

# analysis

May 24, 2024

```
[1]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from scipy.stats import norm, normaltest
from scipy.stats import f
from scipy import stats
import math
pd.options.mode.chained_assignment = None
```

## 1 DATA DESCRIPTION (LIBRARY)

```
[2]: # Read data
data = pd.read_csv("health.csv")
data.head()
```

```
[2]: Unnamed: 0  Age      Income  Gender      Education  Stress_Level  \
0           0   50  3.093457e+06   Male  Bachelor's Degree    4.967887
1           1   44  5.545445e+06   Male  Bachelor's Degree    5.833649
2           2   25  4.401808e+06   Male    Master's Degree    5.587946
3           3   41  4.606865e+06  Female      High School    6.271119
4           4   24  6.956049e+06   Male  Bachelor's Degree    5.895226

      Exercise_Hours_Per_Week  Cholesterol_Level  Weight  Height  \
0                16.632494        200.419036  70.917032  150.401537
1                13.255988        201.010046  70.669576  149.285349
2                11.144370        200.105258  67.464506  150.020695
3                 9.140268        199.648701  67.566598  150.360963
4                 9.775610        199.330152  79.601530  149.730525

      Blood_Pressure  Health_Status
0        125.568820    Excellent
1        125.603505         Fair
2        127.093163    Excellent
3        117.388100         Poor
4        114.163706         Fair
```

```
[3]: # Data information
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2000 entries, 0 to 1999
Data columns (total 12 columns):
#   Column                                Non-Null Count  Dtype
---  -
0   Unnamed: 0                            2000 non-null   int64
1   Age                                    2000 non-null   int64
2   Income                                2000 non-null   float64
3   Gender                                2000 non-null   object
4   Education                             2000 non-null   object
5   Stress_Level                           2000 non-null   float64
6   Exercise_Hours_Per_Week                2000 non-null   float64
7   Cholesterol_Level                      2000 non-null   float64
8   Weight                                 2000 non-null   float64
9   Height                                 2000 non-null   float64
10  Blood_Pressure                         2000 non-null   float64
11  Health_Status                          2000 non-null   object
dtypes: float64(7), int64(2), object(3)
memory usage: 187.6+ KB
```

```
[4]: # Data description
data.describe()
```

```
[4]:
```

	Unnamed: 0	Age	Income	Stress_Level \
count	2000.000000	2000.000000	2.000000e+03	2000.000000
mean	999.500000	39.417500	4.889928e+06	5.356912
std	577.494589	11.560753	2.010795e+06	0.917069
min	0.000000	20.000000	-1.088987e+06	2.528057
25%	499.750000	30.000000	3.580714e+06	4.737650
50%	999.500000	39.000000	4.898901e+06	5.351795
75%	1499.250000	49.250000	6.271595e+06	6.003014
max	1999.000000	59.000000	1.222749e+07	8.581327

	Exercise_Hours_Per_Week	Cholesterol_Level	Weight	Height \
count	2000.000000	2000.000000	2000.000000	2000.000000
mean	9.951842	200.223191	70.234359	150.730565
std	4.909573	0.972594	10.174343	0.680443
min	-4.499310	196.914948	32.581758	149.124594
25%	6.654951	199.581975	63.654894	150.240019
50%	9.927028	200.221522	70.392125	150.663619
75%	13.232218	200.873647	76.894512	151.140489
max	26.816358	203.162335	109.609562	153.870469

```
Blood_Pressure
```

```

count      2000.000000
mean       119.682437
std        11.201412
min        0.000000
25%       113.048602
50%       119.937396
75%       126.608781
max       200.950000

```

```

[5]: # Without using describe function
if 'Unnamed: 0' in data.columns:
    data = data.drop(columns=['Unnamed: 0'])

for column in data.columns:
    col = pd.Series(data[column])
    dtype = data[column].dtype
    print(f"Column: {column}")

    if dtype != "object":
        # Numeric data
        print("Total data: ", col.count())
        print("Mean: ", round(col.mean(), 3))
        print("Median: ", round(col.median(), 3))
        print("Mode: ", [round(val, 3) for val in col.mode().values])
        print("Variance: ", round(col.var(), 3))
        print("Standard Deviation: ", round(col.std(), 3))
        print("Minimum: ", round(col.min(), 3))
        print("Maximum: ", round(col.max(), 3))
        print("Range: ", round(col.max() - col.min(), 3))
        print("Q1: ", round(col.quantile(0.25), 3))
        print("Q3: ", round(col.quantile(0.75), 3))
        print("Interquartile Range (IQR): ", round(col.quantile(0.75) - col.
↪quantile(0.25), 3))
        print("Skewness: ", round(col.skew(), 3))
        print("Kurtosis: ", round(col.kurtosis(), 3))
    else:
        # Non-numeric data
        print("Unique Values: ", col.unique())
        print("Value Counts: ")
        print(col.value_counts(normalize=True).round(3))

    print("\n" + "-"*100 + "\n")

```

```

Column: Age
Total data: 2000
Mean: 39.418
Median: 39.0

```

Mode: [53]  
Variance: 133.651  
Standard Deviation: 11.561  
Minimum: 20  
Maximum: 59  
Range: 39  
Q1: 30.0  
Q3: 49.25  
Interquartile Range (IQR): 19.25  
Skewness: -0.005  
Kurtosis: -1.203

