eda_primary

October 22, 2024

[1]:
```
# Load necessary libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from scipy import stats
import seaborn as sns
from matplotlib import gridspec
import math
import json
```

0.1 Data Analysis on Primary

[2]:
```
# set this to either primary or secondary depending on the analysis you want to␣
↪do
dataset = 'primary'

mappings = json.load(open(f'../dataset/mapping_{dataset}.json'))
data = pd.read_csv(f'../dataset/mapped_{dataset}.csv')
```

[3]:
```
# drop the uuid column as it isn't a quantitative value
data = data.select_dtypes(include=['number'])
print(data.describe())
```

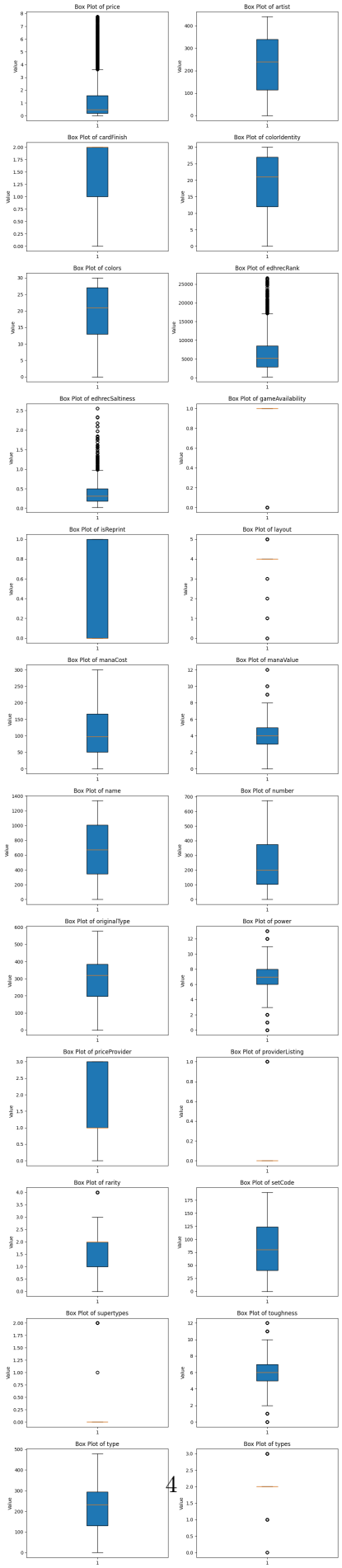
```
              price        artist    cardFinish  colorIdentity        colors  \
count  15214.000000  15214.000000  15214.000000   15214.000000  15214.000000
mean       1.274955    226.710661      1.664322      18.078020     18.300841
std        1.687801    128.233722      0.542586       9.667796      9.662374
min        0.010000      0.000000      0.000000       0.000000      0.000000
25%        0.200000    114.000000      1.000000      12.000000     13.000000
50%        0.490000    240.000000      2.000000      21.000000     21.000000
75%        1.570000    340.000000      2.000000      27.000000     27.000000
max        7.760000    441.000000      2.000000      30.000000     30.000000

         edhrecRank  edhrecSaltiness  gameAvailability     isReprint  \
count  15214.000000     15214.000000      15214.000000  15214.000000
mean    6407.912120         0.393107          0.817405      0.365124
std     4896.242696         0.316997          0.386347      0.481481
min      211.000000         0.020000          0.000000      0.000000
```

```
25%     2828.000000          0.180000          1.000000       0.000000
50%     5196.000000          0.310000          1.000000       0.000000
75%     8537.500000          0.500000          1.000000       1.000000
max    26676.000000          2.550000          1.000000       1.000000

              layout  …  originalType         power  priceProvider  \
count  15214.000000  …  15214.000000  15214.000000   15214.000000
mean       4.000394  …    303.010911      6.702314       1.513935
std        0.263216  …    142.318077      2.498153       1.077383
min        0.000000  …      0.000000      0.000000       0.000000
25%        4.000000  …    197.000000      6.000000       1.000000
50%        4.000000  …    320.000000      7.000000       1.000000
75%        4.000000  …    385.000000      8.000000       3.000000
max        5.000000  …    578.000000     13.000000       3.000000

       providerListing        rarity       setCode    supertypes  \
count     15214.000000  15214.000000  15214.000000  15214.000000
mean          0.171815      2.001906     82.234849      0.027869
std           0.377232      0.941633     52.203650      0.233885
min           0.000000      0.000000      0.000000      0.000000
25%           0.000000      1.000000     40.000000      0.000000
50%           0.000000      2.000000     80.000000      0.000000
75%           0.000000      2.000000    124.000000      0.000000
max           1.000000      4.000000    190.000000      2.000000

          toughness          type         types
count  15214.000000  15214.000000  15214.000000
mean       6.369988    223.054686      1.994939
std        1.981382    122.022967      0.197368
min        0.000000      0.000000      0.000000
25%        5.000000    131.000000      2.000000
50%        6.000000    233.000000      2.000000
75%        7.000000    294.000000      2.000000
max       12.000000    479.000000      3.000000

[8 rows x 24 columns]
```

