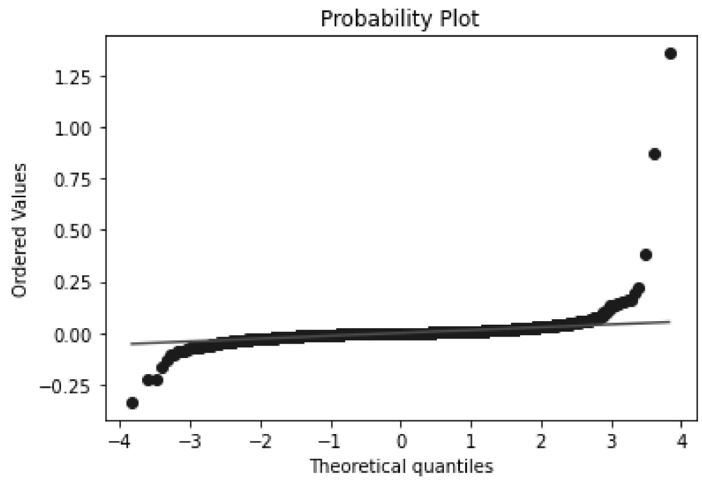
	True Value	Prediction	Error
45936	0.51	0.516	-0.006
23023	0.35	0.348	0.002
34325	0.39	0.396	-0.006
38578	0.40	0.402	-0.002
15979	1.20	1.220	-0.020
...	...	...	...
2106	0.90	0.900	0.000
18207	1.25	1.258	-0.008
37536	0.40	0.404	-0.004
5815	0.73	0.722	0.008
35887	0.32	0.320	0.000

10788 rows × 3 columns

In [24]:
```
plt.figure(figsize=(15,7))
# Errors
ax_x= performance['True Value']
ax_y= performance['Prediction']
yerr= performance['Error']

plt.scatter(range(len(yerr)), yerr, alpha=.5)
plt.title('Homogeneous Errors - KNN', size=15);
plt.hlines(y=0, xmin=0, xmax=11000, linestyle='--', color='white', alpha=.5);
#plt.ylim(-.3, .3);
```