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Column: Income

Total data: 2000

Mean: 4889928.319

Median: 4898900.675

Mode: [-1088986.526, -967729.125, -637266.338, -523574.529, -494410.322, -471927.413, -341848.385, -304466.516, -223218.49, -158270.535, -130776.97, -118514.527, -59339.861, -43277.372, -36434.18, -27027.284, -6596.025, 755.409, 6167.985, 124912.443, 160233.335, 174266.619, 181378.517, 211894.834, 229357.859, 315450.826, 319081.715, 330987.536, 374559.067, 386488.925, 430804.131, 462141.458, 472591.276, 485921.428, 551824.98, 568917.358, 571812.588, 611381.706, 612150.357, 624824.34, 662221.115, 668430.706, 684545.058, 712418.82, 713754.447, 739567.849, 761457.621, 762855.313, 806946.88, 872679.449, 881267.144, 893020.036, 901295.668, 902836.345, 932808.179, 944672.014, 950079.081, 951795.879, 955758.971, 976494.759, 989483.0, 1009181.236, 1013920.888, 1025529.516, 1040723.909, 1042133.83, 1082332.35, 1113784.615, 1138980.485, 1139603.796, 1185218.777, 1228277.481, 1231278.17, 1236955.446, 1254654.204, 1262124.153, 1296953.017, 1316107.442, 1322617.121, 1334377.483, 1337565.811, 1344209.874, 1382423.858, 1395868.831, 1403160.383, 1403819.855, 1404806.94, 1407201.46, 1412994.375, 1419265.465, 1434148.71, 1444439.837, 1448328.503, 1449320.108, 1464631.959, 1468349.659, 1469066.625, 1480674.694, 1483106.261, 1484113.686, 1492805.449, 1517123.706, 1536178.125, 1540400.073, 1540451.814, 1550218.675, 1553211.714, 1572280.326, 1573727.181, 1578633.594, 1612739.475, 1621182.653, 1634235.336, 1646703.887, 1650646.26, 1652943.338, 1655627.845, 1666574.106, 1669373.386, 1671009.111, 1685527.413, 1711423.166, 1718930.155, 1720706.813, 1721092.322, 1737644.643, 1747272.825, 1755267.001, 1757596.53, 1764951.247, 1770275.648, 1803667.743, 1807172.078, 1807854.863, 1821137.83, 1823969.563, 1826475.768, 1829468.171, 1830969.96, 1839795.933, 1840795.729, 1845330.525, 1846065.299, 1847811.474, 1851247.67, 1862197.027, 1869946.932, 1871969.578, 1872776.89, 1874384.701, 1882020.086, 1915919.792, 1916202.763, 1928650.165, 1958710.307, 1969365.202, 1972543.482, 1975218.448, 1976955.921, 1980882.809, 1985951.461, 1987229.069, 1992493.356, 1993824.825, 2011598.96, 2022594.58, 2028393.891, 2034267.333, 2034926.811, 2039020.828, 2039902.659, 2050492.874, 2051917.908, 2072546.191,

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Standard Deviation: 2010795.025

Minimum: -1088986.526

Maximum: 12227492.23

Range: 13316478.756

Q1: 3580713.611

Q3: 6271595.199

Interquartile Range (IQR): 2690881.588

Skewness: -0.006

Kurtosis: -0.032

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Column: Gender

Unique Values: ['Male' 'Female']

Value Counts:

Gender

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Male 0.494

Name: proportion, dtype: float64  
  
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Column: Education

Unique Values: ["Bachelor's Degree" "Master's Degree" 'High School' 'PhD'  
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7.845, 7.873, 7.873, 7.908, 7.917, 7.928, 8.169, 8.192, 8.581]

Variance: 0.841

Standard Deviation: 0.917

Minimum: 2.528

Maximum: 8.581

Range: 6.053

Q1: 4.738

Q3: 6.003

Interquartile Range (IQR): 1.265

Skewness: -0.013

Kurtosis: -0.13

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Column: Exercise\_Hours\_Per\_Week