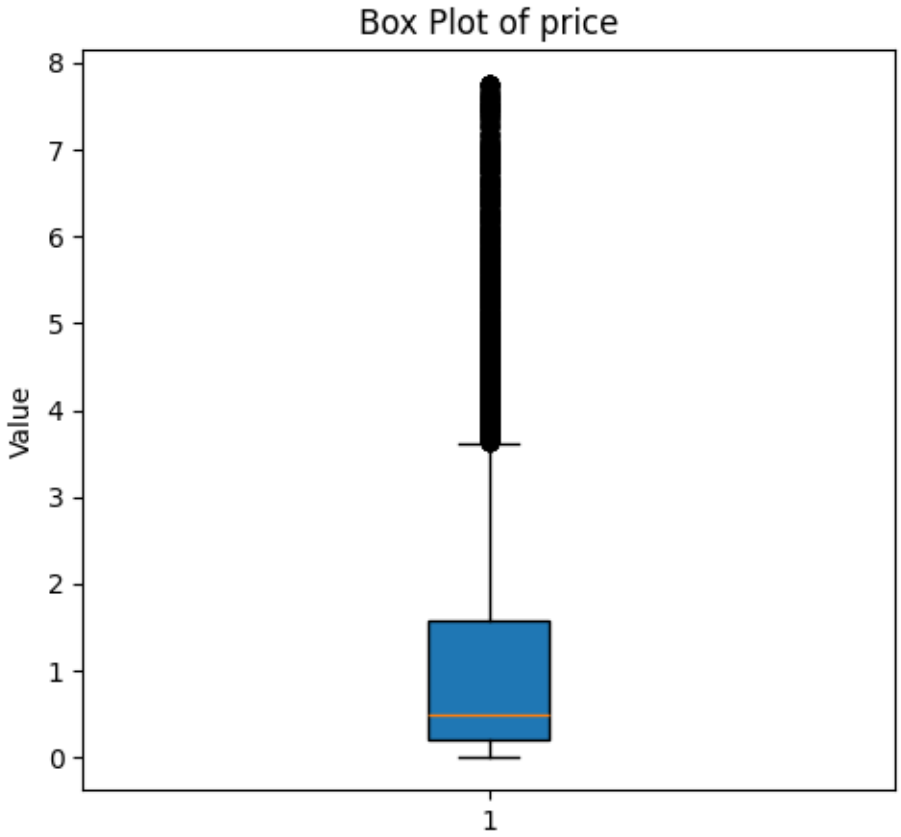
[4]:
```python
# plot function
def plot(data, type, color=plt.cm.viridis(0.2), bins=None, lim=None,␣
 ↪mapping_dict=None):
    """Creates plots for the quantitative DataFrame
    Args:
        - data: dataframe
        - type: type of plot (hist, box)
        - color: plot color
        - bins: number of bins in this hist
        - lim: optional bound for graph
```

```
    """
    # subplot calcuations for size
    num = len(data.columns)
    ncols = 2
    nrows = int(np.ceil(num / ncols))

    # size based on nrows
    plt.figure(figsize=(12, 5*nrows))

    for i, column in enumerate(data.columns):
        plt.subplot(nrows,ncols,i+1)
        if type == "hist":
            plt.hist(data[column], color = color, bins=bins)
            plt.title(f"Histogram of {column}")
            plt.ylabel("Frequency")
            plt.xlabel("Value")
            if lim:
                plt.title(f"Histogram of {column} bounded under {lim}")
                plt.xlim(0,lim)

        elif type == "box":
            if bins == 2 and column != "price":
                sns.boxplot(x = column, y = "price", data = data)
                plt.ylabel("price")
            else:
                plt.boxplot(data[column], whis=lim, patch_artist=True)
                plt.ylabel("Value")
            plt.title(f"Box Plot of {column}")
            if lim:
                plt.ylim(0,lim)
    plt.show()
```

