

Tugas Besar Probabilitas dan Statistika

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```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import scipy.stats as stats
import math
```

Dataset

```
column_header = ["id", "pH", "Hardness", "Solids", "Chloramines",
                  "Sulfate", "Conductivity", "OrganicCarbon", "Trihalomethanes",
                  "Turbidity", "Potability"]
df = pd.read_csv("./water_potability.csv", names=column_header)
df.head()
```

	id	pH	Hardness	Solids	Chloramines	Sulfate \
0	1	8.316766	214.373394	22018.417441	8.059332	356.886136
1	2	9.092223	181.101509	17978.986339	6.546600	310.135738
2	3	5.584087	188.313324	28748.687739	7.544869	326.678363
3	4	10.223862	248.071735	28749.716544	7.513408	393.663396
4	5	8.635849	203.361523	13672.091764	4.563009	303.309771

	Conductivity	OrganicCarbon	Trihalomethanes	Turbidity	Potability
0	363.266516	18.436524	100.341674	4.628771	0
1	398.410813	11.558279	31.997993	4.075075	0
2	280.467916	8.399735	54.917862	2.559708	0
3	283.651634	13.789695	84.603556	2.672989	0
4	474.607645	12.363817	62.798309	4.401425	0

1. Menulis deskripsi statistika (Descriptive Statistics) dari semua kolom pada data yang bersifat numerik

Descriptive Statistics yang akan dicari terdiri dari

- Mean
- Median
- Modus
- Standar Deviasi

- Variansi
- Range
- Nilai Minimum
- Nilai Maksimum
- Kuartil (1, 2, 3)
- IQR
- Skewness
- Kurtosis

```
def statisticDescription(df):
    print("Mean: ", df.mean())
    print("Median: ", df.median())
    print("Modus: ", end="")
    modus = df.mode()
    for i in range(len(modus)):
        if i != 0:
            print(", ", end="")
            print(modus[i], end="")
    print()
    print("Standar Deviasi: ", df.std())
    print("Variansi: ", df.var())
    print("Range: ", df.max() - df.min())
    print("Nilai Minimum: ", df.min())
    print("Nilai Maksimum: ", df.max())
    print("Kuartil 1: ", df.quantile(0.25))
    print("Kuartil 2: ", df.quantile(0.5))
    print("Kuartil 3: ", df.quantile(0.75))
    print("IQR: ", df.quantile(0.75) - df.quantile(0.25))
    print("Skewness: ", df.skew())
    print("Kurtosis: ", df.kurt())
```

Kolom id

Kolom id adalah penomoran setiap row, sehingga deskripsi statistik pada kolom id tidak diperlukan

Kolom pH

```
statisticDescription(df["pH"])
```

```
Mean: 7.0871927687138285
Median: 7.029490455474185
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Kolom Hardness

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Kolom Solids

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Kolom Chloramines

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Kolom Sulfate

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Nilai Minimum: 2.19999999999999886

Nilai Maksimum: 27.00670661116601

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Kuartil 2: 14.323285610653329

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statisticDescription(df["Trihalomethanes"])

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Range: 115.4229870670162

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Nilai Maksimum: 124.0

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Kolom Turbidity

statisticDescription(df["Turbidity"])

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 Nilai Maksimum: 6.494748555990993
 Kuartil 1: 3.442881623557439
 Kuartil 2: 3.967373963531836
 Kuartil 3: 4.5146627202018825
 IQR: 1.0717810966444437
 Skewness: -0.03226597968019271
 Kurtosis: -0.049830796949249745

Kolom Potability

Karen kolom potability adalah kolom target, maka deskripsi statistika pada kolom potability tidak diperlukan

2. Membuat Visualisasi plot distribusi, dalam bentuk histogram dan boxplot untuk setiap kolom numerik. Berikan uraian penjelasan kondisi setiap kolom berdasarkan kedua plot tersebut.

Histogram and Boxplot

```

def displayHistAndBox(df):
    figure, axes = plt.subplots(1, 2, figsize=(16, 6))

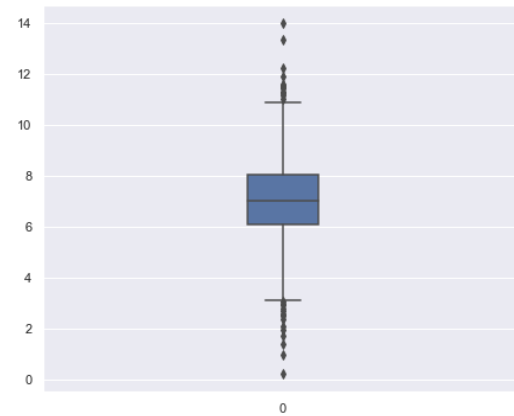
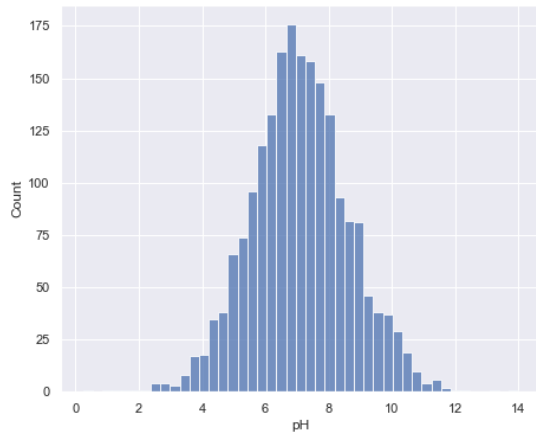
    sns.histplot(data=df, ax=axes[0])
    sns.boxplot(data=df, orient="x", width=0.15, ax=axes[1])
  
```

Kolom id

Karena kolom adalah penomoran row, maka penggambaran Histogram dan Boxplot tidak diperlukan

Kolom pH

```
displayHistAndBox(df["pH"])
```

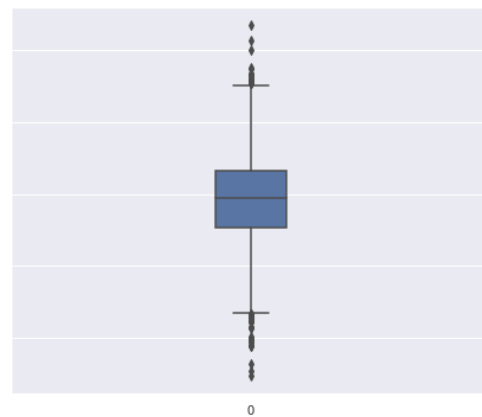
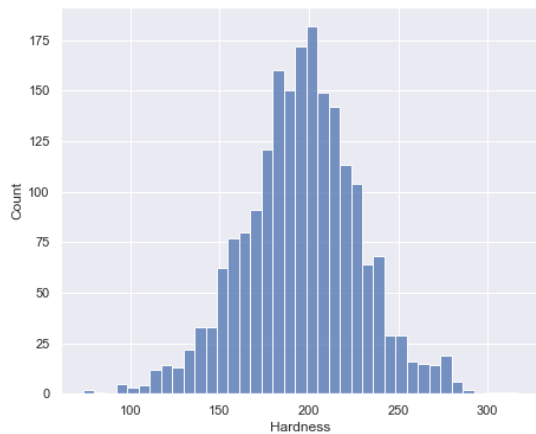


Dari visualisasi histogram yang dihasilkan, dapat dilihat data tidak condong pada satu sisi. Oleh karena itu, dapat disimpulkan skewness dari data kolom pH bersifat symmetrical distribution. Dari histogram juga terlihat bahwa data tersebar secara merata, maka kolom pH bersifat mesokurtic.

Dari visualisasi boxplot yang dihasilkan, dapat dilihat kuartil 1 data bernilai sekitar 6, median data bernilai sekitar 7, dan kuartil 3 data bernilai sekitar 8. Dari boxplot juga terdapat beberapa pencilan atas dan pencilan bawah.

Kolom Hardness

```
displayHistAndBox(df["Hardness"])
```

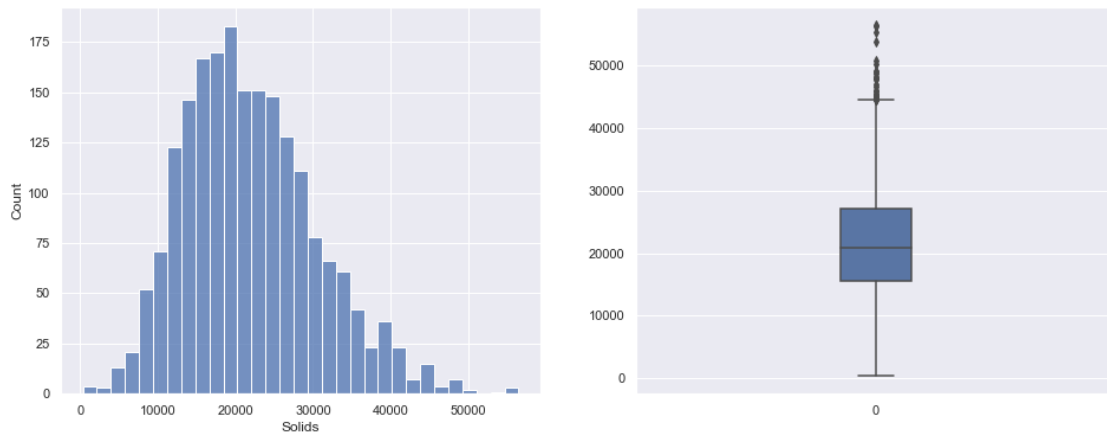


Dari visualisasi histogram yang dihasilkan, dapat dilihat data tidak condong pada satu sisi. Oleh karena itu, dapat disimpulkan skewness dari data kolom Hardness bersifat symmetrical distribution. Dari histogram juga terlihat bahwa data tersebar secara merata, maka kolom Hardness bersifat mesokurtic.

Dari visualisasi boxplot yang dihasilkan, dapat dilihat kuartil 1 data bernilai sekitar 170, median data bernilai sekitar 200, dan kuartil 3 data bernilai sekitar 220. Dari boxplot juga terdapat beberapa pencilan atas dan pencilan bawah.

Kolom Solids

```
displayHistAndBox(df["Solids"])
```

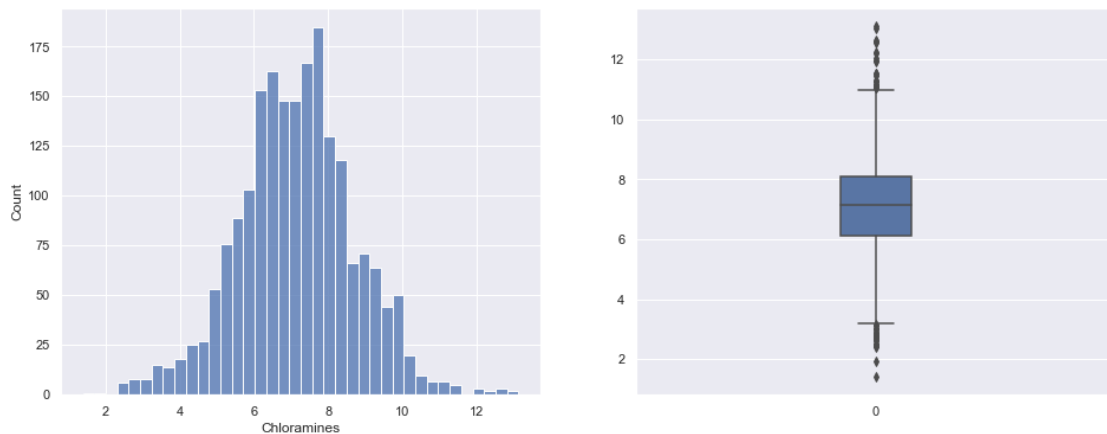


Dari visualisasi histogram yang dihasilkan, dapat dilihat data condong pada sisi sebelah kiri. Oleh karena itu, dapat disimpulkan skewness dari data kolom Solids bersifat positive skew. Dari histogram juga terlihat bahwa data tersebar banyak pada sebelah kiri sehingga terlihat lancip, maka kolom Solids bersifat leptokurtic.

Dari visualisasi boxplot yang dihasilkan, dapat dilihat kuartil 1 data bernilai sekitar 17000, median data bernilai sekitar 20000, dan kuartil 3 data bernilai sekitar 28000. Dari boxplot juga terdapat beberapa pencilan atas dan tidak ada pencilan bawah.

Kolom Chloramines

```
displayHistAndBox(df["Chloramines"])
```

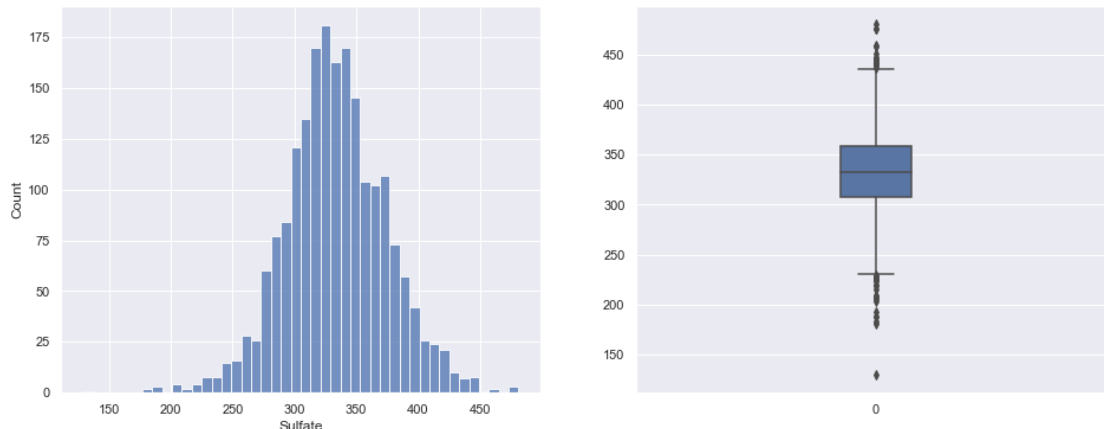


Dari visualisasi histogram yang dihasilkan, dapat dilihat data tidak condong pada satu sisi. Oleh karena itu, dapat disimpulkan skewness dari data kolom Chloramines bersifat symmetrical distribution. Dari histogram juga terlihat bahwa data tersebar secara merata, maka kolom Chloramines bersifat mesokurtic.

Dari visualisasi boxplot yang dihasilkan, dapat dilihat kuartil 1 data bernilai sekitar 6, median data bernilai sekitar 7, dan kuartil 3 data bernilai sekitar 8. Dari boxplot juga terdapat beberapa pencilan atas dan pencilan bawah.