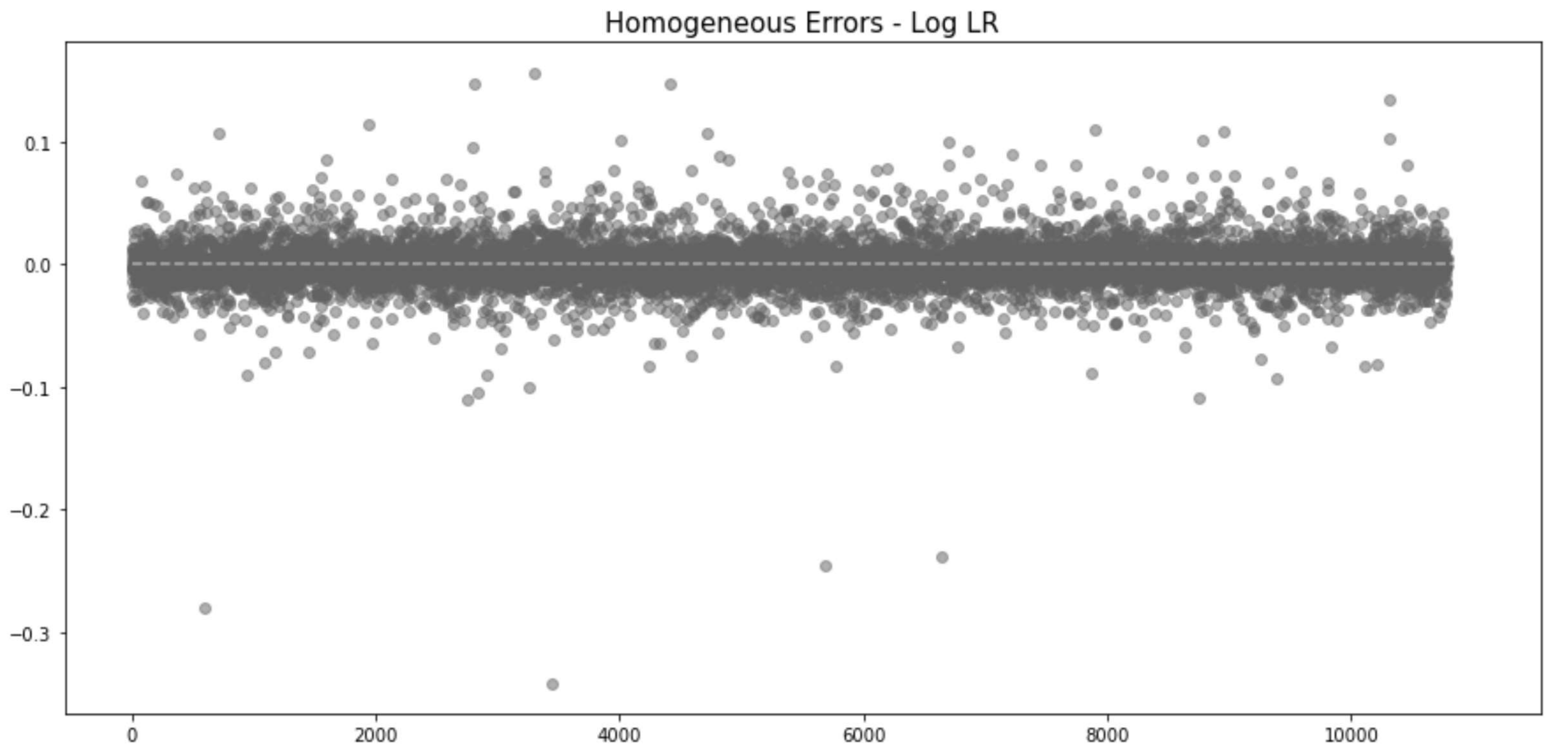


In [25]:
```
from scipy.stats import probplot
#QQ Plot
probplot(yerr, dist='norm', plot=plt);
```

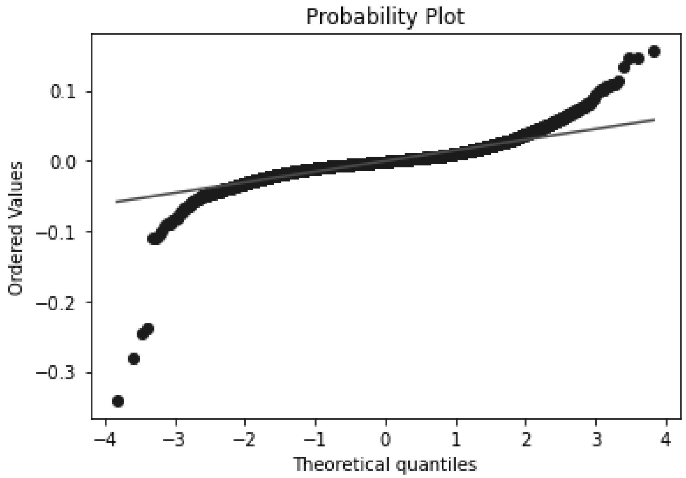


In [26]:
```
# Predictions
preds = lrLog_model.predict(X_test_log)

# Performance
LR_log_performance = pd.DataFrame({ 'True Value': np.exp(y_test_log),
                                    'Prediction': np.exp(preds),
                                    'Error': np.exp(y_test_log) - np.exp(preds)})
```

In [27]:
```python
plt.figure(figsize=(15,7))
# Errors
ax_x= LR_log_performance['True Value']
ax_y= LR_log_performance['Prediction']
yerr= LR_log_performance['Error']

plt.scatter(range(len(yerr)), yerr, alpha=.5)
plt.title('Homogeneous Errors - Log LR', size=15);
plt.hlines(y=0, xmin=0, xmax=11000, linestyle='--', color='white', alpha=.5);
#plt.ylim(-.3, .3);
```



In [28]:
```
# QQ Plot
probplot(yerr, dist='norm', plot=plt);
```



In [29]:
```
pd.DataFrame({'Linear Regression':[score_lr],
              'Log_Linear Regression': [score_log],
              'KNN Regression': [score_knn]})
```

Out[29]:

	Linear Regression	Log_Linear Regression	KNN Regression
0	0.953425	0.998848	0.997853