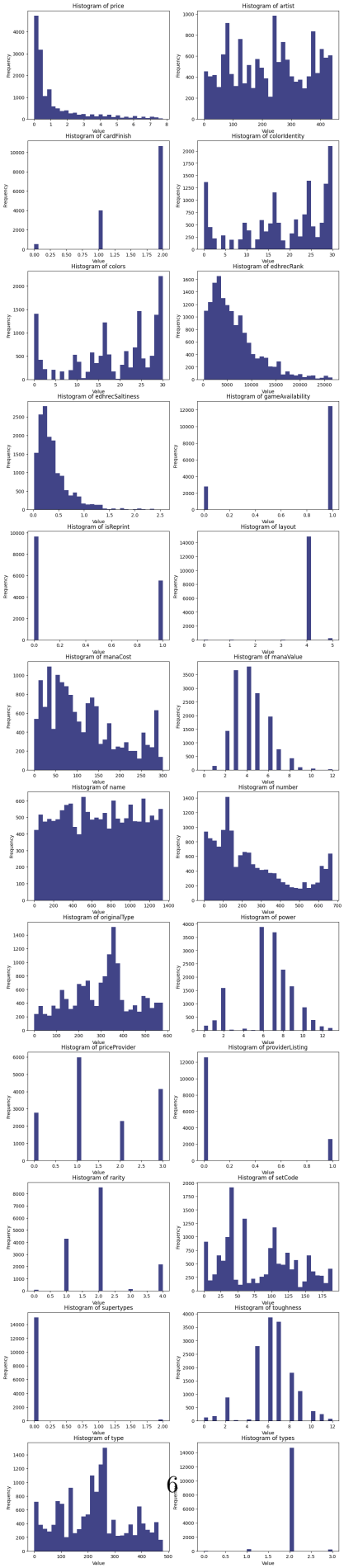
[5]:
```
plot(data, "box")
```


Box Plot of price
Box Plot of artist
Box Plot of cardFinish
Box Plot of colorIdentity
Box Plot of colors
Box Plot of edhrecRank
Box Plot of edhrecSaltiness
Box Plot of gameAvailability
Box Plot of isReprint
Box Plot of layout
Box Plot of manaCost
Box Plot of manaValue
Box Plot of name
Box Plot of number
Box Plot of originalType
Box Plot of power
Box Plot of priceProvider
Box Plot of providerListing
Box Plot of rarity
Box Plot of setCode
Box Plot of supertypes
Box Plot of toughness
Box Plot of type
Box Plot of types
Value
1

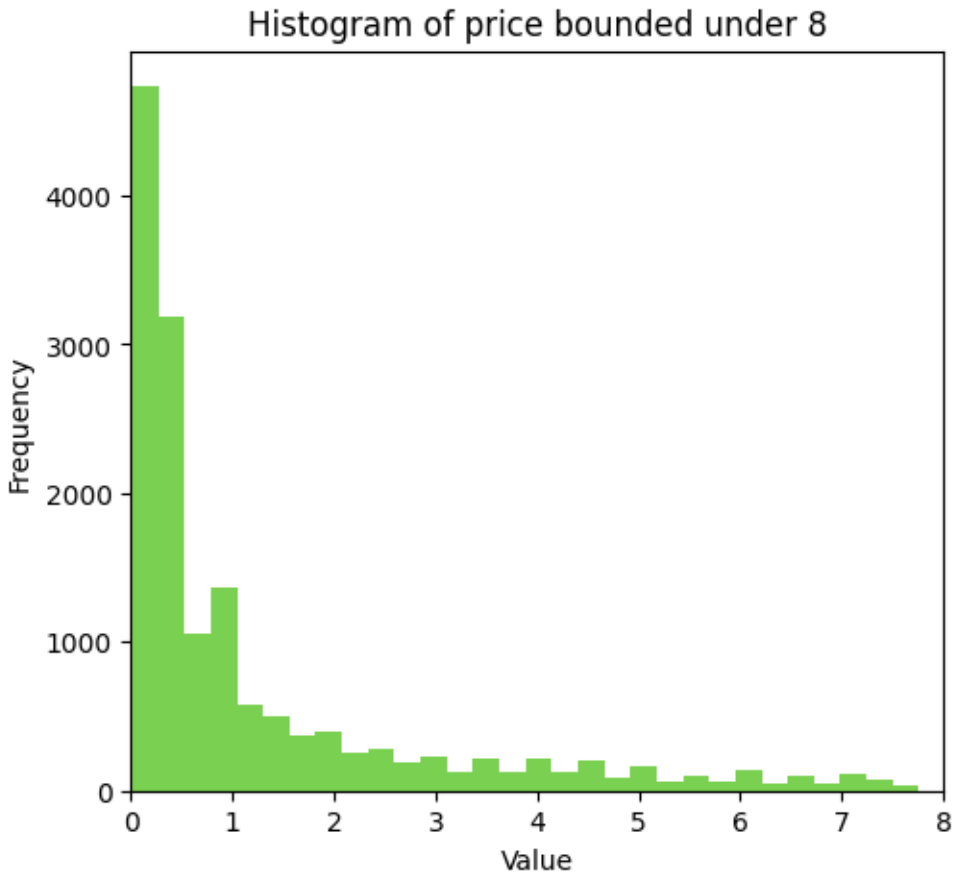
[6]:
```
plot(data[["price"]], "box")
```



