cluster

July 13, 2025

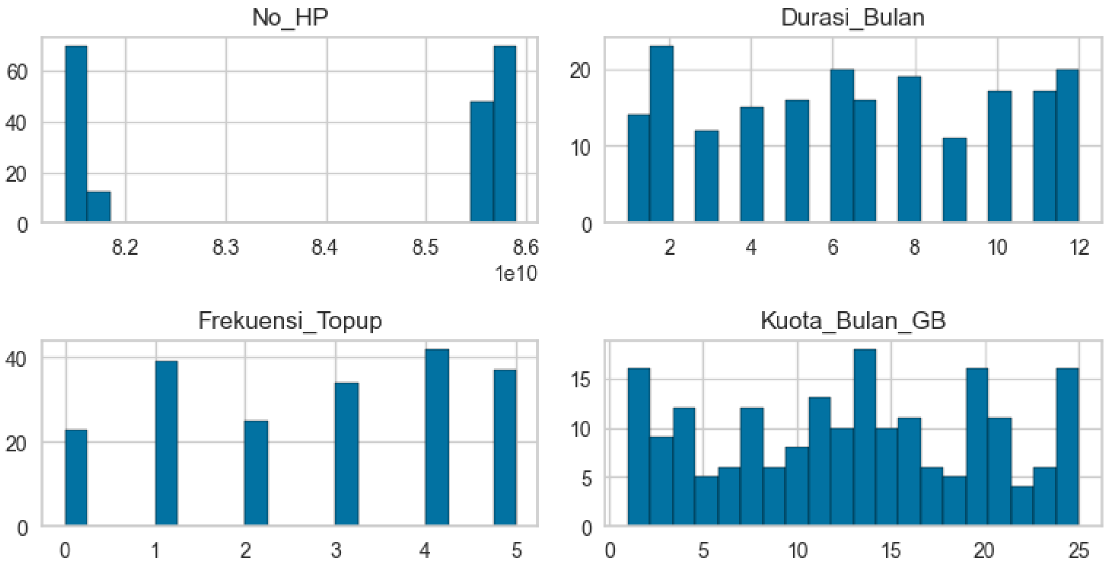
[5]:
```
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.preprocessing import StandardScaler, LabelEncoder
import seaborn as sns
from sklearn.cluster import KMeans
from yellowbrick.cluster import KElbowVisualizer
from sklearn.metrics import silhouette_score
```

[6]:
```
df = pd.read_csv('/var/www/html/Portfolio-Magang-Indosat/data_pelanggan_indosat.
  ↪csv')
df.head()
```

[6]:
```
                      Nama        No_HP      Kota          Paket    Tgl_beli  \
0  Balidin Dongoran, S.T.  85799239640  Surabaya  Freedom Combo  2024-10-08
1            Okto Jailani  81478074443   Jakarta  Freedom Combo  2025-03-15
2     R. Lantar Anggraini  81462526817     Medan  Freedom Combo  2024-07-22
3        Darimin Pradipta  81443713796  Semarang  Unlimited 2GB  2025-01-11
4        Kanda Napitupulu  85669303428  Surabaya         Yellow  2025-03-30

   Durasi_Bulan  Frekuensi_Topup  Kuota_Bulan_GB
0             9                5              16
1             4                1               7
2            12                2              20
3             2                3               5
4            12                1               1
```

[7]:
```
numeric_features = df.select_dtypes(include='number').columns

fig, axes = plt.subplots(3, 2, figsize=(8, 6))
axes = axes.flatten()

for i, column in enumerate(df[numeric_features].columns):
  df[numeric_features][column].hist(ax=axes[i], bins=20, edgecolor='black')
  axes[i].set_title(column)

for j in range(i + 1, len(axes)):
  fig.delaxes(axes[j])
```

```
plt.tight_layout()
plt.show()
```



[8]:

```
# scaling using standardization, karena data terdistribusi normal
std_scale = StandardScaler()
df[numeric_features] = std_scale.fit_transform(df[numeric_features])

df.head()
```