Kolom Sulfate

```
displayHistAndBox(df["Sulfate"])
```

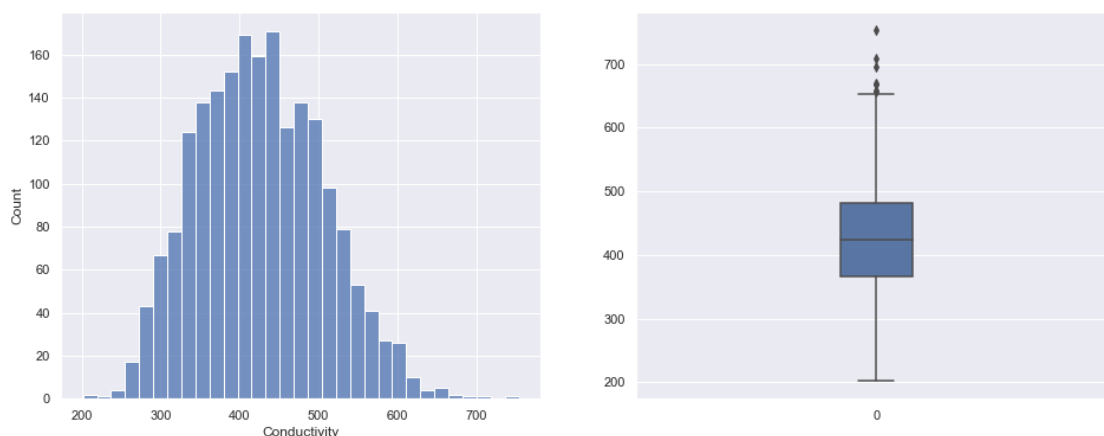


Dari visualisasi histogram yang dihasilkan, dapat dilihat data lebih condong ke sisi sebelah kanan. Oleh karena itu, dapat disimpulkan skewness dari data kolom Sulfate bersifat negative skew. Dari histogram juga terlihat bahwa data tersebar lebih dominan di sebelah kanan dan terlihat lancip, maka kolom Sulfate bersifat leptokurtic.

Dari visualisasi boxplot yang dihasilkan, dapat dilihat kuartil 1 data bernilai sekitar 310, median data bernilai sekitar 330, dan kuartil 3 data bernilai sekitar 360. Dari boxplot juga terdapat beberapa pencilan atas dan pencilan bawah.

Kolom Conductivity

```
displayHistAndBox(df["Conductivity"])
```



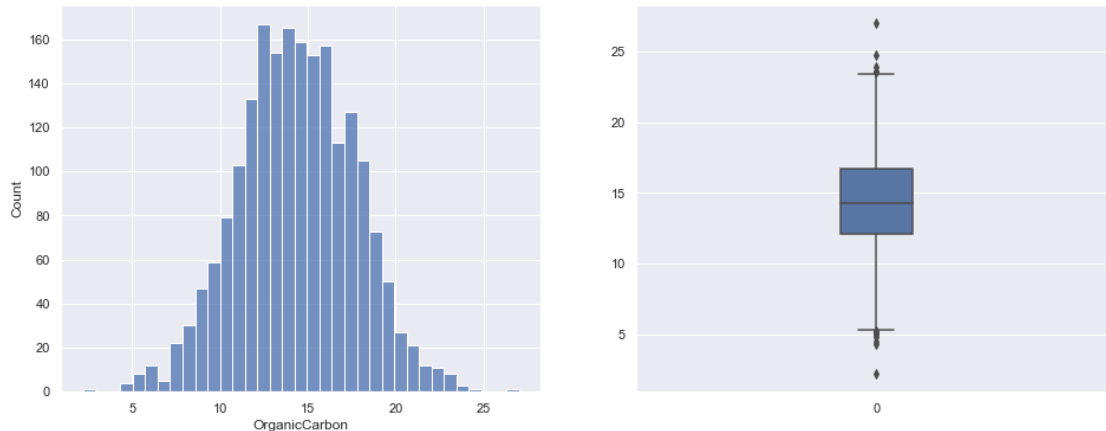
Dari visualisasi histogram yang dihasilkan, dapat dilihat data lebih condong ke sisi kiri. Oleh karena itu, dapat disimpulkan skewness dari data kolom Conductivity bersifat

positive skew. Dari histogram, walaupun bersifat positive skew, sebaran data cukup merata, maka kolom Conductivity bersifat mesokurtic.

Dari visualisasi boxplot yang dihasilkan, dapat dilihat kuartil 1 data bernilai sekitar 370, median data bernilai sekitar 420, dan kuartil 3 data bernilai sekitar 590. Dari boxplot juga terdapat beberapa pencilan atas dan tidak ada pencilan bawah.

Kolom OrganicCarbon

```
displayHistAndBox(df["OrganicCarbon"])
```

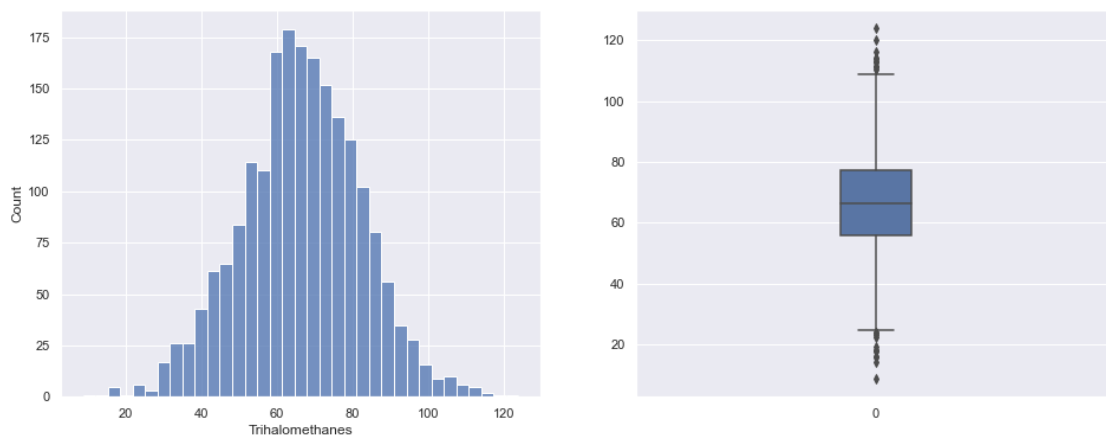


Dari visualisasi histogram yang dihasilkan, dapat dilihat data tidak condong pada satu sisi. Oleh karena itu, dapat disimpulkan skewness dari data kolom OrganicCarbon bersifat symmetrical distribution. Dari histogram juga terlihat bahwa data tersebar secara merata, maka kolom OrganicCarbon bersifat mesokurtic.

Dari visualisasi boxplot yang dihasilkan, dapat dilihat kuartil 1 data bernilai sekitar 13, median data bernilai sekitar 15, dan kuartil 3 data bernilai sekitar 16. Dari boxplot juga terdapat beberapa pencilan atas dan pencilan bawah.

Kolom Trihalomethanes

```
displayHistAndBox(df["Trihalomethanes"])
```

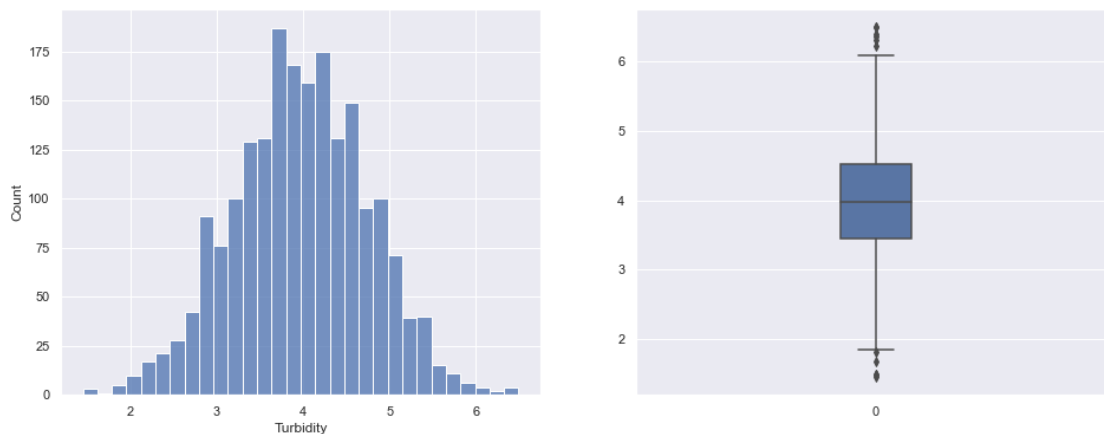


Dari visualisasi histogram yang dihasilkan, dapat dilihat data tidak condong pada satu sisi. Oleh karena itu, dapat disimpulkan skewness dari data kolom Trihalomethanes bersifat symmetrical distribution. Dari histogram juga terlihat bahwa data tersebar secara merata, maka kolom Trihalomethanes bersifat mesokurtic.

Dari visualisasi boxplot yang dihasilkan, dapat dilihat kuartil 1 data bernilai sekitar 60, median data bernilai sekitar 70, dan kuartil 3 data bernilai sekitar 80. Dari boxplot juga terdapat beberapa pencilan atas dan pencilan bawah.

Kolom Turbidity

```
displayHistAndBox(df["Turbidity"])
```



Dari visualisasi histogram yang dihasilkan, dapat dilihat data tidak condong pada satu sisi. Oleh karena itu, dapat disimpulkan skewness dari data kolom Turbidity bersifat symmetrical distribution. Dari histogram juga terlihat bahwa data tersebar secara merata, maka kolom Turbidity bersifat mesokurtic.

Dari visualisasi boxplot yang dihasilkan, dapat dilihat kuartil 1 data bernilai sekitar 3.5, median data bernilai sekitar 4, dan kuartil 3 data bernilai sekitar 4.5. Dari boxplot juga terdapat beberapa pencilan atas dan pencilan bawah.

Kolom Potability

Karen kolom Potability adalah kolom target, maka penggambaran Histogram dan Boxplot tidak diperlukan

3. Menentukan setiap kolom numerik berdistribusi normal atau tidak. Gunakan normality test yang dikaitkan dengan histogram plot.

Level Signifikan

alpha = 0.05

```
def normalityTest(df, alpha):
    k2, p = stats.normaltest(df)
    print("p = {:.g}".format(p))
    if p < alpha:
        print("H0 ditolak, data tidak berdistribusi normal")
```

```

else:
    print("H0 diterima, data berdistribusi normal")

# Gambar perbandingan histogram dengan kurva distribusi normal
mu, std = stats.norm.fit(df)
plt.figure(figsize=(10,6))
plt.hist(df, density=True)
xmin, xmax = plt.xlim()
x = np.linspace(xmin, xmax, 100)
y = stats.norm.pdf(x, mu, std)
plt.plot(x, y, 'r', lw="3")
plt.show

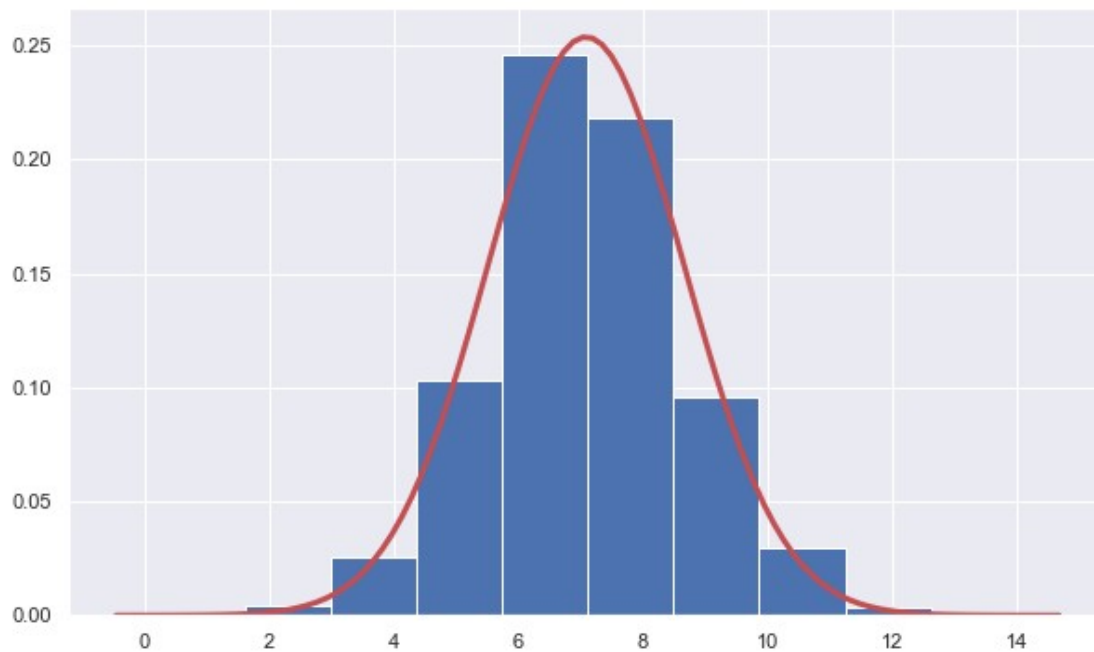
```

Kolom pH

```
normalityTest(df["pH"], alpha)
```

p = 2.65148e-05

H0 ditolak, data tidak berdistribusi normal



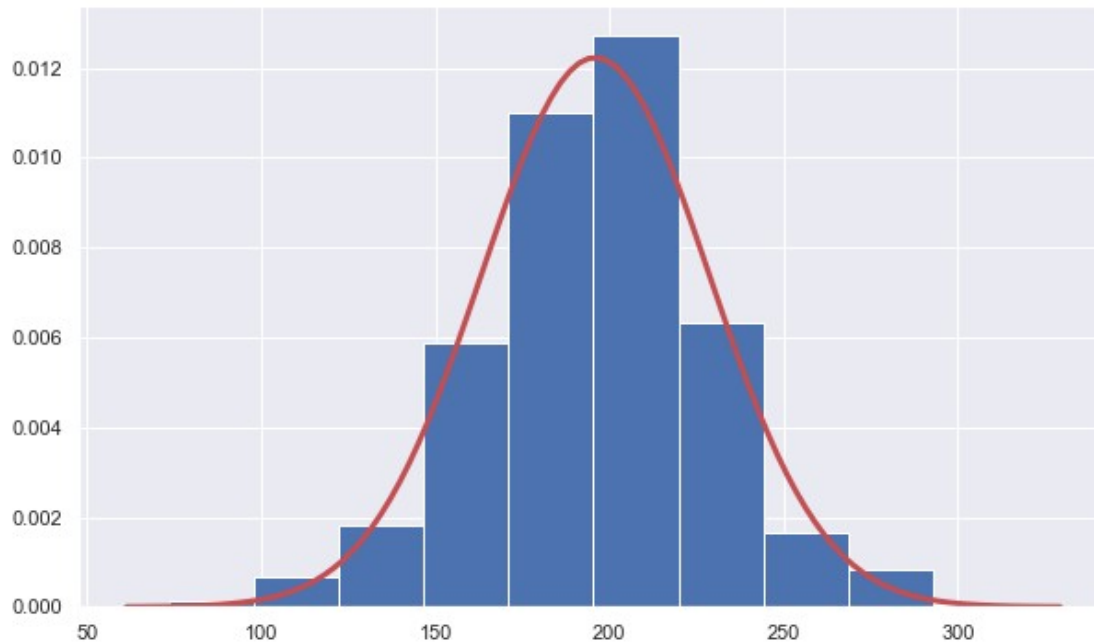
Jika dilihat dari histogram, kolom pH bersifat symmetrical distribution sehingga dapat diasumsikan bahwa kolom pH berdistribusi normal. Akan tetapi, berdasarkan hasil dari normality test, kolom pH tidak berdistribusi normal. Hal ini dapat disebabkan oleh nilai mean, median, dan moduse yang tidak memenuhi kriteria distribusi normal.