[7]:
```
plot(data, "hist", bins=30)
```


Histogram of price
Histogram of artist
Histogram of cardFinish
Histogram of colorIdentity
Histogram of colors
Histogram of edhrecRank
Histogram of edhrecSaltiness
Histogram of gameAvailability
Histogram of isReprint
Histogram of layout
Histogram of manaCost
Histogram of manaValue
Histogram of name
Histogram of number
Histogram of originalType
Histogram of power
Histogram of priceProvider
Histogram of providerListing
Histogram of rarity
Histogram of setCode
Histogram of supertypes
Histogram of toughness
Histogram of type
Histogram of types
Frequency
Value

[8]:
```
plot(data[["price"]], "hist", plt.cm.viridis(0.8), bins=30, lim=8)
print(data['price'].describe())
```

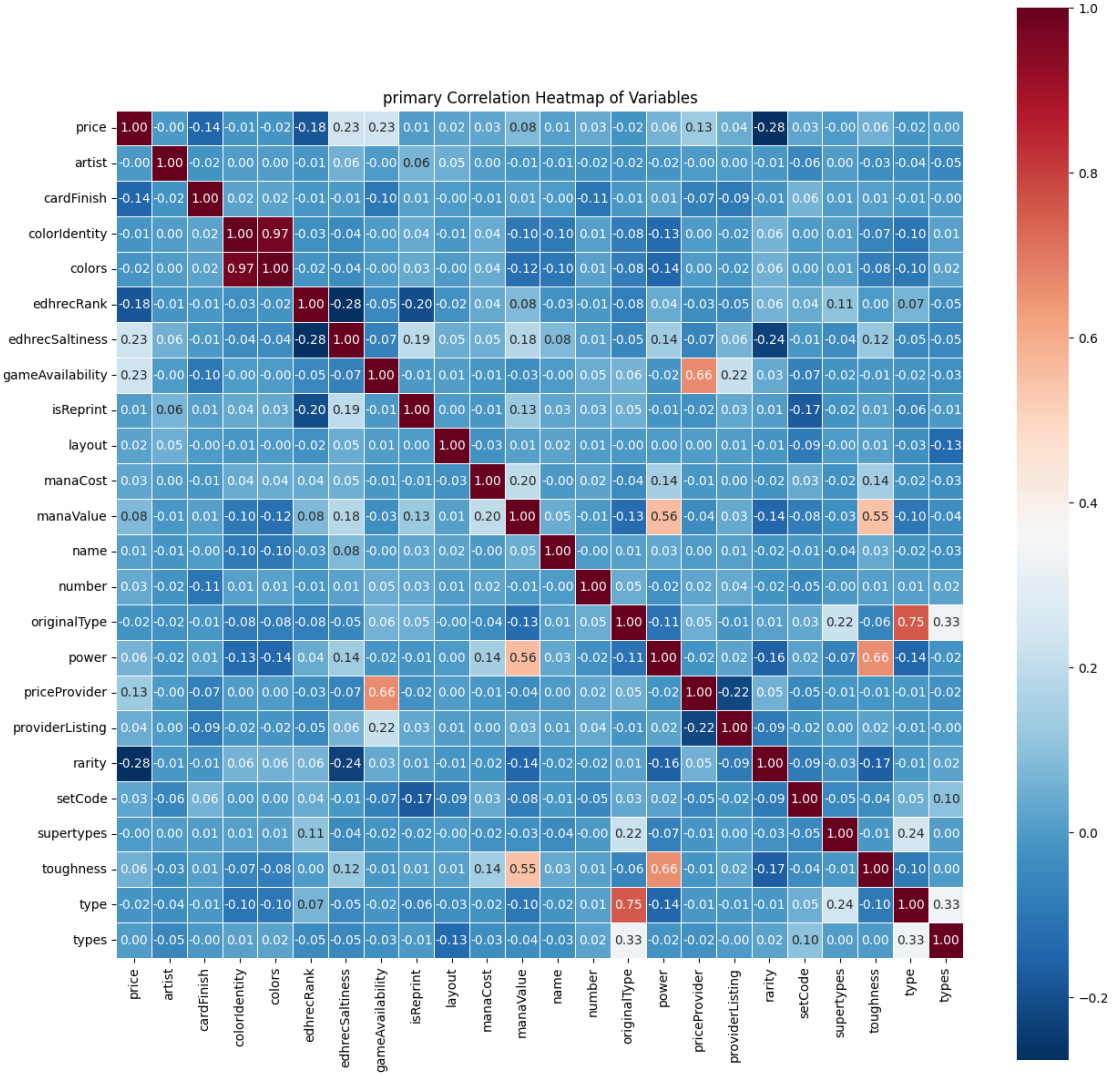



```
count    15214.000000
mean         1.274955
std          1.687801
min          0.010000
25%          0.200000
50%          0.490000
75%          1.570000
max          7.760000
Name: price, dtype: float64
```