[8]:

```
                      Nama     No_HP      Kota          Paket    Tgl_beli  \
0  Balidin Dongoran, S.T.  0.873539  Surabaya  Freedom Combo  2024-10-08
1            Okto Jailani -1.219428   Jakarta  Freedom Combo  2025-03-15
2     R. Lantar Anggraini -1.226958     Medan  Freedom Combo  2024-07-22
3        Darimin Pradipta -1.236070  Semarang  Unlimited 2GB  2025-01-11
4        Kanda Napitupulu  0.810604  Surabaya         Yellow  2025-03-30

   Durasi_Bulan  Frekuensi_Topup  Kuota_Bulan_GB
0      0.692458         1.359747        0.448111
1     -0.738240        -1.025774       -0.830177
2      1.550877        -0.429394        1.016239
3     -1.310520         0.166986       -1.114241
4      1.550877        -1.025774       -1.682369
```

[9]:

```
# ubah fitur kategori menjadi numerik dengan LabelEncoder
kategori_features = df.select_dtypes(include='object').columns
encoders = {}
df_temp = df.copy()
```

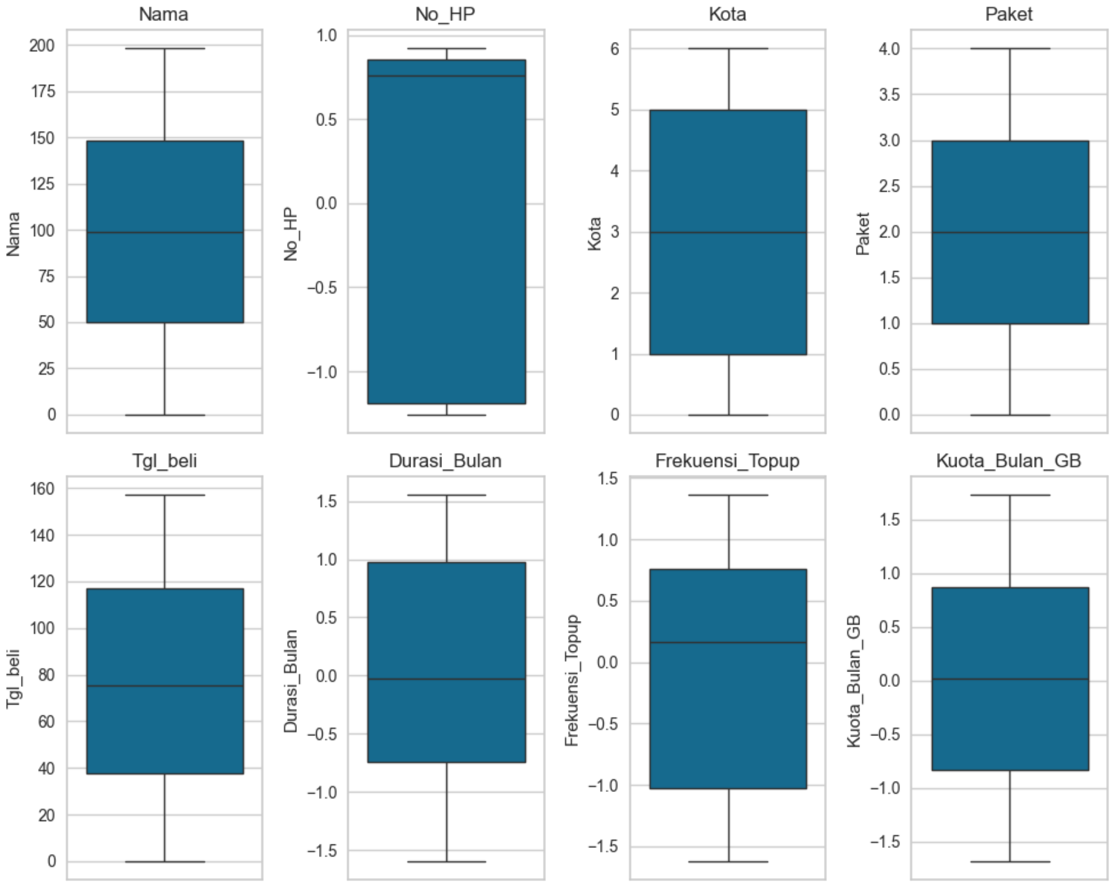
```
for feature in kategori_features:
    le = LabelEncoder()
    df_temp[feature] = le.fit_transform(df[feature])
    encoders[feature] = le

df = df_temp
df.head()
```