Kolom Hardness

```
normalityTest(df["Hardness"], alpha)
```

p = 0.000134424

H0 ditolak, data tidak berdistribusi normal



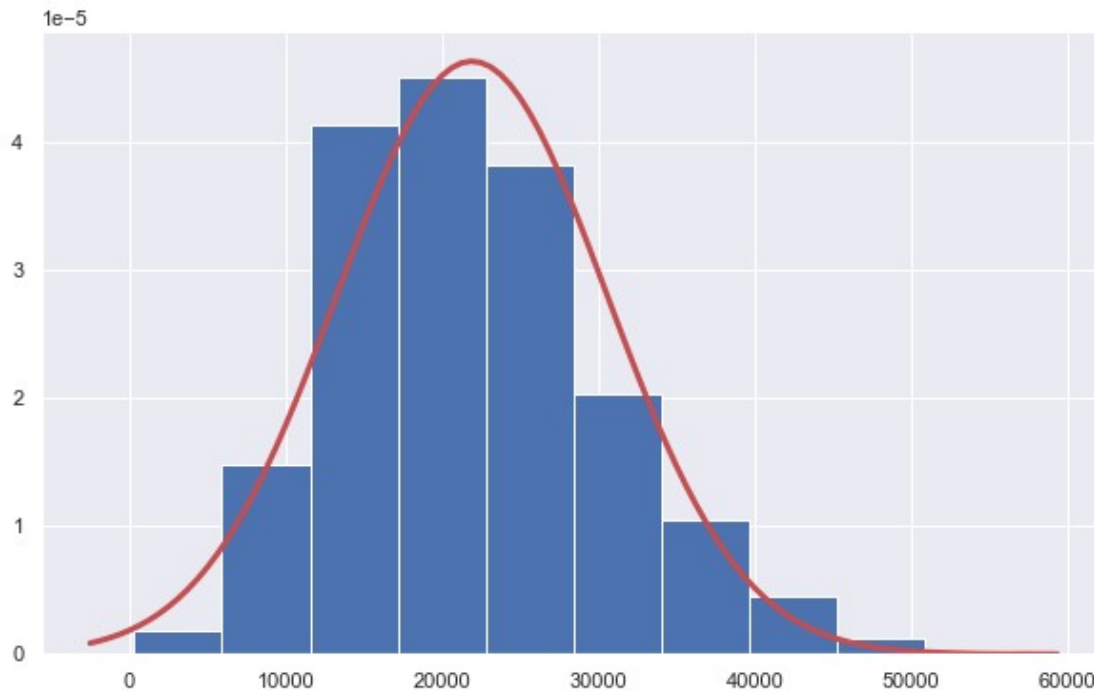
Jika dilihat dari histogram, kolom Hardness bersifat symmetrical distribution sehingga dapat diasumsikan bahwa kolom Hardness berdistribusi normal. Akan tetapi, berdasarkan hasil dari normality test, kolom Hardness tidak berdistribusi normal. Hal ini dapat disebabkan oleh nilai mean, median, dan moduse yang tidak memenuhi kriteria distribusi normal.

Kolom Solids

```
normalityTest(df["Solids"], alpha)
```

p = 2.07966e-24

H0 ditolak, data tidak berdistribusi normal



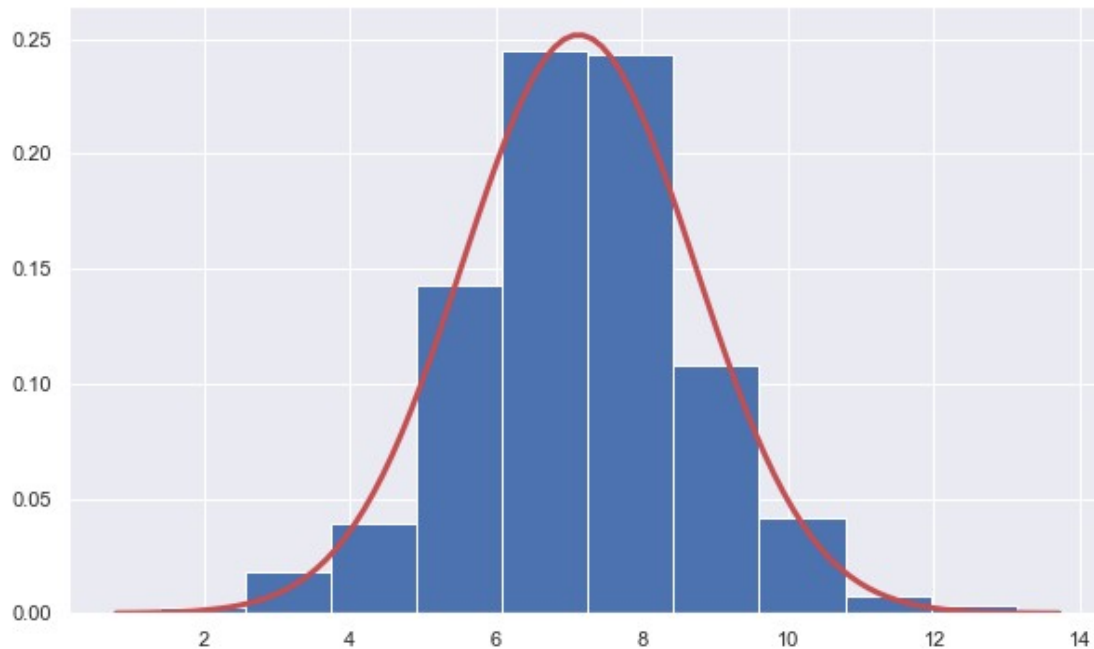
Jika dilihat dari histogram, kolom tidak berdistribusi normal karena kolom Solids bersifat positive skew. Berdasarkan hasil dari normality test juga menunjukkan bahwa kolom Solids tidak berdistribusi normal.

Kolom Chloramines

```
normalityTest(df["Chloramines"], alpha)
```

p = 0.000250483

H0 ditolak, data tidak berdistribusi normal



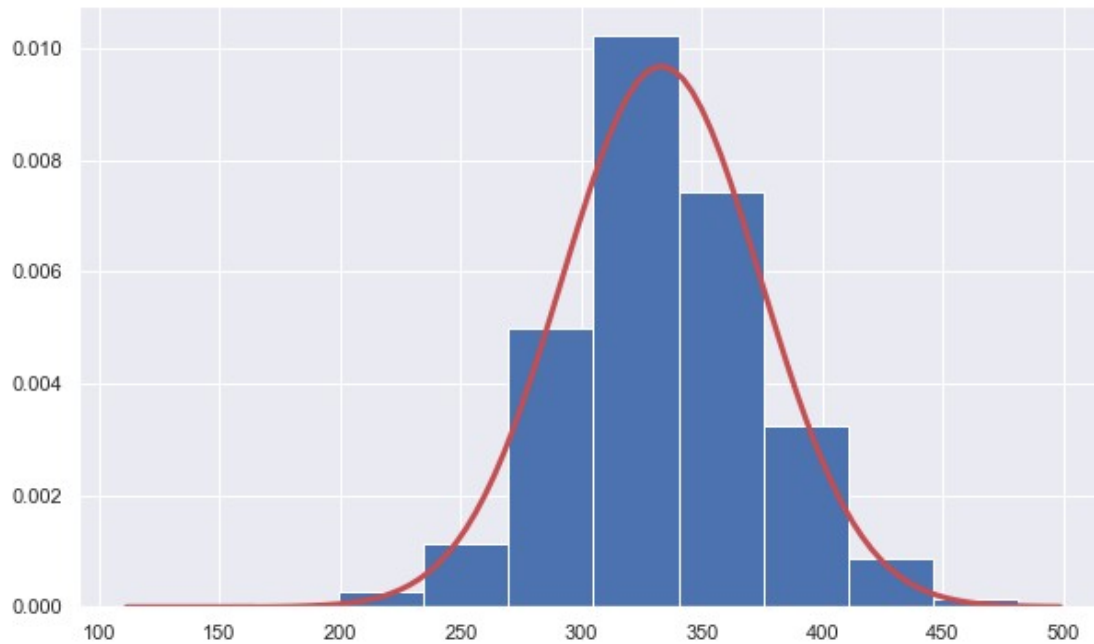
Jika dilihat dari histogram, kolom Chloramines bersifat symmetrical distribution sehingga dapat diasumsikan bahwa kolom Chloramines berdistribusi normal. Akan tetapi, berdasarkan hasil dari normality test, kolom Chloramines tidak berdistribusi normal. Hal ini dapat disebabkan oleh nilai mean, median, dan moduse yang tidak memenuhi kriteria distribusi normal.

Kolom Sulfate

```
normalityTest(df["Sulfate"], alpha)
```

p = 4.42559e-07

H0 ditolak, data tidak berdistribusi normal



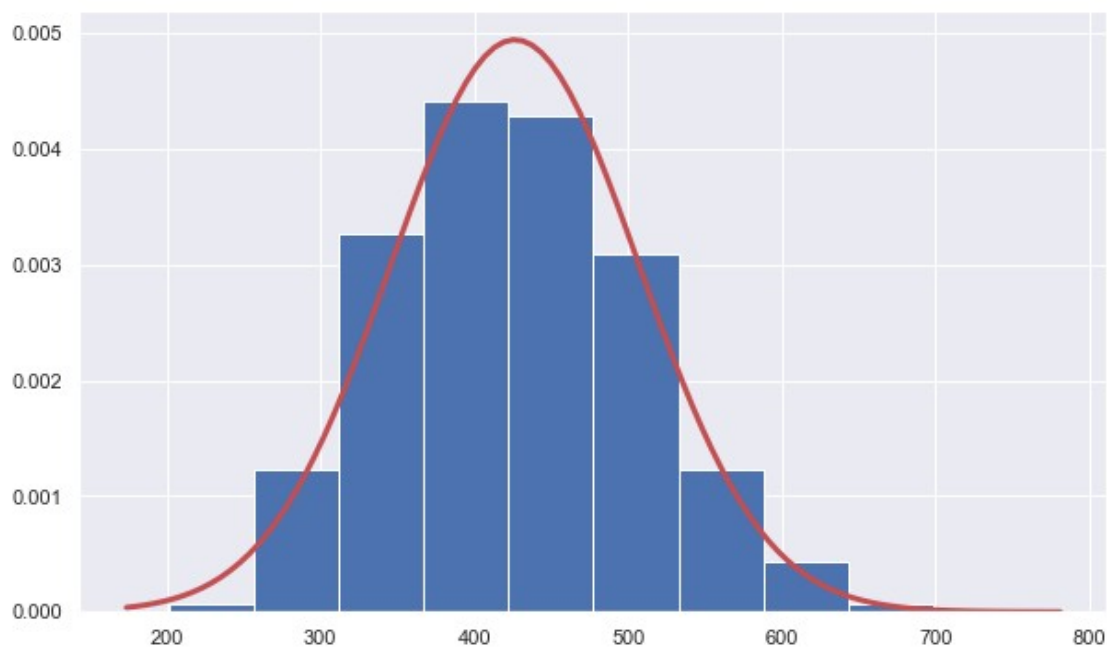
Jika dilihat dari histogram, kolom tidak berdistribusi normal karena kolom Sulfate bersifat negative skew. Berdasarkan hasil dari normality test juga menunjukkan bahwa kolom Sulfate tidak berdistribusi normal.

Kolom Conductivity

```
normalityTest(df["Conductivity"], alpha)
```

$p = 4.39018e-07$

H_0 ditolak, data tidak berdistribusi normal



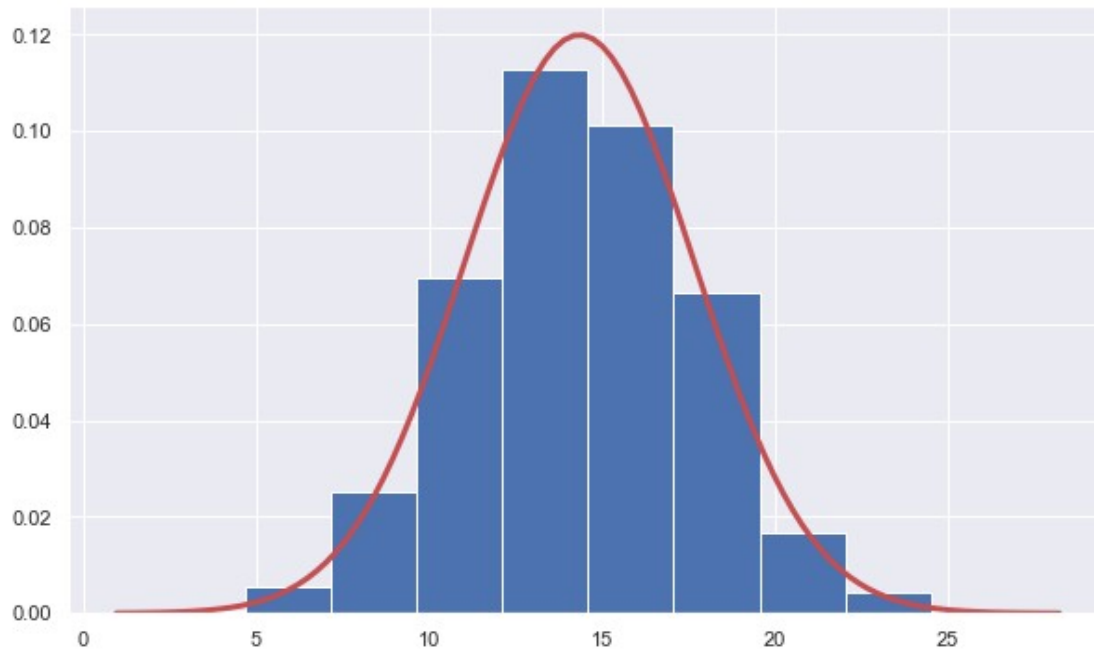
Jika dilihat dari histogram, kolom tidak berdistribusi normal karena kolom Conductivity bersifat positive skew. Berdasarkan hasil dari normality test juga menunjukkan bahwa kolom Conductivity tidak berdistribusi normal.