[9]:
```
# Correlations
def corr(data, dataset):
    """Plot correlation between variables in a dataframe
    Args:
```

```
        - data: dataframe
    """
    correlation_matrix = data.corr()

    # get price to be the first variable
    ordered = ['price'] + [col for col in correlation_matrix.columns if col !=␣
↪'price']
    ordered_correlation_matrix = correlation_matrix.loc[ordered, ordered]

    plt.figure(figsize=(15,15))
    sns.heatmap(ordered_correlation_matrix, annot=True, fmt='.2f',␣
↪cmap='RdBu_r', square=True, linewidths=0.5)
    plt.title(f"{dataset} Correlation Heatmap of Variables")
    plt.savefig(f'../dataset/graphs/Correlation_{dataset}.png', format='png')
    plt.show()
```

[10]:
```
corr(data, dataset)
```



[11]:
```
from statsmodels.stats.outliers_influence import variance_inflation_factor
from statsmodels.tools.tools import add_constant

df = data.copy()
# Define a function to calculate VIF
def calculate_vif(df):
    # Adding a constant for intercept
    X = add_constant(df)
    vif_data = pd.DataFrame()
    vif_data['feature'] = X.columns
    vif_data['VIF'] = [variance_inflation_factor(X.values, i) for i in range(X.
 ↪shape[1])]
    return vif_data
```

```
# Calculate VIF
vif_results = calculate_vif(df.drop(columns='price'))  # Drop the dependent␣
 ↪variable
print("Variance Inflation Factor (VIF) results:")

# Identify features with high VIF
high_vif = vif_results[vif_results['VIF'] > 10]  # or 5 based on context
print("\nFeatures with high VIF (> 10):")
print(high_vif)
```

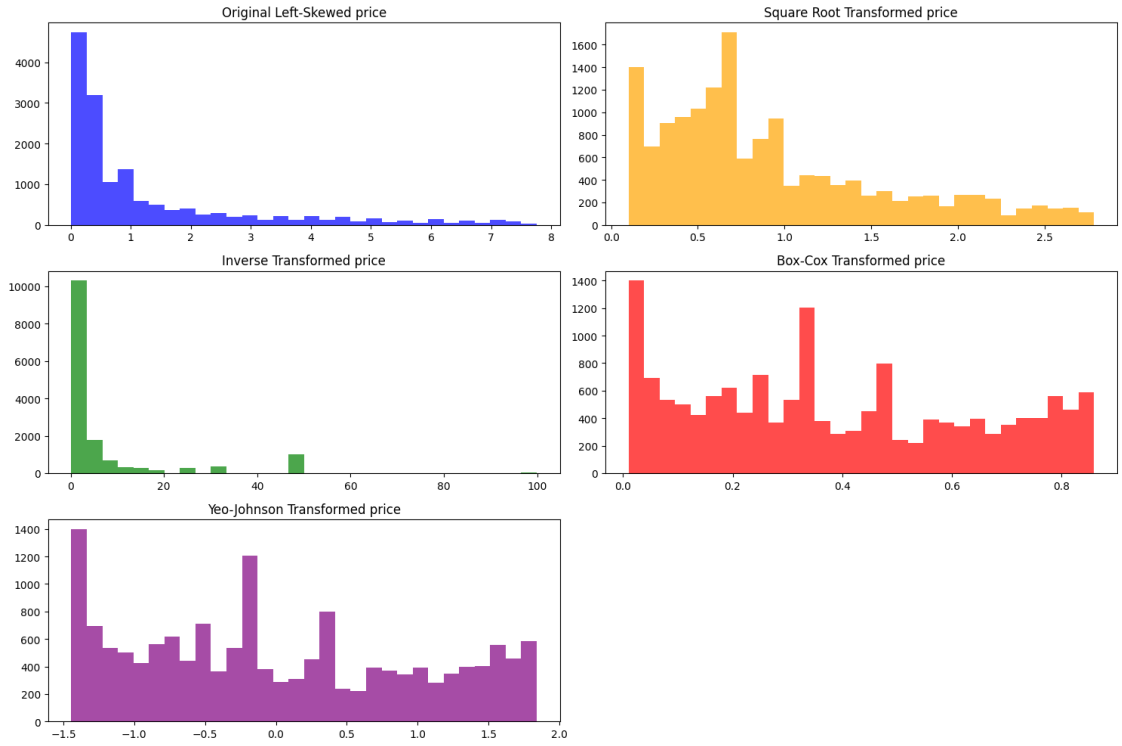
```
Variance Inflation Factor (VIF) results:

Features with high VIF (> 10):
         feature         VIF
0          const  450.867711
3  colorIdentity   20.310883
4         colors   20.384228
```