[9]:

```
   Nama     No_HP  Kota  Paket  Tgl_beli  Durasi_Bulan  Frekuensi_Topup  \
0    11  0.873539     5      0        44      0.692458         1.359747
1   115 -1.219428     1      0       108     -0.738240        -1.025774
2   138 -1.226958     3      0         2      1.550877        -0.429394
3    23 -1.236070     4      2        86     -1.310520         0.166986
4    88  0.810604     5      4       114      1.550877        -1.025774

   Kuota_Bulan_GB
0        0.448111
1       -0.830177
2        1.016239
3       -1.114241
4       -1.682369
```

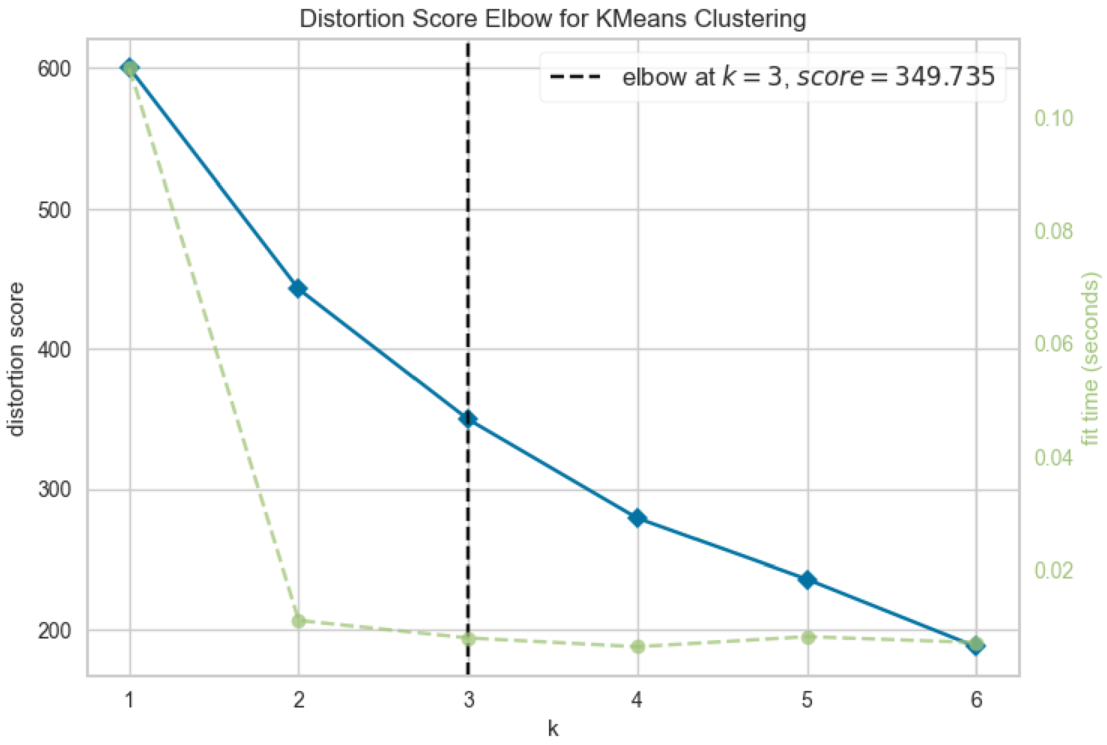
[10]:

```
# Melakukan Handling Outlier Data berdasarkan jumlah outlier, apakah␣
 ↪menggunakan metode drop atau mengisi nilai tersebut.
for feature in df[numeric_features].columns:
    Q1 = df[feature].quantile(0.25)
    Q3 = df[feature].quantile(0.75)
    IQR = Q3 - Q1
    lower = Q1 - 1.5 * IQR
    upper = Q3 + 1.5 * IQR

    # tangani outlier dengan median
    median = df[feature].median()
    df.loc[:, feature] = df[feature].apply(lambda x: median if x < lower or x >␣
 ↪upper else x)

# visualisasikan
cols = 4
fig, axes = plt.subplots(2, cols, figsize=(10, 8))

for i, feature in enumerate(df.columns):
    baris, kolom = divmod(i, cols)
    sns.boxplot(y=df[feature], ax=axes[baris, kolom])
    axes[baris, kolom].set_title(f'{feature}')

plt.tight_layout()
plt.show()
```