Total data: 2000

Mean: 9.952

Median: 9.927

Mode: [-4.499, -4.299, -4.248, -3.645, -3.633, -3.344, -3.064, -2.688, -2.636,  
-2.636, -2.502, -2.087, -2.077, -1.927, -1.906, -1.67, -1.553, -1.443, -1.326,  
-1.3, -1.272, -1.219, -1.208, -0.955, -0.951, -0.95, -0.943, -0.805, -0.764,  
-0.758, -0.491, -0.433, -0.392, -0.38, -0.353, -0.343, -0.326, -0.309, -0.273,  
-0.142, -0.064, 0.023, 0.029, 0.149, 0.197, 0.242, 0.336, 0.358, 0.362, 0.371,  
0.435, 0.472, 0.497, 0.63, 0.643, 0.699, 0.783, 0.783, 0.799, 0.899, 0.937,  
1.027, 1.032, 1.046, 1.063, 1.069, 1.093, 1.143, 1.161, 1.214, 1.274, 1.284,  
1.29, 1.31, 1.334, 1.352, 1.365, 1.366, 1.382, 1.456, 1.471, 1.542, 1.557, 1.57,  
1.575, 1.585, 1.609, 1.609, 1.635, 1.732, 1.747, 1.763, 1.776, 1.825, 1.84,  
1.849, 1.864, 1.895, 1.902, 1.919, 1.921, 1.926, 1.932, 1.94, 1.947, 1.955,  
2.091, 2.114, 2.152, 2.169, 2.175, 2.179, 2.186, 2.2, 2.204, 2.204, 2.214,  
2.229, 2.246, 2.264, 2.279, 2.286, 2.33, 2.334, 2.342, 2.352, 2.355, 2.356,  
2.373, 2.386, 2.409, 2.414, 2.415, 2.499, 2.511, 2.539, 2.554, 2.554, 2.564,  
2.564, 2.572, 2.602, 2.605, 2.624, 2.628, 2.633, 2.643, 2.657, 2.691, 2.727,  
2.765, 2.766, 2.779, 2.806, 2.807, 2.873, 2.913, 2.981, 2.993, 3.024, 3.032,  
3.084, 3.103, 3.15, 3.152, 3.168, 3.175, 3.176, 3.223, 3.226, 3.252, 3.274,  
3.308, 3.325, 3.328, 3.332, 3.349, 3.379, 3.386, 3.393, 3.403, 3.418, 3.442,  
3.448, 3.47, 3.493, 3.497, 3.499, 3.5, 3.503, 3.532, 3.562, 3.565, 3.567, 3.57,  
3.576, 3.585, 3.587, 3.598, 3.605, 3.64, 3.641, 3.641, 3.643, 3.65, 3.653,  
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3.777, 3.786, 3.801, 3.813, 3.82, 3.826, 3.829, 3.85, 3.852, 3.864, 3.889,  
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4.047, 4.056, 4.067, 4.072, 4.085, 4.125, 4.162, 4.174, 4.179, 4.182, 4.189,  
4.199, 4.203, 4.203, 4.217, 4.219, 4.223, 4.243, 4.248, 4.248, 4.251, 4.272,  
4.278, 4.279, 4.283, 4.305, 4.309, 4.359, 4.376, 4.394, 4.411, 4.421, 4.422,  
4.453, 4.456, 4.466, 4.473, 4.482, 4.488, 4.5, 4.536, 4.548, 4.551, 4.554,  
4.571, 4.574, 4.576, 4.598, 4.601, 4.616, 4.618, 4.621, 4.624, 4.625, 4.677,  
4.693, 4.713, 4.723, 4.726, 4.726, 4.726, 4.738, 4.751, 4.755, 4.758, 4.778,



4.778, 4.79, 4.791, 4.801, 4.808, 4.844, 4.91, 4.922, 4.927, 4.937, 4.939, 4.94,  
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25.531, 26.796, 26.816]

Variance: 24.104

Standard Deviation: 4.91

Minimum: -4.499

Maximum: 26.816

Range: 31.316

Q1: 6.655

Q3: 13.232

Interquartile Range (IQR): 6.577

Skewness: 0.061

Kurtosis: 0.018

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Column: Cholesterol\_Level

Total data: 2000

Mean: 200.223

Median: 200.222

Mode: [196.915, 197.009, 197.028, 197.23, 197.366, 197.382, 197.398, 197.451,  
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202.921, 202.942, 203.162]

Variance: 0.946

Standard Deviation: 0.973

Minimum: 196.915

Maximum: 203.162

Range: 6.247

Q1: 199.582

Q3: 200.874

Interquartile Range (IQR): 1.292

Skewness: -0.072

Kurtosis: 0.006

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Column: Weight

Total data: 2000

Mean: 70.234

Median: 70.392

Mode: [32.582, 38.022, 38.667, 40.21, 41.274, 42.271, 42.429, 42.931, 43.21,  
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96.614, 97.445, 97.456, 97.475, 97.577, 97.861, 100.333, 100.976, 102.708,  
103.488, 109.61]

Variance: 103.517

Standard Deviation: 10.174  
Minimum: 32.582  
Maximum: 109.61  
Range: 77.028  
Q1: 63.655  
Q3: 76.895  
Interquartile Range (IQR): 13.24  
Skewness: -0.058  
Kurtosis: 0.125

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Column: Height  
Total data: 2000  
Mean: 150.731  
Median: 150.664

Mode: [149.125, 149.144, 149.225, 149.256, 149.268, 149.285, 149.294, 149.315,  
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152.658, 152.68, 152.706, 152.717, 152.734, 152.755, 152.771, 152.782, 152.79,  
152.804, 152.842, 152.942, 152.956, 153.043, 153.107, 153.134, 153.137, 153.363,  
153.494, 153.844, 153.87]

Variance: 0.463  
Standard Deviation: 0.68  
Minimum: 149.125  
Maximum: 153.87  
Range: 4.746  
Q1: 150.24  
Q3: 151.14  
Interquartile Range (IQR): 0.9  
Skewness: 0.657  
Kurtosis: 0.708