[12]:
```
# drop primary colorIdentity
data = data.drop(columns='colorIdentity')
```

[13]:
```
## transform data for normalcy
df = data.copy()


import scipy.stats as stats
from sklearn.preprocessing import PowerTransformer


def transforms (df, col):
    df['square_root_transformed'] = np.sqrt(df[col])
    df['inverse_transformed'] = 1 / (df[col] + 1e-5)  # Adding a small value to␣
 ↪avoid division by zero
    df['boxcox_transformed'], _ = stats.boxcox(df[col] + 1)  # Adding 1 to␣
 ↪handle zeros
    pt = PowerTransformer(method='yeo-johnson')
    df['yeo_transformed'] = pt.fit_transform(df[[col]])

    skewness = {
        'Original': df[col].skew(),
        'Square Root': df['square_root_transformed'].skew(),
        'Inverse': df['inverse_transformed'].skew(),
        'Box-Cox': df['boxcox_transformed'].skew(),
        'Yeo-Johnson': df['yeo_transformed'].skew(),
    }

    for transform, skew in skewness.items():
```

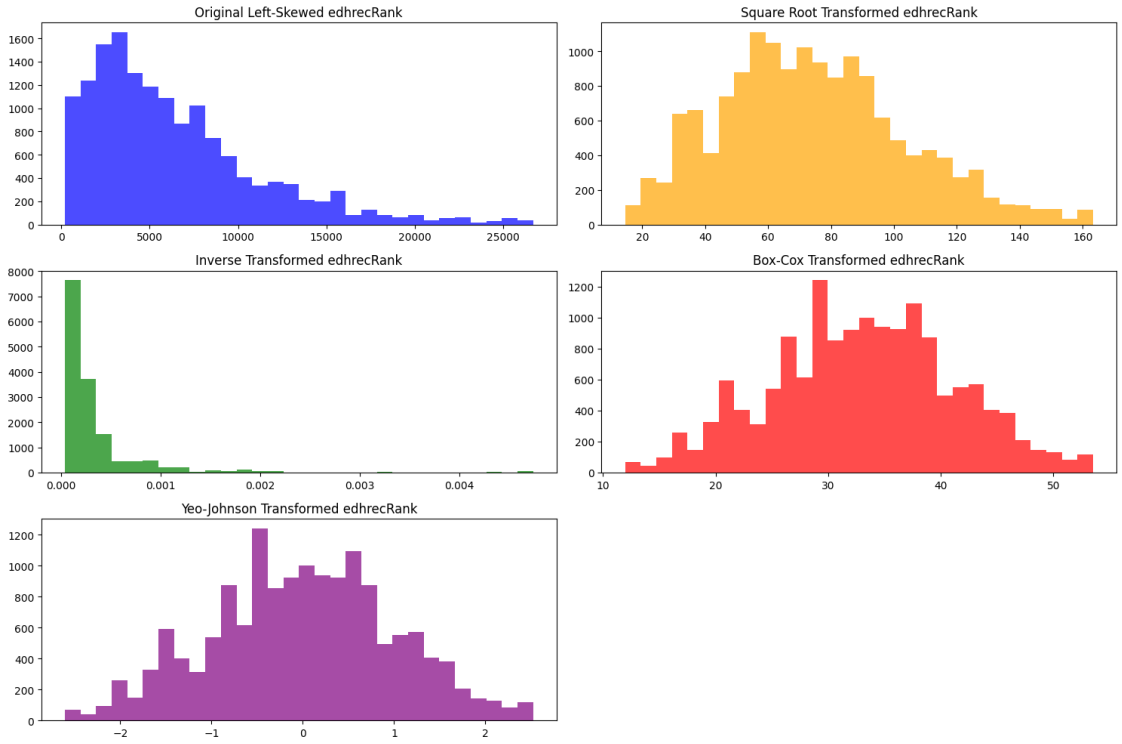
```
        print(f'{transform} skewness: {skew}')

    # Visualize the transformed data
    plt.figure(figsize=(15, 10))

    plt.subplot(3, 2, 1)
    plt.hist(df[col], bins=30, alpha=0.7, color='blue')
    plt.title(f'Original Left-Skewed {col}')

    plt.subplot(3, 2, 2)
    plt.hist(df['square_root_transformed'], bins=30, alpha=0.7, color='orange')
    plt.title(f'Square Root Transformed {col}')

    plt.subplot(3, 2, 3)
    plt.hist(df['inverse_transformed'], bins=30, alpha=0.7, color='green')
    plt.title(f'Inverse Transformed {col}')

    plt.subplot(3, 2, 4)
    plt.hist(df['boxcox_transformed'], bins=30, alpha=0.7, color='red')
    plt.title(f'Box-Cox Transformed {col}')

    plt.subplot(3, 2, 5)
    plt.hist(df['yeo_transformed'], bins=30, alpha=0.7, color='purple')
    plt.title(f'Yeo-Johnson Transformed {col}')

    plt.tight_layout()
    plt.show()

    return df

price = transforms(df,'price')
```

```
Original skewness: 1.8797424226421264
Square Root skewness: 0.9869019315131625
Inverse skewness: 2.897941980106822
Box-Cox skewness: 0.2672870971411354
Yeo-Johnson skewness: 0.2672871064070785
```