[11]:

```
# Melakukan visualisasi Elbow Method menggunakan KElbowVisualizer()
cluster_features = df[['Durasi_Bulan', 'Kuota_Bulan_GB', 'Frekuensi_Topup']]
kmeans_elbow = KMeans(random_state=42)
kelbow_visual = KElbowVisualizer(kmeans_elbow, k=(1, 7))
kelbow_visual.fit(cluster_features)

kelbow_visual.show()
```



```
[11]: <Axes: title={'center': 'Distortion Score Elbow for KMeans Clustering'},
      xlabel='k', ylabel='distortion score'>
```

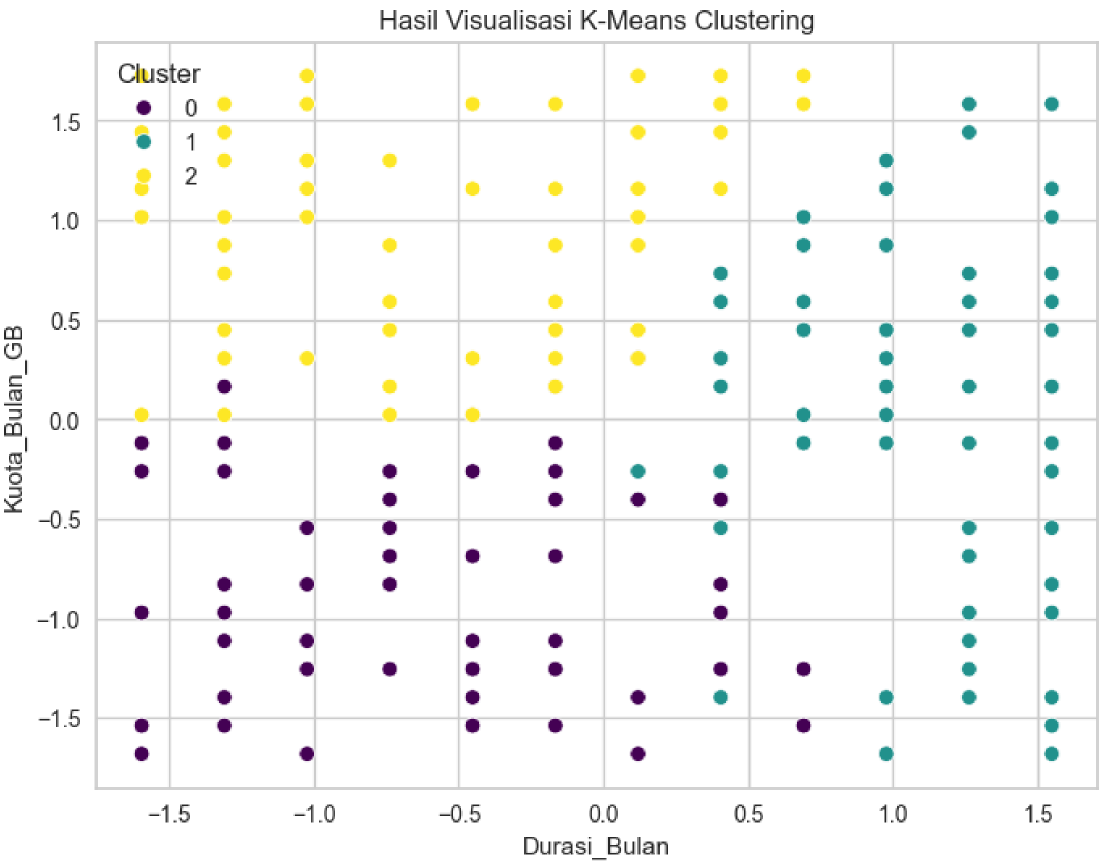
```
[12]: # Menggunakan algoritma K-Means Clustering
      kmeans = KMeans(n_clusters=3, random_state=42)
      kmeans.fit(cluster_features)
```

```
[12]: KMeans(n_clusters=3, random_state=42)
```

```
[13]: # Menghitung dan menampilkan nilai Silhouette Score.
      silhouette_score(cluster_features, kmeans.fit_predict(cluster_features))
```

```
[13]: 0.2413538505054932
```

```
[14]: # Membuat visualisasi hasil clustering
      df['Cluster'] = kmeans.labels_
      plt.figure(figsize=(8, 6))
      sns.scatterplot(data=df, x='Durasi_Bulan', y='Kuota_Bulan_GB', hue='Cluster',␣
       ↪palette='viridis')
      plt.title('Hasil Visualisasi K-Means Clustering')
      plt.xlabel('Durasi_Bulan')
      plt.ylabel('Kuota_Bulan_GB')
      plt.show()
```