---

---

Column: Blood\_Pressure  
Total data: 2000  
Mean: 119.682  
Median: 119.937  
Mode: [0.0]  
Variance: 125.472  
Standard Deviation: 11.201  
Minimum: 0.0  
Maximum: 200.95  
Range: 200.95  
Q1: 113.049  
Q3: 126.609  
Interquartile Range (IQR): 13.56  
Skewness: -1.627  
Kurtosis: 18.838

---

---

Column: Health\_Status  
Unique Values: ['Excellent' 'Fair' 'Poor' 'Good']  
Value Counts:  
Health\_Status  
Fair 0.260  
Poor 0.252  
Excellent 0.252  
Good 0.237  
Name: proportion, dtype: float64

---

---

```
[6]: numeric_data = data.select_dtypes(include=[int, float])
Q1 = numeric_data.quantile(0.25)
Q3 = numeric_data.quantile(0.75)
IQR = Q3 - Q1
```

```
[7]: # Additional data description for non numeric data
string_data = data.select_dtypes(include=[object])

print("Unique Values:\n", string_data.nunique())
print("\nProportions:\n", string_data.value_counts(normalize=False))
```

Unique Values:

```
Gender          2
Education       6
Health_Status   4
dtype: int64
```

Proportions:

Gender	Education	Health_Status	
Male	Bachelor's Degree	Good	134
Female	Bachelor's Degree	Excellent	129
Male	Bachelor's Degree	Excellent	126
		Fair	124
Female	Bachelor's Degree	Poor	112
		Fair	108
		Good	106
Male	Bachelor's Degree	Poor	101
Female	Master's Degree	Fair	77
		Poor	67
Male	Master's Degree	Poor	66
Female	Master's Degree	Excellent	62
Male	Master's Degree	Good	59
		Fair	53
		Excellent	50
Female	Master's Degree	Good	48
	PhD	Poor	39
	High School	Fair	39
Male	High School	Fair	39
Female	High School	Poor	38
Male	PhD	Poor	36
Female	High School	Excellent	35
		Good	34
	PhD	Excellent	33
Male	High School	Excellent	31
		Poor	30
	PhD	Good	29
Female	PhD	Good	28

Male	PhD	Excellent	28
		Fair	28
Female	PhD	Fair	26
Male	High School	Good	25
	Other	Fair	12
Female	Other	Fair	12
		Poor	9
Male	Other	Excellent	6
Female	Other	Good	5
Male	Other	Good	5
		Poor	5
Female	Other	Excellent	3
Male	undefined	Fair	1
Female	undefined	Good	1
Male	undefined	Poor	1

Name: count, dtype: int64

```
[8]: print (data["Education"].unique())
```

```
["Bachelor's Degree" "Master's Degree" 'High School' 'PhD' 'Other'
 'undefined']
```

## 2 DATA DESCRIPTION (MANUAL)

### 2.1 Fungsi Buatan

```
[9]: # Mean
def mean_own(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None
    return sum(lst) / len(lst)

# Median
def median_own(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None
    sorted_lst = sorted(lst)
    n = len(sorted_lst)
    if n % 2 == 0:
        mid = n // 2
        return (sorted_lst[mid - 1] + sorted_lst[mid]) / 2
    else:
        return sorted_lst[n // 2]

# Modus
def mode_own(lst):
    freq_map = {}
```

```

for item in lst:
    if item in freq_map:
        freq_map[item] += 1
    else:
        freq_map[item] = 1

max_freq = max(freq_map.values())
mode = [key for key, value in freq_map.items() if value == max_freq]

if len(mode) == 0:
    return list(set(lst))
else:
    return mode

# Standard Deviation
def std_own(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None

    mean = mean_own(lst)
    sum_squared_diff = sum((x - mean) ** 2 for x in lst)
    mean_squared_diff = sum_squared_diff / len(lst)
    std_dev = math.sqrt(mean_squared_diff)

    return std_dev

# Variance
def variance_own(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None
    return std_own(lst)**2

# Maximum Value
def max_data_own(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None
    return max(lst)

# Minimum Value
def min_data_own(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None
    return min(lst)

# Range
def range(lst):
    if not all(isinstance(x, (float, int)) for x in lst):

```

```

        return None
    return max_data_own(lst) - min_data_own(lst)

# First Quartile
def quartile_first(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None

    sorted_lst = sorted(lst)

    n = len(sorted_lst)

    if n % 2 == 0:
        lower_half = sorted_lst[:n // 2]
        q1_index = len(lower_half) // 2
        q1 = (lower_half[q1_index - 1] + lower_half[q1_index]) / 2
    else:
        lower_half = sorted_lst[:n // 2 + 1]
        q1_index = len(lower_half) // 2
        q1 = lower_half[q1_index]

    return q1

# Second Quartile
def quartile_second(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None

    sorted_lst = sorted(lst)

    n = len(sorted_lst)

    if n % 2 == 0:
        q2_index = n // 2
        q2 = (sorted_lst[q2_index - 1] + sorted_lst[q2_index]) / 2
    else:
        q2_index = n // 2
        q2 = sorted_lst[q2_index]

    return q2

# Third Quartile
def quartile_third(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None

    sorted_lst = sorted(lst)