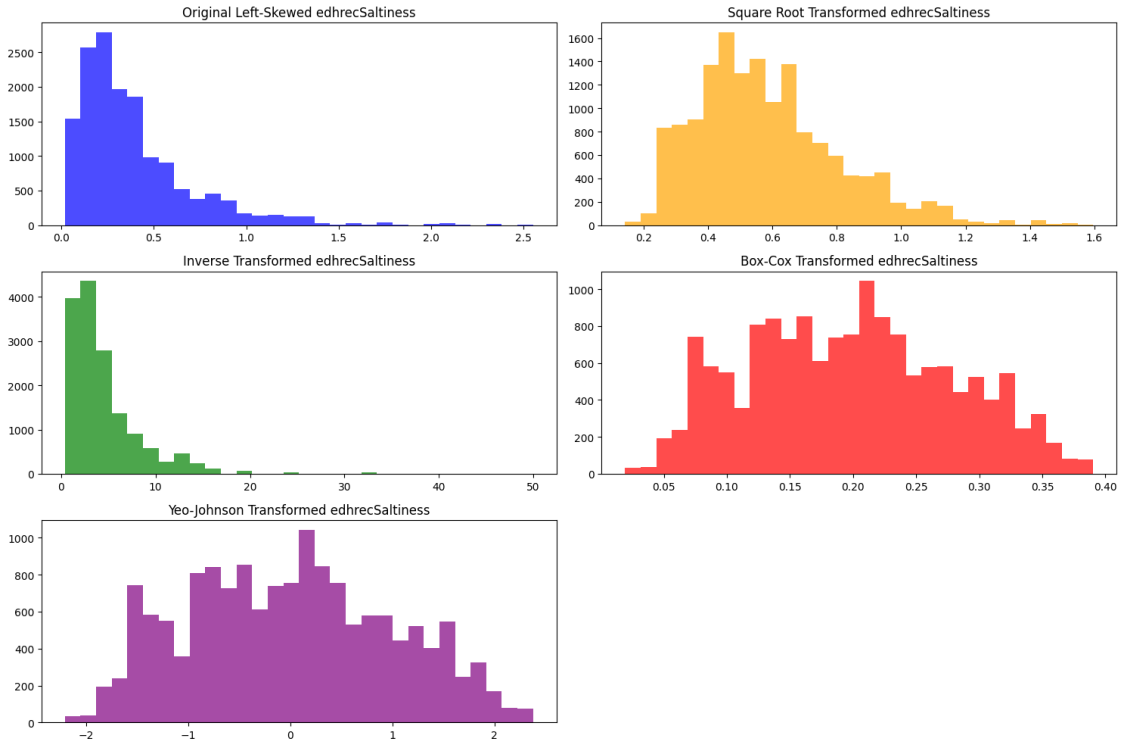


[14]:
```
transform = data.copy()
transform['price'] = price['boxcox_transformed']

edr = transforms(df,'edhrecRank')
transform['price'] = edr['boxcox_transformed']

eds = transforms(df,'edhrecSaltiness')
transform['price'] = eds['boxcox_transformed']
```

```
Original skewness: 1.3436672116449409
Square Root skewness: 0.431495503769983
Inverse skewness: 4.935464842530545
Box-Cox skewness: -0.03143200332053425
Yeo-Johnson skewness: -0.03143199807916926
```




```
Original skewness: 2.076552905652101
Square Root skewness: 0.9077919528684577
Inverse skewness: 2.777608178060753
Box-Cox skewness: 0.14709876564098792
Yeo-Johnson skewness: 0.14709871974529082
```