[15]:

```
# inverse dataset
df[numeric_features] = std_scale.inverse_transform(df[numeric_features])

for feature in kategori_features:
    df[feature] = encoders[feature].inverse_transform(df[feature].astype(int))

df.head()
```

[15]:

```
                    Nama         No_HP      Kota           Paket    Tgl_beli  \
0  Balidin Dongoran, S.T.  8.579924e+10  Surabaya    Freedom Combo  2024-10-08
1            Okto Jailani  8.147807e+10   Jakarta    Freedom Combo  2025-03-15
2     R. Lantar Anggraini  8.146253e+10     Medan    Freedom Combo  2024-07-22
3        Darimin Pradipta  8.144371e+10  Semarang    Unlimited 2GB  2025-01-11
4        Kanda Napitupulu  8.566930e+10  Surabaya           Yellow  2025-03-30

   Durasi_Bulan  Frekuensi_Topup  Kuota_Bulan_GB  Cluster
0           9.0              5.0            16.0        1
1           4.0              1.0             7.0        0
2          12.0              2.0            20.0        1
```

```
3           2.0              3.0              5.0        0
4          12.0              1.0              1.0        1
```

[16]:

```
# descriptive features

descriptive_features = ['Durasi_Bulan', 'Frekuensi_Topup', 'Kuota_Bulan_GB']
descriptive_features_categorical = ['Kota', 'Paket']

agg_result = df.groupby('Cluster')[descriptive_features].agg(['mean', 'min',␣
 ↪'max', 'count'])
agg_result_categorical = df.
 ↪groupby('Cluster')[descriptive_features_categorical].agg(pd.Series.mode)

display(agg_result)
display(agg_result_categorical)
```

```
        Durasi_Bulan                  Frekuensi_Topup                  \
                mean min   max count            mean min  max count
Cluster
0           4.441176 1.0  10.0    68        2.176471 0.0  5.0    68
1          10.333333 7.0  12.0    72        2.902778 0.0  5.0    72
2           4.500000 1.0   9.0    60        3.116667 0.0  5.0    60

        Kuota_Bulan_GB
                  mean   min   max count
Cluster
0             6.705882   1.0  15.0    68
1            12.902778   1.0  24.0    72
2            19.733333  13.0  25.0    60
```

```
                        Kota             Paket
Cluster
0                 Yogyakarta     Unlimited 2GB
1                   Surabaya  Freedom Internet
2          [Bandung, Semarang]  Freedom Internet
```