```

```

n = len(sorted_lst)

if n % 2 == 0:
    upper_half = sorted_lst[n // 2:]
    q3_index = len(upper_half) // 2
    q3 = (upper_half[q3_index - 1] + upper_half[q3_index]) / 2
else:
    upper_half = sorted_lst[n // 2 + 1:]
    q3_index = len(upper_half) // 2
    q3 = upper_half[q3_index]

return q3

# IQR (Interquartile Range)
def iqr_own(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None
    return quartile_third(lst) - quartile_first(lst)

# Skewness
def skewness_own(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None

    mean = mean_own(lst)
    std_dev = std_own(lst)
    n = len(lst)

    skewness = (sum((x - mean) ** 3 for x in lst) * n) / ((n - 1) * (n - 2) *
↳ std_dev ** 3)

    return skewness

# Kurtosis
def kurtosis_own(lst):
    if not all(isinstance(x, (float, int)) for x in lst):
        return None

    mean = mean_own(lst)
    std_dev = std_own(lst)
    n = len(lst)

    kurtosis = (sum((x - mean) ** 4 for x in lst) * n * (n + 1)) / ((n - 1) *
↳ (n - 2) * (n - 3) * std_dev ** 4) - (3 * (n - 1) ** 2) / ((n - 2) * (n - 3))

    return kurtosis

```



```

# Unique Value
def unique_values_own(lst):
    if not all(isinstance(x, str) for x in lst):
        return None

    unique_set = set(lst)
    num_unique = len(unique_set)

    return num_unique

# Proportion
def proportion(lst):
    arr = {}
    for x in lst:
        if x in arr:
            arr[x] += 1
        else:
            arr.setdefault(x, 1)

    sum_val = sum(arr.values())
    for x in arr:
        arr[x] /= sum_val

    return arr

def calculate_length(lst):
    length = 0
    for _ in lst:
        length += 1
    return length

```

## 2.2 Result

```

[10]: if 'Unnamed: 0' in data.columns:
        data = data.drop(columns=['Unnamed: 0'])

    for column in data.columns:
        col = pd.Series(data[column])
        dtype = data[column].dtype
        print(f"Column: {column}")

        if dtype != "object":
            # Numeric data
            print("Total data: ", calculate_length(col))
            print("Mean: ", round(mean_own(col), 3))
            print("Median: ", round(median_own(col), 3))

```

```

print("Mode: ", mode_own(col))
print("Variance: ", round(variance_own(col), 3))
print("Standard Deviation: ", round(std_own(col), 3))
print("Minimum: ", round(min_data_own(col), 3))
print("Maximum: ", round(max_data_own(col), 3))
print("Range: ", round(max_data_own(col) - min_data_own(col), 3))
print("Q1: ", round(quantile_first(col), 3))
print("Q2: ", round(quantile_second(col), 3))
print("Q3: ", round(quantile_third(col), 3))
print("Interquartile Range (IQR): ", round(quantile_third(col) -
↪quantile_first(col), 3))
print("Skewness: ", round(skewness_own(col), 3))
print("Kurtosis: ", round(kurtosis_own(col), 3))
else:
    # Non-numeric data
    print("Unique Values: ", col.unique())
    print("Value Counts: ")
    print(col.value_counts(normalize=True).round(3))

print("\n" + "-"*100 + "\n")

```

```

Column: Age
Total data: 2000
Mean: 39.417
Median: 39.0
Mode: [53]
Variance: 133.584
Standard Deviation: 11.558
Minimum: 20
Maximum: 59
Range: 39
Q1: 30.0
Q2: 39.0
Q3: 49.5
Interquartile Range (IQR): 19.5
Skewness: -0.005
Kurtosis: -1.202

```

```

-----

Column: Income
Total data: 2000
Mean: 4889928.319
Median: 4898900.675
Mode: [3093456.839129376, 5545445.499981578, 4401808.3739984725,
4606864.577252259, 6956049.081191243, 6267972.350701972, 4639778.386743392,

```

3943475.683596707, 7769673.732480399, 5014654.99835294, 6204544.576247538,  
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Variance: 4041274982323.478

Standard Deviation: 2010292.263

Minimum: -1088986.526

Maximum: 12227492.23

Range: 13316478.756

Q1: 3579592.599

Q2: 4898900.675

Q3: 6272831.37

Interquartile Range (IQR): 2693238.772

Skewness: -0.006

Kurtosis: -0.029

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Column: Gender

Unique Values: ['Male' 'Female']

Value Counts:

Gender

Female 0.505

Male 0.494

Name: proportion, dtype: float64  
  
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Column: Education

Unique Values: ["Bachelor's Degree" "Master's Degree" 'High School' 'PhD' 'Other']

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Value Counts:
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Other                0.028
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Column: Stress_Level
Total data: 2000
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Median: 5.352
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Variance: 0.841

Standard Deviation: 0.917

Minimum: 2.528

Maximum: 8.581

Range: 6.053

Q1: 4.738

Q2: 5.352

Q3: 6.003

Interquartile Range (IQR): 1.266



Skewness: -0.013  
Kurtosis: -0.127

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Column: Exercise\_Hours\_Per\_Week