[21]:
```
# Initialize a results list
results = []

# Calculate t-scores and p-values for each independent variable
for col in data.columns:
    if col != 'price':
        t_stat, p_value = stats.ttest_ind(df[col], df['price'],␣
 ↪equal_var=False)  # Welch's t-test
        results.append({'Variable': col, 'T-score': t_stat, 'P-value': p_value})

# Create a results DataFrame
results_df = pd.DataFrame(results)


print(f"Primary Dataset Results: \n{results_df.to_string(index=False)}")
```

```
Primary Dataset Results:
        Variable    T-score       P-value
          artist 216.822599  0.000000e+00
      cardFinish  27.089676 1.704672e-158
          colors 214.102136  0.000000e+00
      edhrecRank 161.394553  0.000000e+00
 edhrecSaltiness -63.338320  0.000000e+00
gameAvailability -32.594882 4.997116e-226
```

```
       isReprint -63.939938  0.000000e+00
          layout 196.797219  0.000000e+00
        manaCost 172.520311  0.000000e+00
       manaValue 160.126938  0.000000e+00
            name 216.281241  0.000000e+00
          number 157.891695  0.000000e+00
    originalType 261.491856  0.000000e+00
           power 222.045356  0.000000e+00
   priceProvider  14.721119  7.443080e-49
 providerListing -78.676648  0.000000e+00
          rarity  46.393962  0.000000e+00
         setCode 191.189442  0.000000e+00
      supertypes -90.274842  0.000000e+00
       toughness 241.450764  0.000000e+00
            type 224.161196  0.000000e+00
           types  52.260535  0.000000e+00
```

[16]:
```
# Initialize a results list
results = []

# Calculate t-scores and p-values for each independent variable
for col in transform.columns:
    if col != 'price':
        t_stat, p_value = stats.ttest_ind(df[col], df['price'],␣
 ↪equal_var=False)  # Welch's t-test
        results.append({'Variable': col, 'T-score': t_stat, 'P-value': p_value})

# Create a results DataFrame
results_df = pd.DataFrame(results)

print(f"Primary Dataset Results: \n{results_df.to_string(index=False)}")
```

```
Primary Dataset Results:
        Variable    T-score       P-value
          artist 216.822599  0.000000e+00
      cardFinish  27.089676 1.704672e-158
          colors 214.102136  0.000000e+00
      edhrecRank 161.394553  0.000000e+00
 edhrecSaltiness -63.338320  0.000000e+00
gameAvailability -32.594882 4.997116e-226
       isReprint -63.939938  0.000000e+00
          layout 196.797219  0.000000e+00
        manaCost 172.520311  0.000000e+00
       manaValue 160.126938  0.000000e+00
            name 216.281241  0.000000e+00
          number 157.891695  0.000000e+00
    originalType 261.491856  0.000000e+00
           power 222.045356  0.000000e+00
```

```
   priceProvider  14.721119  7.443080e-49
providerListing -78.676648  0.000000e+00
          rarity  46.393962  0.000000e+00
         setCode 191.189442  0.000000e+00
      supertypes -90.274842  0.000000e+00
       toughness 241.450764  0.000000e+00
            type 224.161196  0.000000e+00
           types  52.260535  0.000000e+00
```

[17]:
```
print(transform)

transform.to_csv('../dataset/transform_primary.csv', index = False)
```

```
          price  artist  cardFinish  colors  edhrecRank  edhrecSaltiness  \
0      0.077700     341           2      23     20330.0             0.09
1      0.077700     341           1      23     20330.0             0.09
2      0.077700     341           2      23     20330.0             0.09
3      0.077700     341           2      23     20330.0             0.09
4      0.077700     341           2      23     20330.0             0.09
…           …     …           …      …           …                …
15209  0.244063     274           2      16      5527.0             0.45
15210  0.244063     274           1      16      5527.0             0.45
15211  0.244063     274           2      16      5527.0             0.45
15212  0.244063     274           1      16      5527.0             0.45
15213  0.244063     274           2      16      5527.0             0.45

       gameAvailability  isReprint  layout  manaCost  …  originalType  \
0                     0          0       4        60  …           578
1                     0          0       4        60  …           578
2                     1          0       4        60  …           578
3                     1          0       4        60  …           578
4                     1          0       4        60  …           578
…                   …        …      …       …  …            …
15209                 1          1       4        12  …           138
15210                 1          1       4        12  …           138
15211                 1          1       4        12  …           138
15212                 1          1       4        12  …           138
15213                 1          1       4        12  …           138

       power  priceProvider  providerListing  rarity  setCode  supertypes  \
0          6              0                0       2      118           0
1          6              0                0       2      118           0
2          6              3                0       2      118           0
3          6              1                1       2      118           0
4          6              1                0       2      118           0
…      …            …               …      …       …          …
15209      6              1                1       2      146           0
15210      6              1                1       2      146           0
```

```
15211      6              1                0       2      146           0
15212      6              1                0       2      146           0
15213      6              2                0       2      146           0

       toughness  type  types
0              6   222      2
1              6   222      2
2              6   222      2
3              6   222      2
4              6   222      2
…          …   …    …
15209          5    30      2
15210          5    30      2
15211          5    30      2
15212          5    30      2
15213          5    30      2

[15214 rows x 23 columns]
```