Kolom OrganicCarbon

```
normalityTest(df["OrganicCarbon"], alpha)
```

p = 0.88255

H0 diterima, data berdistribusi normal



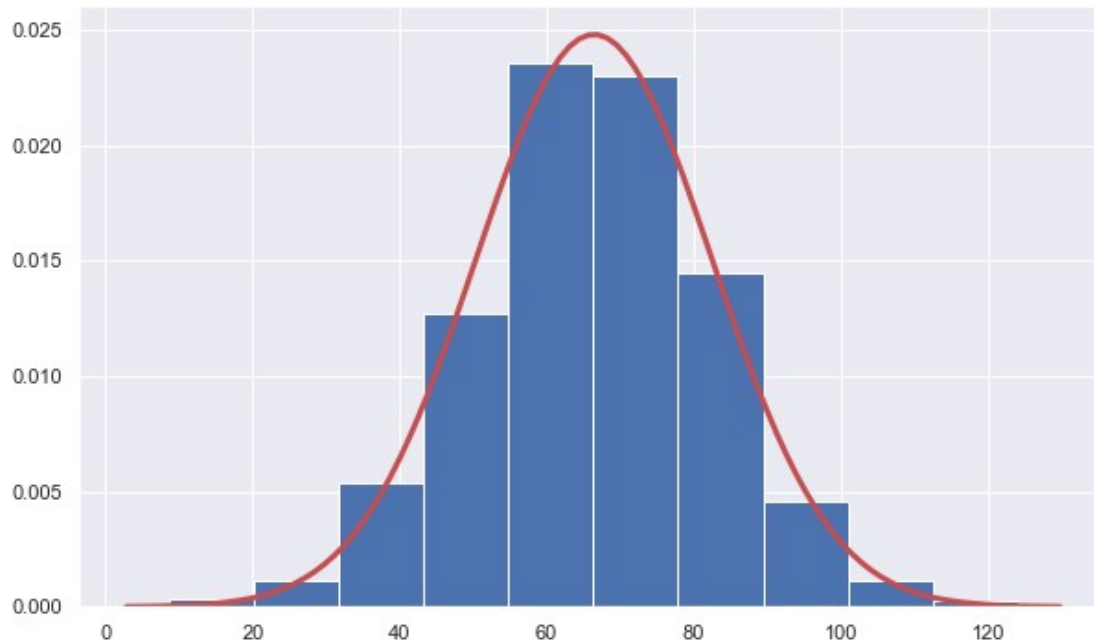
Berdasarkan hasil dari normality test, kolom OrganicCarbon berdistribusi normal dan jika kita lihat dari histogram pada kolom OrganicCarbon, dapat kita asumsikan bahwa kolom OrganicCarbon berdistribusi normal karena histogram bersifat symmetrical distribution.

Kolom Trihalomethanes

```
normalityTest(df["Trihalomethanes"], alpha)
```

p = 0.10436

H0 diterima, data berdistribusi normal



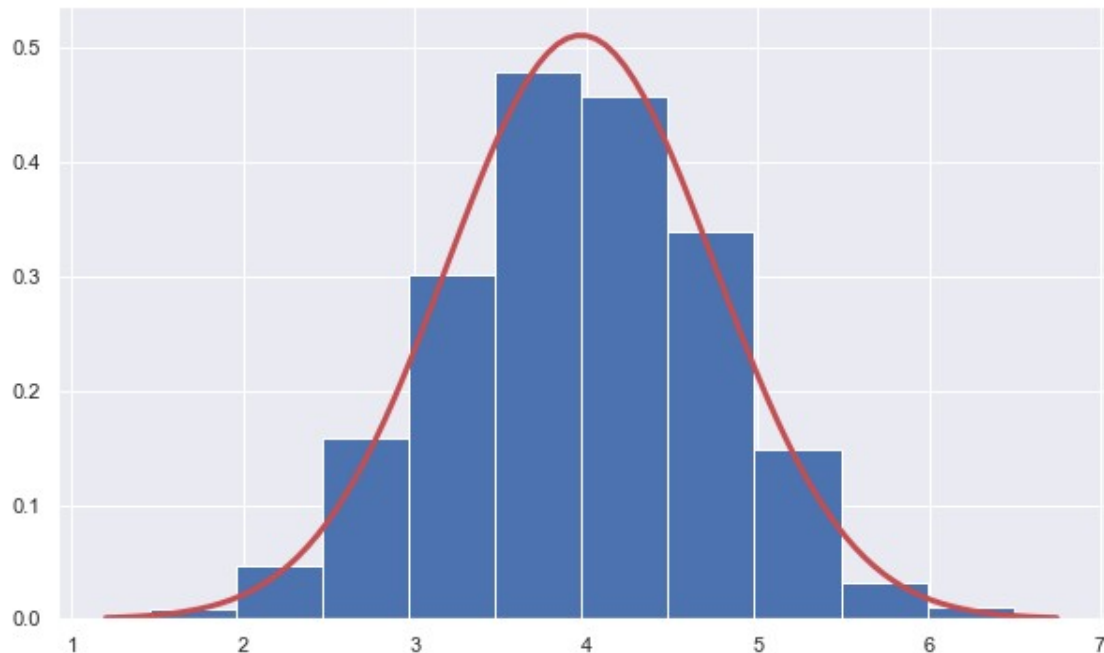
Berdasarkan hasil dari normality test, kolom Trihalomethanes berdistribusi normal dan jika kita lihat dari histogram pada kolom Trihalomethanes, dapat kita asumsikan bahwa kolom Trihalomethanes berdistribusi normal karena histogram bersifat symmetrical distribution.

Kolom Turbidity

```
normalityTest(df["Turbidity"], alpha)
```

p = 0.769472

H0 diterima, data berdistribusi normal



Berdasarkan hasil dari normality test, kolom Turbidity berdistribusi normal dan jika kita lihat dari histogram pada kolom Turbidity, dapat kita asumsikan bahwa kolom Turbidity berdistribusi normal karena histogram bersifat symmetrical distribution.

4. Melakukan test hipotesis 1 sampel, dengan menuliskan 6 langkah testing dan menampilkan juga boxplotnya untuk kolom/bagian yang bersesuaian.

6 langkah testing:

1. Tentukan Hipotesis nol ($H_0: \theta = \theta_0$), dimana θ bisa berupa μ , σ^2 , p , atau data lain berdistribusi tertentu (normal, binomial, dsc.).
2. Pilih hipotesis alternatif H_1 salah dari $\theta > \theta_0$, $\theta < \theta_0$, atau $\theta \neq \theta_0$.
3. Tentukan tingkat signifikan α .
4. Tentukan uji statistik yang sesuai dan tentukan daerah kritis.
5. Hitung nilai uji statistik dari data sample. Hitung p-value sesuai dengan uji statistik yang digunakan.
6. Ambil keputusan dengan TOLAK H_0 jika nilai uji terletak di daerah kritis atau dengan tes signifikan, TOLAK H_0 jika p-value lebih kecil dibanding tingkat signifikansi α yang diinginkan.

Perhitungan nilai uji statistik dari data sampel

```
def nilaiUji(mean, miu, sigma, n):
    return (mean - miu) / (sigma / (math.sqrt(n)))
```

Perhitungan nilai proportion test dari data sampel

```
def nilaiProportionTest(p, p0, n):
    return (p - p0) / math.sqrt(p0 * (1 - p0) / n)
```

4a. Nilai Rata-rata pH di atas 7

- Hipotesis nol $H_0: \mu = 7$
- Akan dipilih hipotesis satu $H_1: \mu > 7$
- Tingkat signifikan $\alpha = 0.05$
- Dengan $\alpha = 0.05$, maka daerah kritis adalah $z > z_{0.05} = 1.645$ karena $P(Z < 1.645) = 0.95$

$P(Z > z) = 0.95$ diperoleh dari: $P(Z > z) = 1 - \alpha$

```
z = nilaiUji(df["pH"].mean(), 7, df["pH"].std(), df["pH"].count())
print(f"Nilai uji z = {z}")
```

```
if z > 1.645:
    print("H0 ditolak karena nilai uji berada di dalam daerah kritis.")
else:
    print("H0 diterima karena nilai uji berada di luar daerah kritis.")
```

```
print()
```

```
pvalue = 1 - stats.norm.cdf(z)
print(f"P value = {pvalue}")
```

```
if pvalue < alpha:
    print(f"H0 ditolak karena nilai p value lebih kecil dari alpha ({alpha})")
else:
    print(f"H0 diterima karena nilai p value lebih besar atau sama dengan alpha ({alpha})")
```

```
plt.figure(figsize=(10,6))
sns.boxplot(data=df["pH"], orient="x", width=0.1)
```

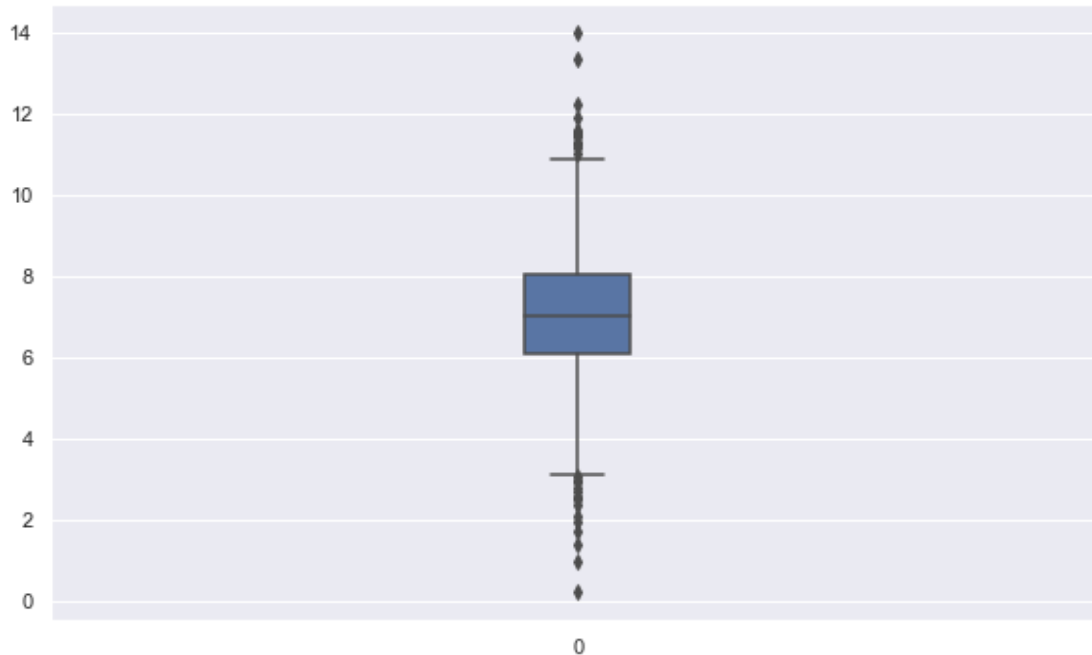
Nilai uji z = 2.485445147379887

H0 ditolak karena nilai uji berada di dalam daerah kritis.

P value = 0.006469476288896492

H0 ditolak karena nilai p value lebih kecil dari alpha (0.05)

<AxesSubplot:>



4b. Nilai Rata-rata Hardness tidak sama dengan 205

- Hipotesis nol $H_0: \mu = 205$
- Akan dipilih hipotesis satu $H_1: \mu \neq 205$
- Tingkat signifikan $\alpha = 0.05$
- Dengan $\alpha = 0.05$, maka daerah kritis adalah $z < -1.96$ dan $z > 1.96$, diperoleh dari $P(Z < z) = 0.975$ atau 0.025

$P(Z < z) = 0.975$ atau 0.025 diperoleh dari: $P(Z < z) = 1 - \alpha/2$ atau $P(Z < z) = \alpha/2$

```
z = nilaiUji(df["Hardness"].mean(), 205, df["Hardness"].std(),
df["Hardness"].count())
print(f"Nilai uji z = {z}")
if z < -1.96 or z > 1.96:
    print("H0 ditolak karena nilai uji berada di dalam daerah kritis.")
else:
    print("H0 diterima karena nilai uji berada di luar daerah kritis.")

print()
```

```
pvalue = 1 - stats.norm.cdf(z)
pvalue = pvalue * 2
print(f"P value = {pvalue}")
```

```
if pvalue < alpha:
    print(f"H0 ditolak karena nilai p value lebih kecil dari alpha ({alpha})")
else:
```

```
print(f"H0 diterima karena nilai p value lebih besar atau sama  
dengan alpha ({alpha})")
```

```
plt.figure(figsize=(10,6))  
sns.boxplot(data=df["Hardness"], orient="x", width=0.1)
```

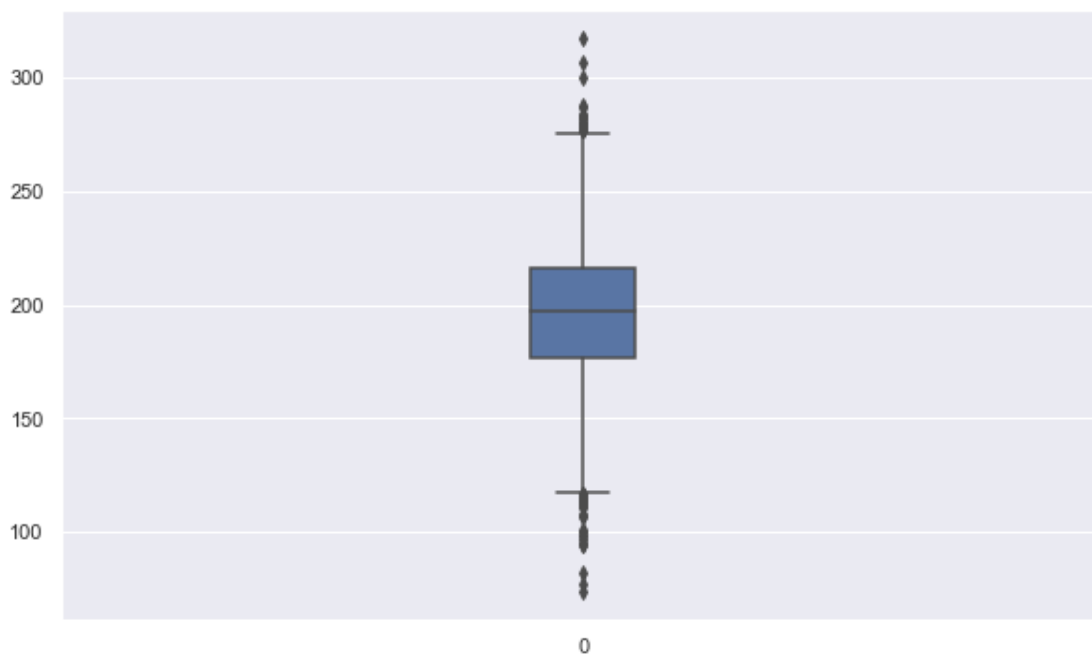
Nilai uji z = -12.403137170010732

H0 ditolak karena nilai uji berada di dalam daerah kritis.