Total data: 2000

Mean: 9.952

Median: 9.927

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Variance: 24.092

Standard Deviation: 4.908

Minimum: -4.499

Maximum: 26.816

Range: 31.316

Q1: 6.654

Q2: 9.927

Q3: 13.233

Interquartile Range (IQR): 6.579

Skewness: 0.061

Kurtosis: 0.021

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Column: Cholesterol\_Level

Total data: 2000

Mean: 200.223

Median: 200.222

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Variance: 0.945

Standard Deviation: 0.972

Minimum: 196.915

Maximum: 203.162

Range: 6.247

Q1: 199.582

Q2: 200.222

Q3: 200.874

Interquartile Range (IQR): 1.292

Skewness: -0.072

Kurtosis: 0.009

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Column: Weight

Total data: 2000

Mean: 70.234

Median: 70.392

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Variance: 103.465

Standard Deviation: 10.172

Minimum: 32.582

Maximum: 109.61

Range: 77.028

Q1: 63.645

Q2: 70.392

Q3: 76.902

Interquartile Range (IQR): 13.257

Skewness: -0.058

Kurtosis: 0.128

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Column: Height

Total data: 2000

Mean: 150.731

Median: 150.664

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150.11437983693048, 149.82851069074087, 150.58719281668985, 150.82561415408767,  
151.27995377099333]

Variance: 0.463

Standard Deviation: 0.68

Minimum: 149.125

Maximum: 153.87

Range: 4.746

Q1: 150.24

Q2: 150.664

Q3: 151.141

Interquartile Range (IQR): 0.901

Skewness: 0.658

Kurtosis: 0.712

-----  
-----

Column: Blood\_Pressure

Total data: 2000

Mean: 119.682

Median: 119.937

Mode: [0.0]

Variance: 125.409

Standard Deviation: 11.199

Minimum: 0.0

Maximum: 200.95

Range: 200.95

Q1: 113.048

Q2: 119.937

Q3: 126.612

Interquartile Range (IQR): 13.563

Skewness: -1.628

Kurtosis: 18.86

-----  
-----

Column: Health\_Status

Unique Values: ['Excellent' 'Fair' 'Poor' 'Good']

Value Counts:

Health\_Status

Fair 0.260

Poor 0.252

```
Excellent    0.252
Good         0.237
Name: proportion, dtype: float64
```

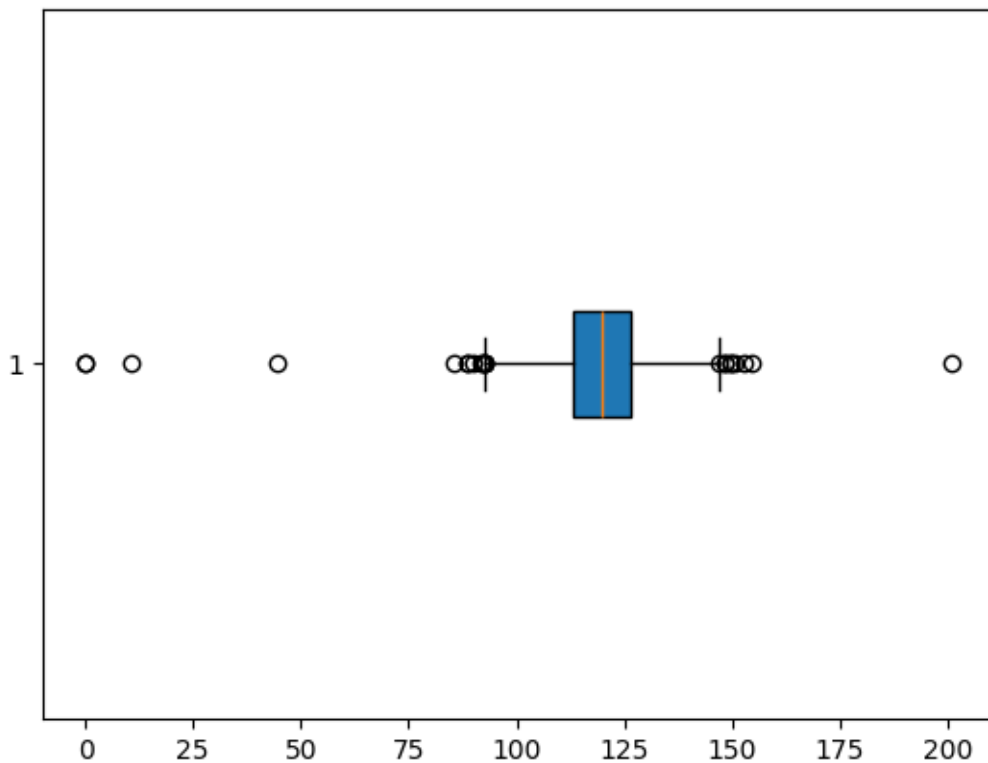
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### 3 FINDING AND HANDLING OUTLIERS

3.0.1 Disini, kita akan menganggap data yang berada diluar rentang  $Q1 - 1.5IQR$  dan  $Q3 + 1.5IQR$  adalah outliers, kita akan menggunakan bantuan boxplot untuk mencarinya, titik-titik yang berada diluar whiskers (garis yang keluar dari box) adalah outliers.

```
[11]: # Blood_Pressure
blood_pressure_data = data["Blood_Pressure"]
plt.boxplot(blood_pressure_data, vert=False, patch_artist=True)
plt.show()
```



```
[12]: # Check for outliers
```

```

outliers_blood_pressure = blood_pressure_data[(blood_pressure_data <
↳Q1["Blood_Pressure"] - 1.5 * IQR["Blood_Pressure"]) | (blood_pressure_data >
↳Q3["Blood_Pressure"] + 1.5 * IQR["Blood_Pressure"])]
outliers_blood_pressure

```

```

[12]: 43      90.027285
      117      85.650116
      192      91.953005
      230     150.635116
      249     148.131915
      316      0.000000
      323     148.158032
      417      92.692620
      526     149.568502
      617     10.780000
      715     149.463928
      924      88.578819
     1123     147.048143
     1223     88.665138
     1230     152.643476
     1421      92.479926
     1507      92.114951
     1551      0.000000
     1643      44.450000
     1696     154.427656
     1807      92.561036
     1920     200.950000
Name: Blood_Pressure, dtype: float64

```

Disini terlihat bahwa kolom Blood Pressure juga memiliki outliers sehingga perlu diteliti lebih lanjut.

```

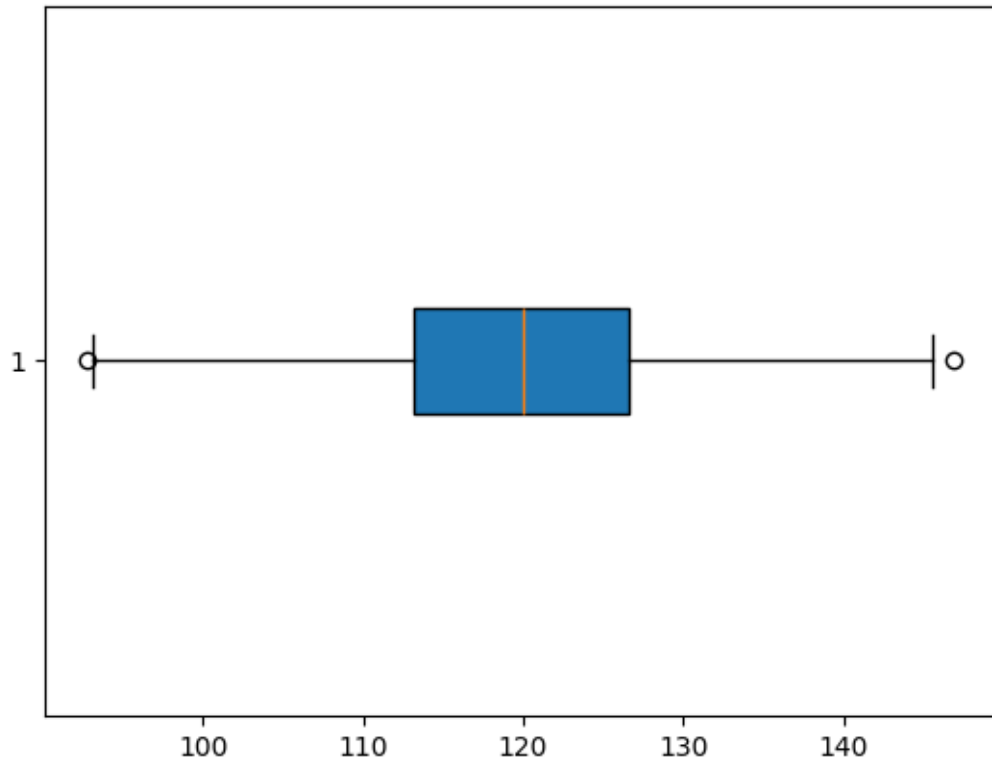
[13]: # Remove outliers
      data = data.drop(outliers_blood_pressure.index)

```

```

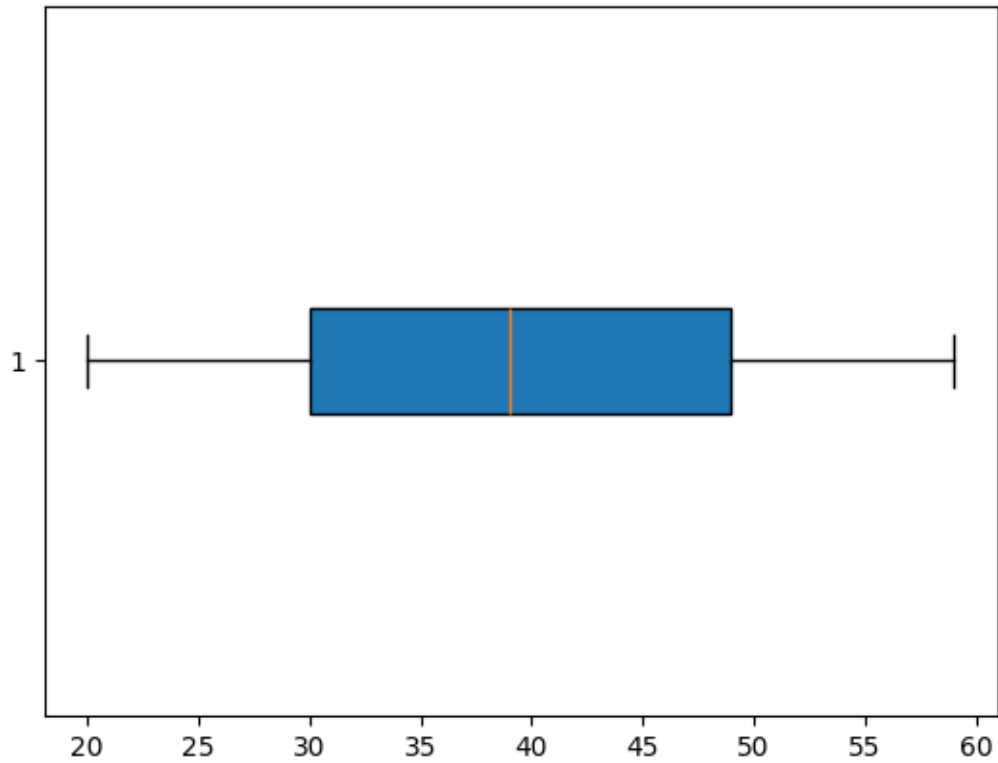
[14]: plt.boxplot(data["Blood_Pressure"], vert=False, patch_artist=True)
      plt.show()