P value = 2.0

H0 diterima karena nilai p value lebih besar atau sama dengan alpha (0.05)

<AxesSubplot:>



4c. Nilai Rata-rata 100 baris pertama kolom Solids bukan 21900

- Hipotesis nol $H_0: \mu = 21900$
- Akan dipilih hipotesis satu $H_1: \mu \neq 21900$
- Tingkat signifikan $\alpha = 0.05$
- Dengan $\alpha = 0.05$, maka daerah kritis adalah $z < -1.96$ dan $z > 1.96$, diperoleh dari $P(Z < z) = 0.975$ atau 0.025

$P(Z < z) = 0.975$ atau 0.025 diperoleh dari: $P(Z < z) = 1 - \alpha/2$ atau $P(Z < z) = \alpha/2$

```
z = nilaiUji(df["Solids"].head(100).mean(), 21900,  
df["Solids"].head(100).std(), 100)  
print(f"Nilai uji z = {z}")
```

```

if z < -1.96 or z > 1.96:
    print("H0 ditolak karena nilai uji berada di dalam daerah kritis.")
else:
    print("H0 diterima karena nilai uji berada di luar daerah kritis.")

```

```
print()
```

```

pvalue = 1 - stats.norm.cdf(z)
pvalue = 2 * pvalue
print(f"P value = {pvalue}")

```

```

if pvalue < alpha:
    print(f"H0 ditolak karena nilai p value lebih kecil dari alpha ({alpha})")
else:
    print(f"H0 diterima karena nilai p value lebih besar atau sama dengan alpha ({alpha})")

```

```

plt.figure(figsize=(10,6))
sns.boxplot(data=df["Solids"].head(100), orient="x", width=0.1)

```

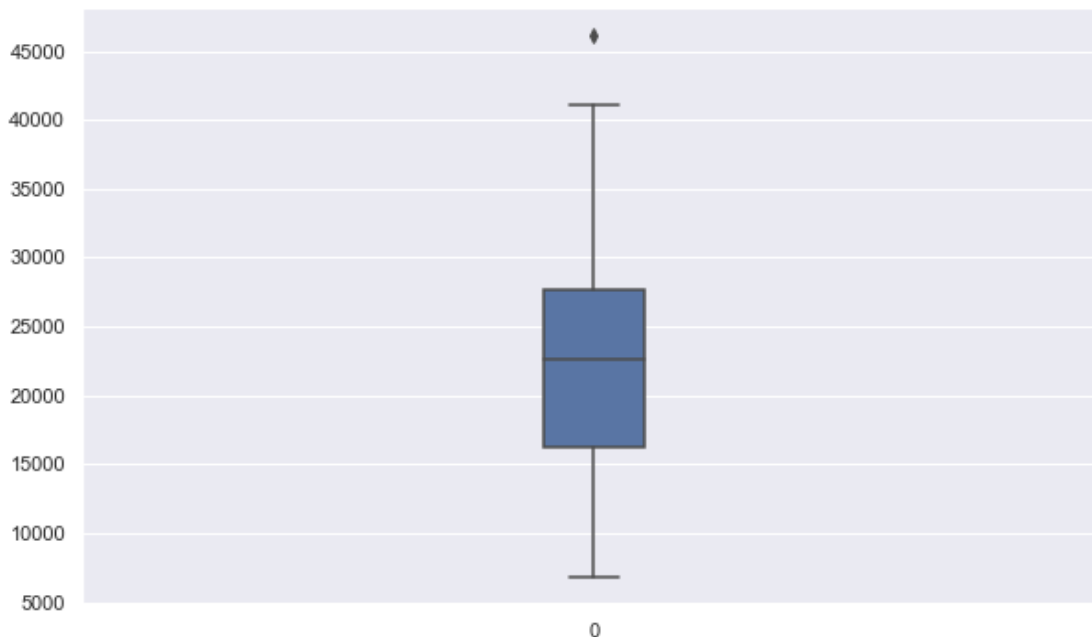
Nilai uji z = 0.5636797715721551

H0 diterima karena nilai uji berada di luar daerah kritis.

P value = 0.5729720864655174

H0 diterima karena nilai p value lebih besar atau sama dengan alpha (0.05)

<AxesSubplot:>



4d. Proporsi nilai Conductivity yang lebih dari 450, adalah tidak sama dengan 10%

- Hipotesis nol $H_0: p_0 = 0.1$
- Akan dipilih hipotesis alternatif $H_1: p_0 \neq 0.1$
- Tingkat signifikan $\alpha = 0.05$
- Dengan $\alpha = 0.05$, akan digunakan uji statistik tes proporsi menggunakan Z, dengan daerah kritis $z < -1.96$ dan $z > 1.96$ yang diperoleh dari $P(Z < z) = 1 - (0.05 / 2) = 0.975$

```
p = 0
for i in range(len(df["Conductivity"])):
    if df["Conductivity"].iloc[i] > 450:
        p += 1
p = p / len(df["Conductivity"])

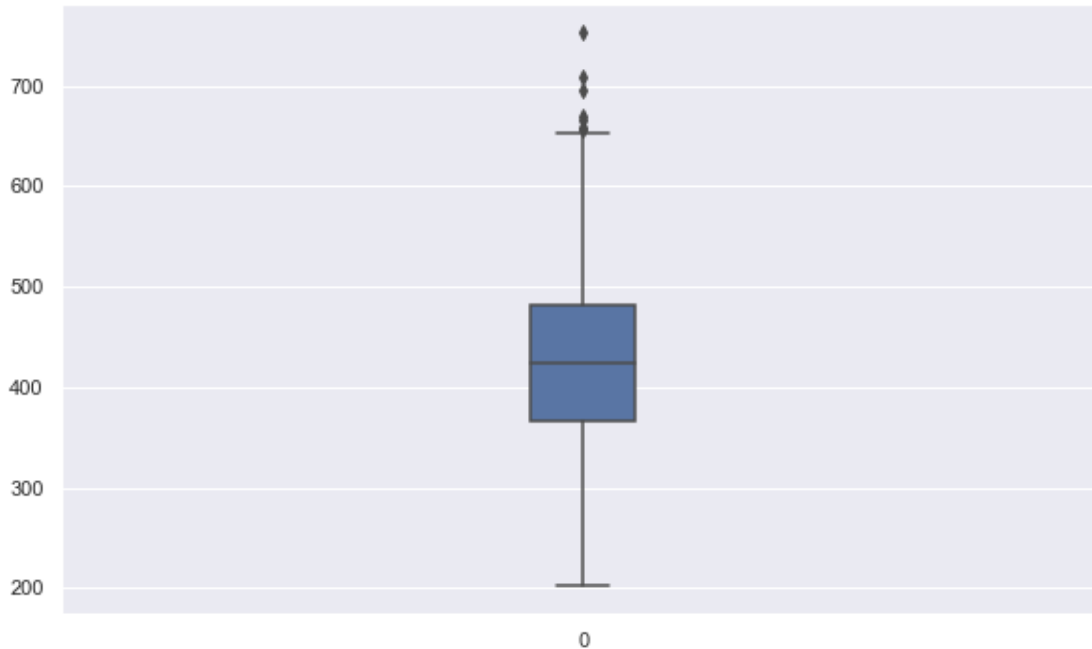
z = nilaiProportionTest(p, 0.1, len(df["Conductivity"]))
print(f"Nilai uji dari hasil tes proporsi = {z}")
pvalue = 2 * (1 - stats.norm.cdf(z))
print(f"P value = {pvalue}")

if pvalue < alpha:
    print(f"H0 ditolak karena nilai p value lebih kecil dari alpha ({alpha})")
else:
    print(f"H0 diterima karena nilai p value lebih besar atau sama dengan alpha ({alpha})")

plt.figure(figsize=(10,6))
sns.boxplot(data=df["Conductivity"], orient="x", width=0.1)

Nilai uji dari hasil tes proporsi = 40.44637613158932
P value = 0.0
H0 ditolak karena nilai p value lebih kecil dari alpha (0.05)

<AxesSubplot:>
```

4e. Proporsi nilai Trihalomethanes yang kurang dari 40, adalah kurang dari 5%

- Hipotesis nol $H_0: p_0 = 0.05$
- Akan dipilih hipotesis alternatif $H_1: p_0 < 0.05$
- Tingkat signifikan $\alpha = 0.05$
- Dengan $\alpha = 0.05$, akan digunakan uji statistik tes proporsi menggunakan Z, dengan daerah kritis $z < -1.645$ yang diperoleh dari $P(Z < z) = 1 - 0.05 = 0.95$

```
p = 0
for i in range(len(df["Trihalomethanes"])):
    if df["Trihalomethanes"].iloc[i] < 40:
        p += 1
p = p / len(df["Trihalomethanes"])

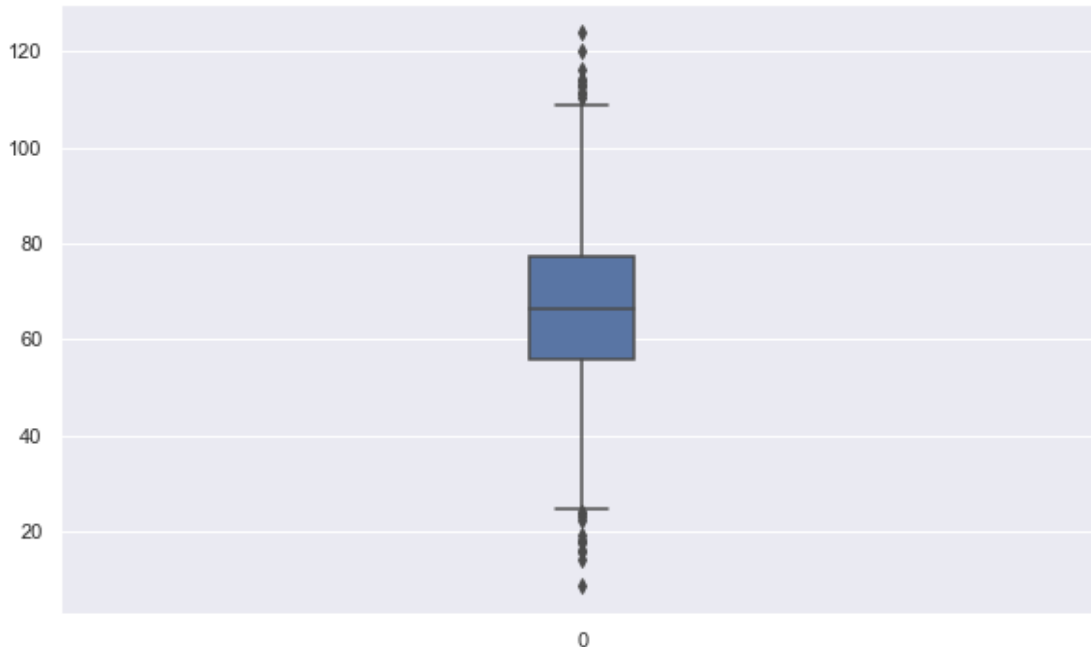
z = nilaiProportionTest(p, 0.1, len(df["Trihalomethanes"]))
print(f"Nilai uji dari hasil tes proporsi = {z}")
pvalue = stats.norm.cdf(z)
print(f"P value = {pvalue}")

if pvalue < alpha:
    print(f"H0 ditolak karena nilai p value lebih kecil dari alpha ({alpha})")
else:
    print(f"H0 diterima karena nilai p value lebih besar atau sama dengan alpha ({alpha})")

plt.figure(figsize=(10,6))
sns.boxplot(data=df["Trihalomethanes"], orient="x", width=0.1)
```

Nilai uji dari hasil tes proporsi = -7.063245831803284
P value = 8.13287923868401e-13
H0 ditolak karena nilai p value lebih kecil dari alpha (0.05)

<AxesSubplot:>



Melakukan test hipotesis 2 sampel, dengan menuliskan 6 langkah testing dan menampilkan juga boxplotnya untuk kolom/bagian yang bersesuaian.

```
def nilaiUji2(mean1, mean2, sigma1, sigma2, n1, n2, myu0):  
    return ((mean1 - mean2) - myu0) / math.sqrt(sigma1**2 / n1 +  
sigma2**2 / n2)
```

5a Data kolom Sulfate dibagi 2 sama rata: bagian awal dan bagian akhir kolom. Benarkah rata-rata kedua bagian tersebut sama?

- Hipotesis nol H0: $\mu_1 = \mu_2$
- Akan dipilih hipotesis satu H1: $\mu_1 \neq \mu_2$
- Tingkat signifikan $\alpha = 0.05$
- Dengan $\alpha = 0.05$, maka daerah kritis adalah $z < -1.96$ dan $z > 1.96$, diperoleh dari $P(Z < z) = 0.975$ atau 0.025

$P(Z < z) = 0.975$ atau 0.025 diperoleh dari: $P(Z < z) = 1 - \alpha/2$ atau $P(Z < z) = \alpha/2$

```
firsthalf = df["Sulfate"].head(len(df["Sulfate"]) // 2)  
rest = df["Sulfate"].tail(len(df["Sulfate"]) // 2)  
z = nilaiUji2(firsthalf.mean(), rest.mean(), firsthalf.std(),  
rest.std(), firsthalf.count(), rest.count(), 0)  
print(f"Nilai uji z = {z}")
```

```

pvalue = 2 * min(stats.norm.cdf(z), 1 - stats.norm.cdf(z))
print(f"Nilai dari p value = {pvalue}")

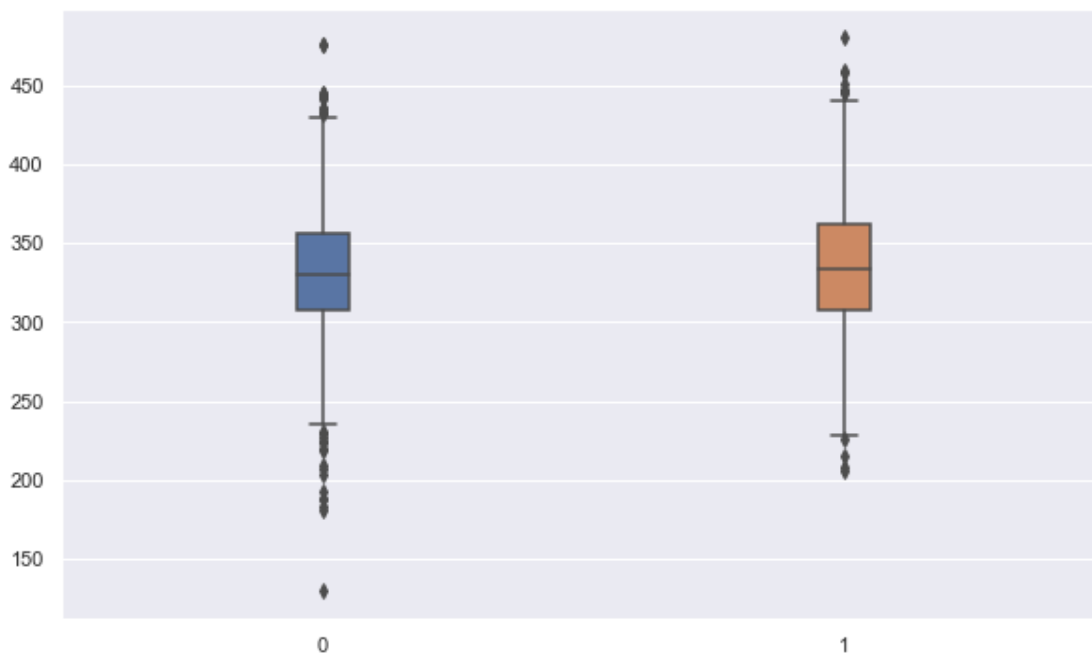
if z < -1.96 or z > 1.96:
    print("H0 ditolak karena nilai uji berada di dalam daerah kritis.")
else:
    print("H0 diterima karena nilai uji berada di luar daerah kritis.")

plt.figure(figsize=(10,6))
sns.boxplot(data=[firsthalf, rest] , orient="x", width=0.1)

Nilai uji z = -2.0752690696871983
Nilai dari p value = 0.0379616043851286
H0 ditolak karena nilai uji berada di dalam daerah kritis.

```

<AxesSubplot:>



5b Data kolom OrganicCarbon dibagi 2 sama rata: bagian awal dan bagian akhir kolom. Benarkah rata-rata bagian awal lebih besar dari pada bagian akhir sebesar 0.15?

- Hipotesis nol $H_0: \mu_1 - \mu_2 = 0.15$
- Akan dipilih hipotesis satu $H_1: \mu_1 - \mu_2 \neq 0.15$
- Tingkat signifikan $\alpha = 0.05$
- Dengan $\alpha = 0.05$, maka daerah kritis adalah $z < -1.96$ dan $z > 1.96$, diperoleh dari $P(Z < z) = 0.975$ atau 0.025

$P(Z < z) = 0.975$ atau 0.025 diperoleh dari: $P(Z < z) = 1 - \alpha/2$ atau $P(Z < z) = \alpha/2$

```

firsthalf = df["OrganicCarbon"].head(len(df["OrganicCarbon"]) // 2)
rest = df["OrganicCarbon"].tail(len(df["OrganicCarbon"]) // 2)
z = nilaiUji2(firsthalf.mean(), rest.mean(), firsthalf.std(),
rest.std(), firsthalf.count(), rest.count(), 0.15)
print(f"Nilai uji z = {z}")

pvalue = 2 * min(stats.norm.cdf(z), 1 - stats.norm.cdf(z))
print(f"Nilai dari p value = {pvalue}")

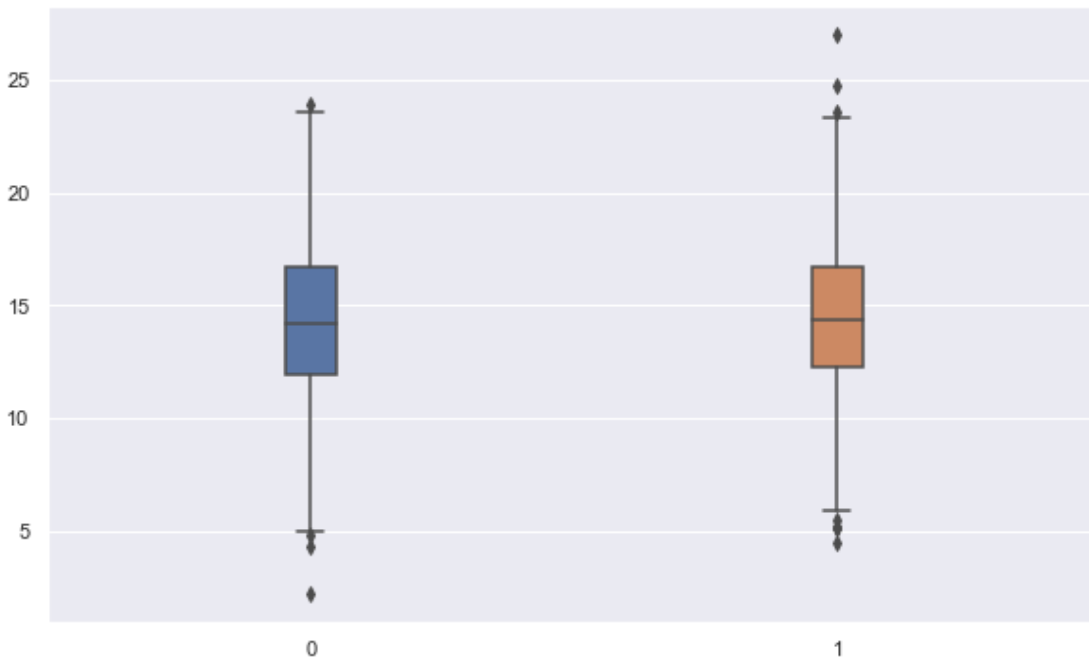
if z < -1.96 or z > 1.96:
    print("H0 ditolak karena nilai uji berada di dalam daerah kritis.")
else:
    print("H0 diterima karena nilai uji berada di luar daerah kritis.")

plt.figure(figsize=(10,6))
sns.boxplot(data=[firsthalf, rest] , orient="x", width=0.1)

Nilai uji z = -2.413145517798807
Nilai dari p value = 0.01581550381760006
H0 ditolak karena nilai uji berada di dalam daerah kritis.

```

<AxesSubplot:>



5c Rata-rata 100 baris pertama kolom Chloramines sama dengan 100 baris terakhirnya?

- Hipotesis nol $H_0: \mu_1 = \mu_2$
- Akan dipilih hipotesis satu $H_1: \mu_1 \neq \mu_2$
- Tingkat signifikan $\alpha = 0.05$

- Dengan $\alpha = 0.05$, maka daerah kritis adalah $z = -1.96$ dan $z = 1.96$, diperoleh dari $P(Z < z) = 0.975$ atau 0.025

$P(Z < z) = 0.975$ atau 0.025 diperoleh dari: $P(Z < z) = 1 - \alpha/2$ atau $P(Z < z) = \alpha/2$

```

firsthalf = df["Chloramines"].head(100)
rest = df["Chloramines"].tail(100)
z = nilaiUji2(firsthalf.mean(), rest.mean(), firsthalf.std(),
rest.std(), firsthalf.count(), rest.count(), 0)
print(f"Nilai uji z = {z}")

pvalue = 2 * min(stats.norm.cdf(z), 1 - stats.norm.cdf(z))
print(f"Nilai dari p value = {pvalue}")

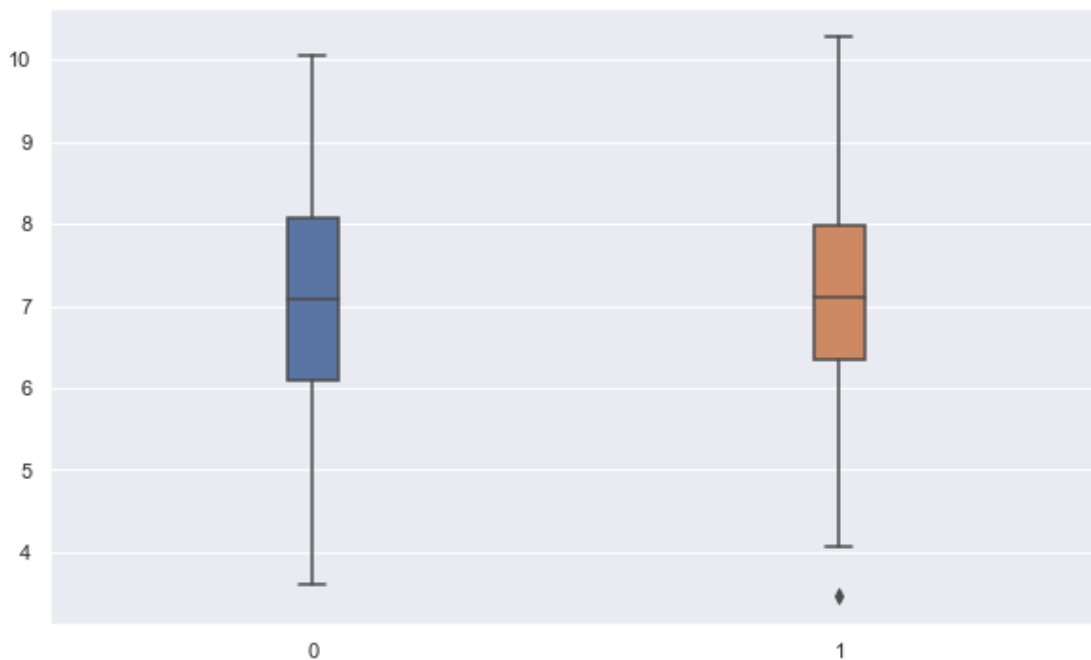
if z > -1.96 and z < 1.96:
    print("H0 ditolak karena nilai uji berada di dalam daerah kritis.")
else:
    print("H0 diterima karena nilai uji berada di luar daerah kritis.")

plt.figure(figsize=(10,6))
sns.boxplot(data=[firsthalf, rest] , orient="x", width=0.1)

Nilai uji z = -0.7059424842236872
Nilai dari p value = 0.48022390604502796
H0 ditolak karena nilai uji berada di dalam daerah kritis.

```

<AxesSubplot:>



5d Proporsi nilai bagian awal Turbidity yang lebih dari 4, adalah lebih besar daripada, proporsi nilai yang sama di bagian akhir Turbidity ?

- Hipotesis nol $H_0: p_1 = p_2$
- Akan dipilih hipotesis satu $H_1: p_1 - p_2 > 0$
- Tingkat signifikan $\alpha = 0.05$
- Dengan $\alpha = 0.05$, maka daerah kritis adalah $z > 1.645$ yang diperoleh dari $P(Z < z) = 1 - \alpha = 0.95$

```
firsthalf = df["Turbidity"].head(len(df["Turbidity"]) // 2)
rest = df["Turbidity"].tail(len(df["Turbidity"]) // 2)
p1 = 0
p2 = 0
for i in range(len(df["Turbidity"]) // 2):
    if df["Turbidity"].iloc[i] > 4:
        p1 += 1
for i in range(len(df["Turbidity"]) // 2, len(df["Turbidity"])):
    if df["Turbidity"].iloc[i] > 4:
        p2 += 1
p1 = p1 / len(df["Turbidity"])
p2 = p2 / len(df["Turbidity"])
p = p1 + p2
#karena n sama bisa langsung di tambah
z = (p1 - p2) / math.sqrt(p * (1-p) * (len(df["Turbidity"]) // 2))
print(f"Nilai uji z = {z}")

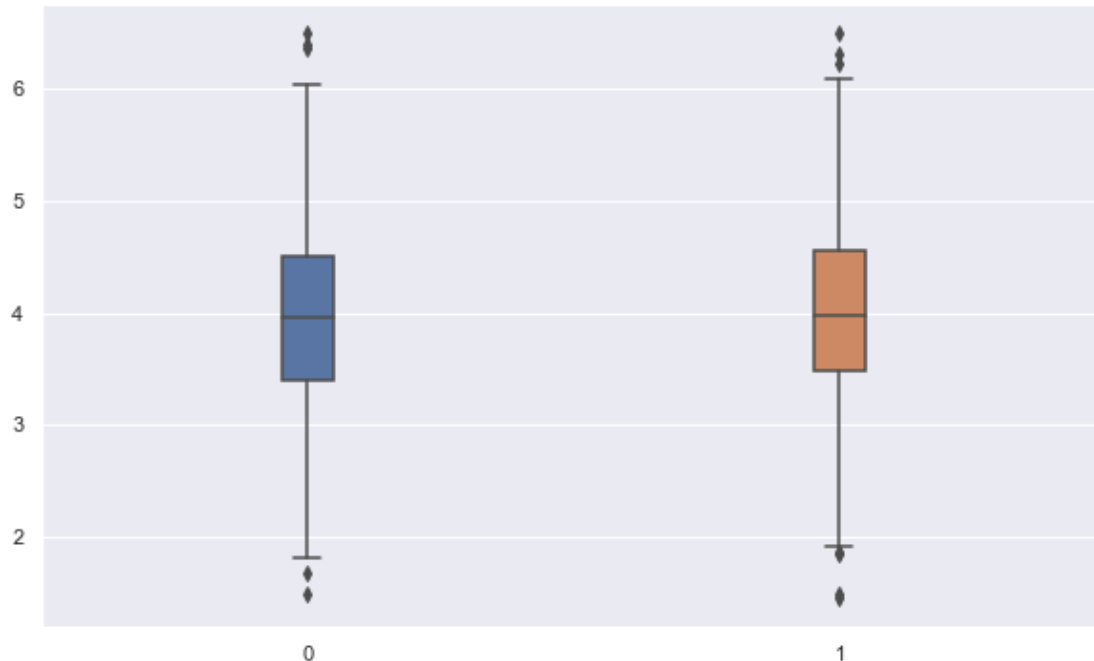
pvalue = 1 - stats.norm.cdf(z)
print(f"Nilai dari p value = {pvalue}")

if z > 1.645:
    print("H0 ditolak karena nilai uji berada di dalam daerah kritis.")
else:
    print("H0 diterima karena nilai uji berada di luar daerah kritis.")

plt.figure(figsize=(10,6))
sns.boxplot(data=[firsthalf, rest] , orient="x", width=0.1)

Nilai uji z = -9.420321853502591e-05
Nilai dari p value = 0.5000375816467679
H0 diterima karena nilai uji berada di luar daerah kritis.

<AxesSubplot:>
```



5e Bagian awal kolom Sulfate memiliki variansi yang sama dengan bagian akhirnya?

- Hipotesis nol H_0 : $\text{var1} = \text{var2}$
- Akan dipilih hipotesis satu H_1 : $\text{var1} \neq \text{var2}$
- Tingkat signifikan $\alpha = 0.05$
- Dengan $\alpha = 0.05$, akan ditentukan daerah kritis dengan uji statistik tes variansi

Mencari daerah kritis dengan tes variansi

Menentukan derajat kebebasan

`v = len(df["Sulfate"]) // 2 - 1` *# derajat kebebasan : n - 1*

Dengan menggunakan stats.f.ppf, yaitu mencari inverse dari total distribusi dari variabel random

`f1 = stats.f.ppf(0.025, v, v)` *# $\alpha / 2$*

`f2 = stats.f.ppf(0.975, v, v)` *# $1 - \alpha / 2$*

`print(f"Daerah kritis: f < {f1} atau f > {f2}")`

Daerah kritis: f < 0.883572344355818 atau f > 1.1317692392568777

`firsthalf = df["Sulfate"].head(len(df["Sulfate"]) // 2)`

`rest = df["Sulfate"].tail(len(df["Sulfate"]) // 2)`

`f = firsthalf.var() / rest.var()`

`print(f"Nilai uji f = {f}")`

`pvalue = 2 * min(stats.f.cdf(f, v, v), 1 - stats.f.cdf(f, v, v))`

`print(f"Nilai dari p value = {pvalue}")`

`if f < f1 or f > f2:`

```

    print("H0 ditolak karena nilai uji berada di luar daerah kritis.")
else:
    print("H0 diterima karena nilai uji berada di dalam daerah
kritis.")

```

```

plt.figure(figsize=(10,6))
sns.boxplot(data=[firsthalf, rest] , orient="x", width=0.1)

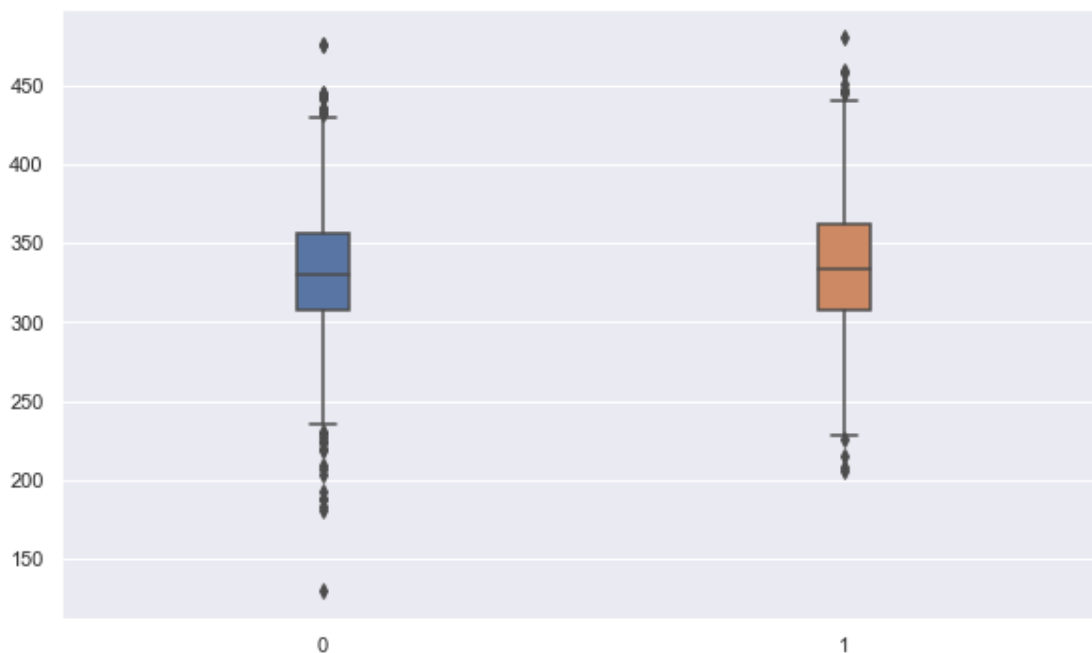
```

Nilai uji f = 1.0152511043950063

Nilai dari p value = 0.8105332960349165

H0 diterima karena nilai uji berada di dalam daerah kritis.

<AxesSubplot:>



```

def UjiKorelasi(data1, data2):
    sns.scatterplot(x = data1, y = data2, data = df)
    cor = df[data1].corr(df[data2], method = "pearson")
    print("Nilai Korelasi antara " + data1 + " dengan " + data2 + "
adalah " + str(cor))
    if (cor > 0.5):
        print("Data " + data1 + " dan " + data2 + " Berkorelasi kuat
dan positif")
    elif (cor < -0.5):
        print("Data " + data1 + " dan " + data2 + " Berkorelasi kuat
dan negatif")
    else:
        print("Data " + data1 + " dan " + data2 + " tidak
berkorelasi/korelasinya lemah")

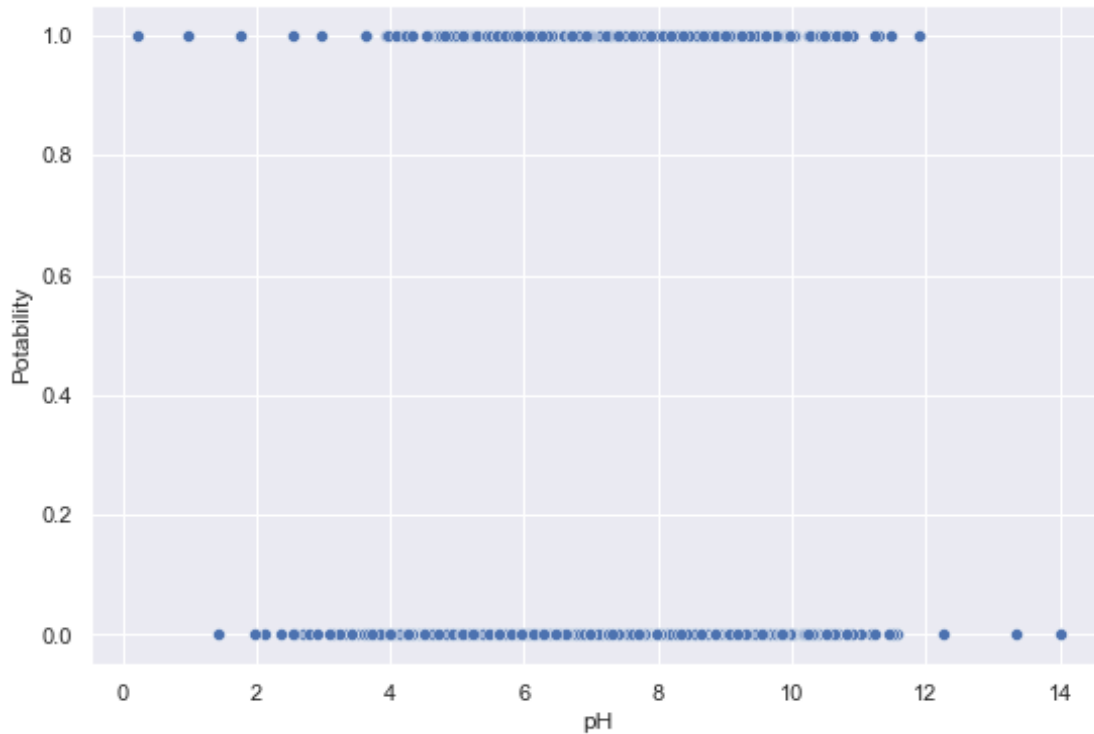
```


6 Test korelasi: tentukan apakah setiap kolom non-target berkorelasi dengan kolom target, dengan menggambarkan juga scatter plot nya. Gunakan correlation test.

```
UjiKorelasi("pH", "Potability")
```

Nilai Korelasi antara pH dengan Potability adalah 0.01547509440843348

Data pH dan Potability tidak berkorelasi/korelasinya lemah

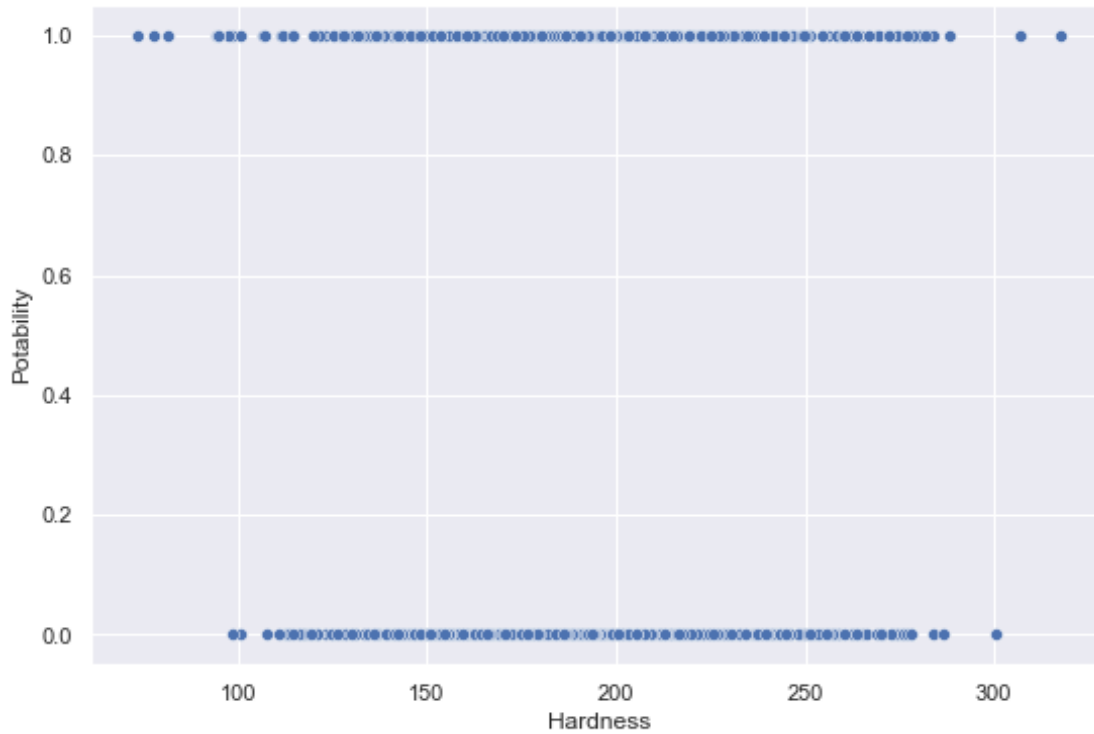


```
UjiKorelasi("Hardness", "Potability")
```

Nilai Korelasi antara Hardness dengan Potability adalah -

0.0014631528959479344

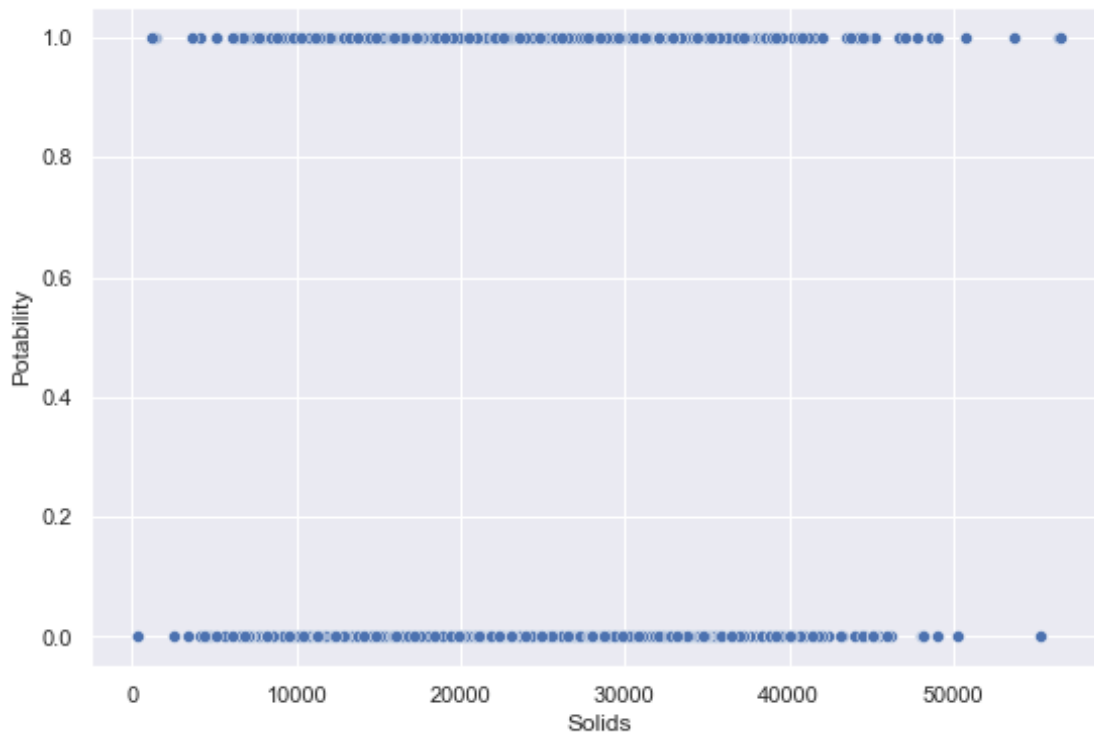
Data Hardness dan Potability tidak berkorelasi/korelasinya lemah



```
UjiKorelasi("Solids", "Potability")
```

Nilai Korelasi antara Solids dengan Potability adalah
0.03897657818173466

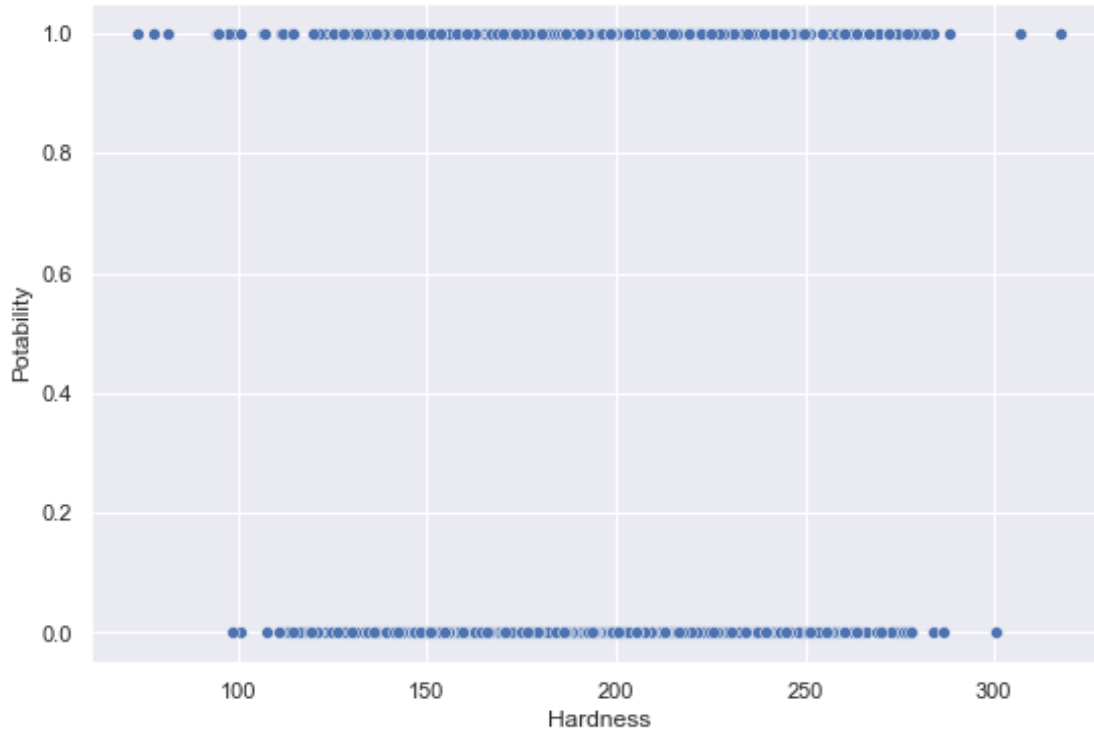
Data Solids dan Potability tidak berkorelasi/korelasinya lemah



```
UjiKorelasi("Hardness", "Potability")
```

Nilai Korelasi antara Hardness dengan Potability adalah -
0.0014631528959479344

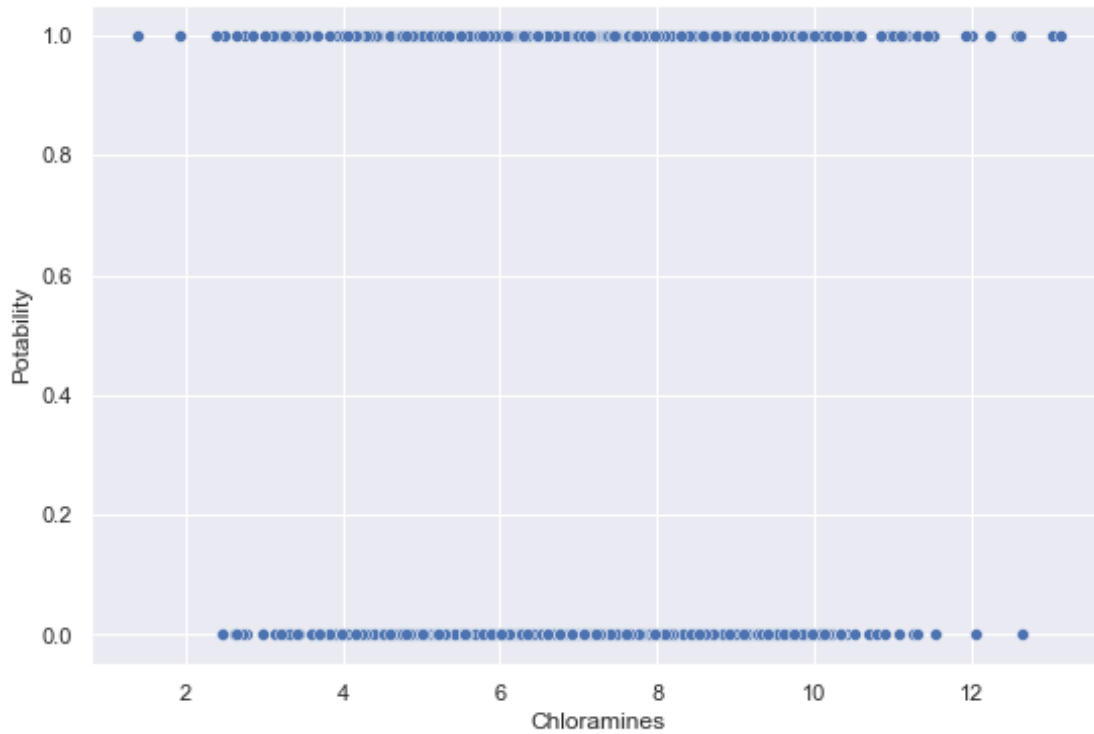
Data Hardness dan Potability tidak berkorelasi/korelasinya lemah



```
UjiKorelasi("Chloramines", "Potability")
```

Nilai Korelasi antara Chloramines dengan Potability adalah
0.02077892184052409

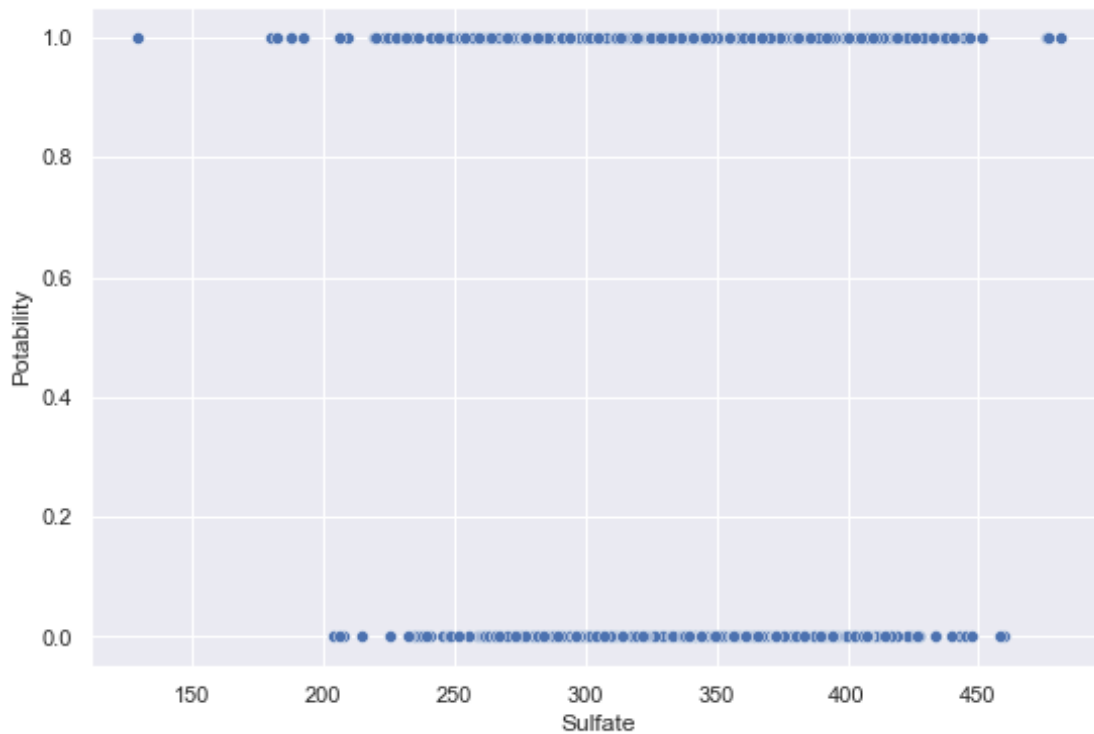
Data Chloramines dan Potability tidak berkorelasi/korelasinya lemah



`UjiKorelasi("Sulfate", "Potability")`

Nilai Korelasi antara Sulfate dengan Potability adalah -
0.015703164419273778

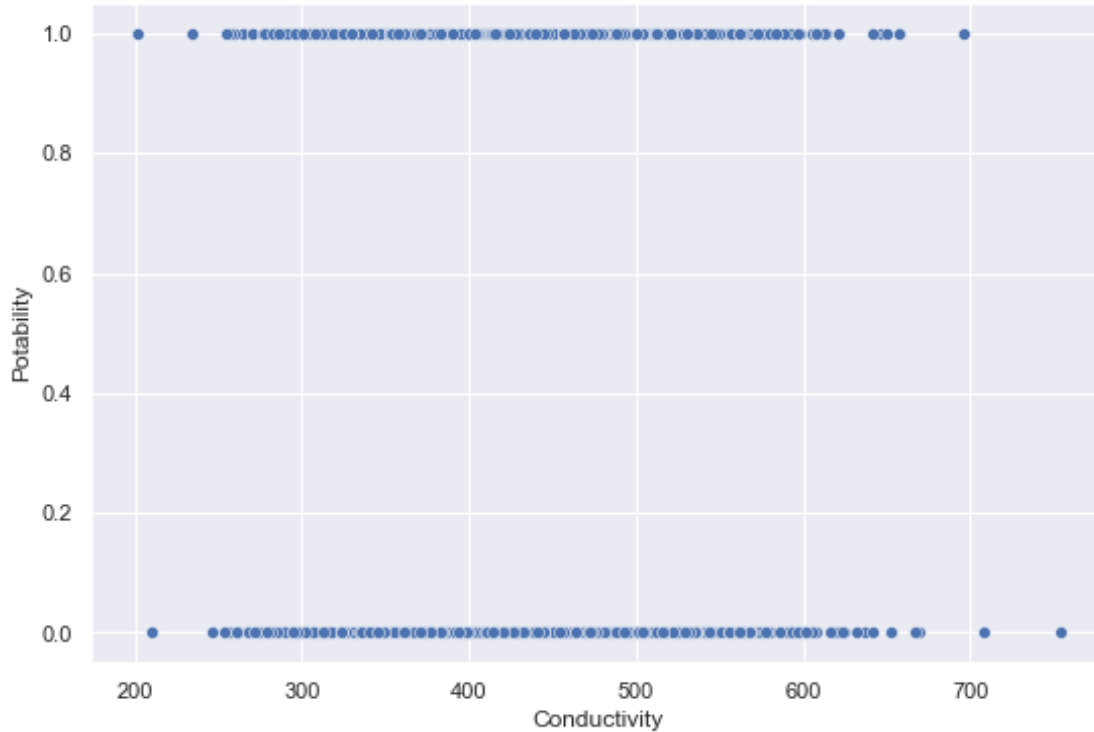
Data Sulfate dan Potability tidak berkorelasi/korelasinya lemah



```
UjiKorelasi("Conductivity", "Potability")
```

Nilai Korelasi antara Conductivity dengan Potability adalah -
0.016257120111377067

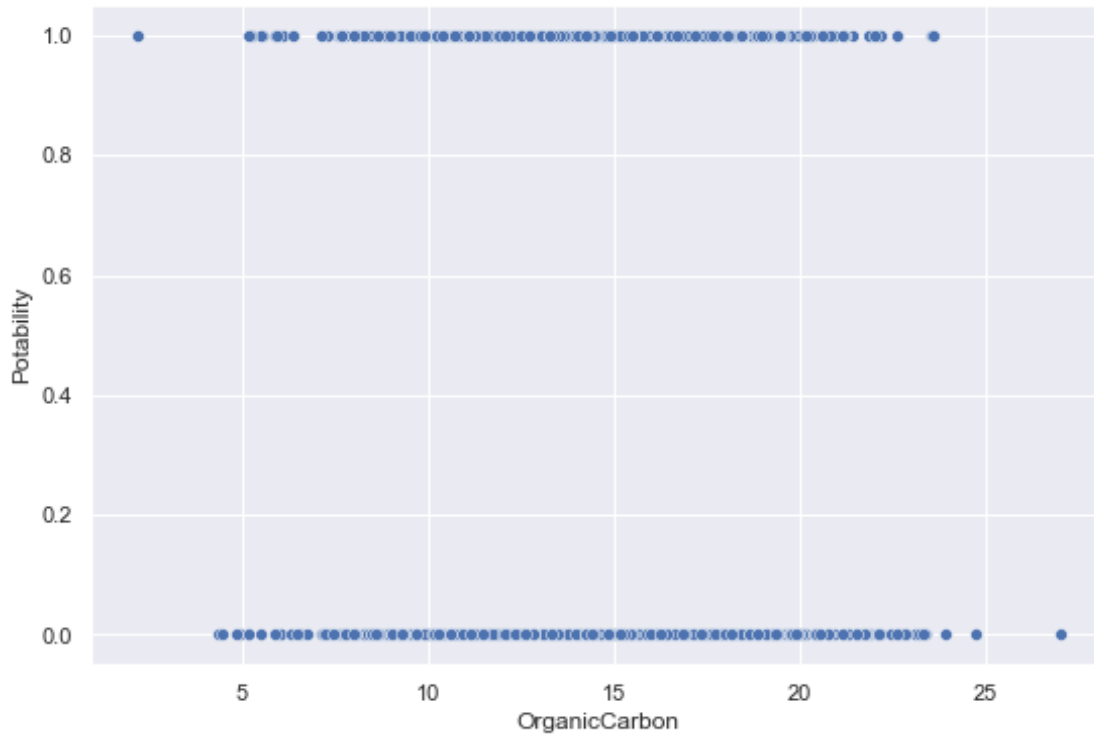
Data Conductivity dan Potability tidak berkorelasi/korelasinya lemah



```
UjiKorelasi("OrganicCarbon", "Potability")
```

Nilai Korelasi antara OrganicCarbon dengan Potability adalah -
0.015488461910747259

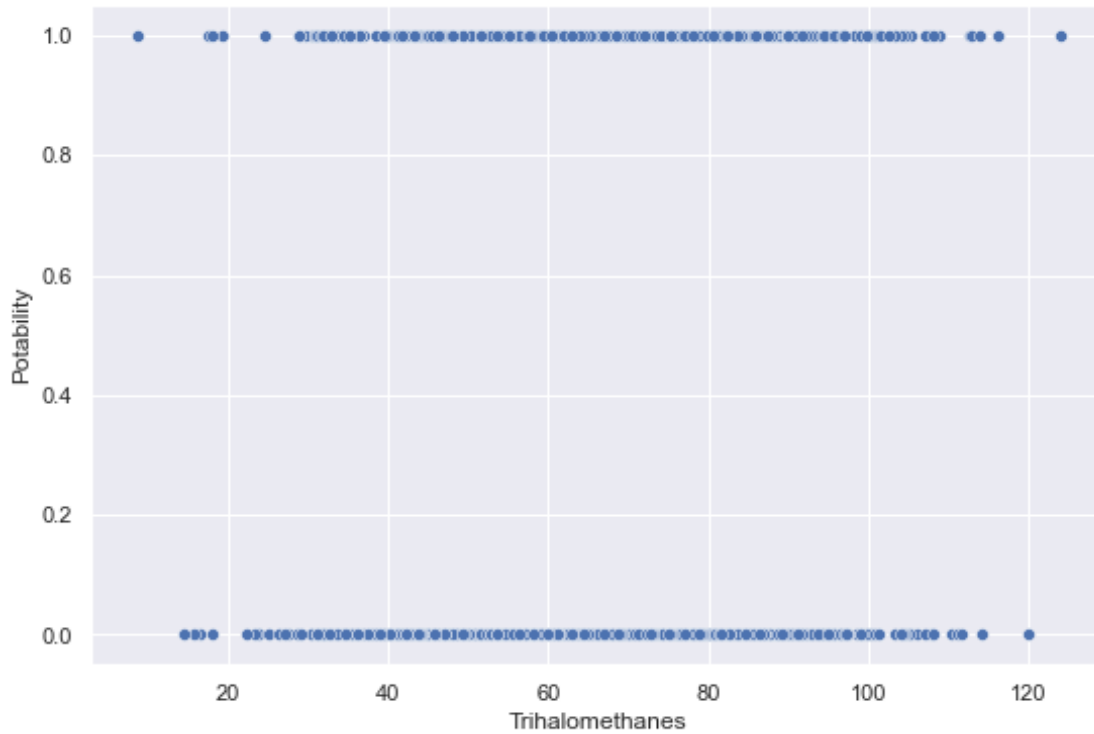
Data OrganicCarbon dan Potability tidak berkorelasi/korelasinya lemah



```
UjiKorelasi("Trihalomethanes", "Potability")
```

Nilai Korelasi antara Trihalomethanes dengan Potability adalah
0.009236711064712997

Data Trihalomethanes dan Potability tidak berkorelasi/korelasinya
lemah



`UjiKorelasi("Turbidity", "Potability")`

Nilai Korelasi antara Turbidity dengan Potability adalah
0.022331042640622665

Data Turbidity dan Potability tidak berkorelasi/korelasinya lemah