```



Berdasarkan data pada <https://www.heart.org/en/health-topics/high-blood-pressure/understanding-blood-pressure-readings>, walaupun masih ada outliers, tetapi outliers tersebut masih dalam batas wajar sehingga tidak perlu ditangani lebih lanjut.

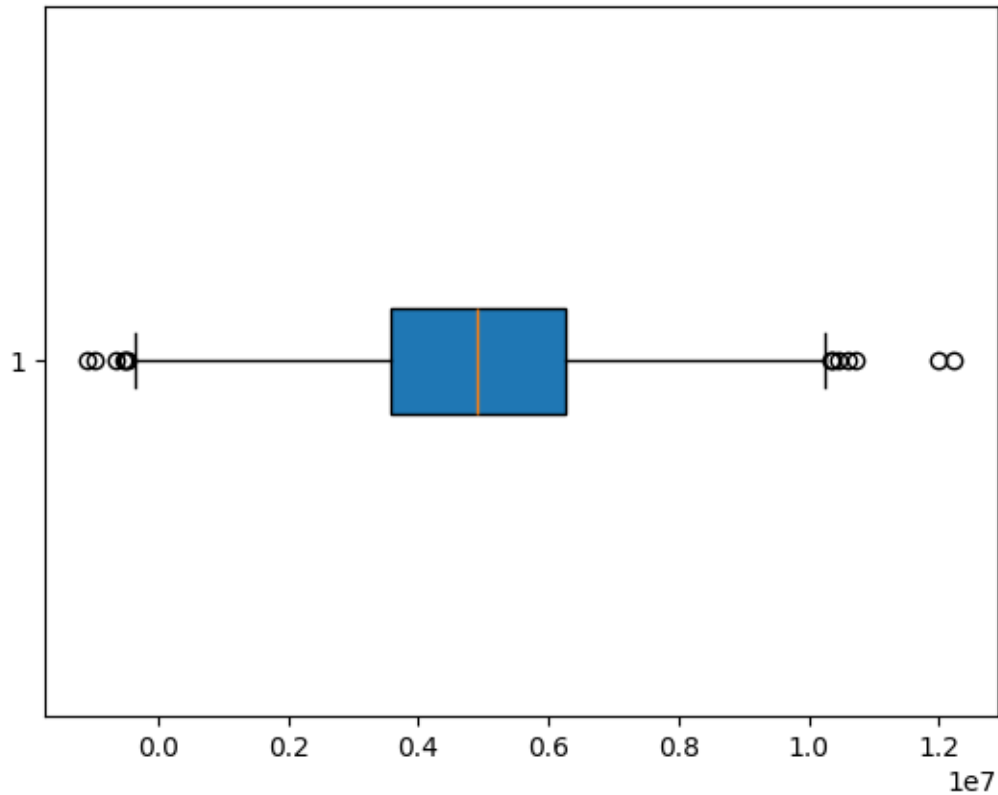
```
[15]: # Age
age_data = data["Age"]
plt.boxplot(age_data, vert=False, patch_artist=True)
plt.show()
```



Karena tidak ada titik titik diluar whiskers, maka kolom age aman dari outliers

```
[16]: # Income
income_data = data["Income"]
plt.boxplot(income_data, vert=False, patch_artist=True)
plt.show()
```





Disini terlihat kolom data income memiliki banyak outlier sehingga data tersebut perlu di cek lebih lanjut.

Dari boxplot tersebut, ada income yang bernilai negatif yang jelas hal ini tidak masuk akal sehingga untuk menangani ini, kita perlu membatasi income minimum adalah 0.

```
[17]: outliers_income = income_data[(income_data < Q1["Income"] - 1.5 * IQR["Income"]) | (income_data > Q3["Income"] + 1.5 * IQR["Income"])]
outliers_income
```

```
[17]: 102    -5.235745e+05
      453    -6.372663e+05
      514    -4.944103e+05
      579     1.044300e+07
      673     1.060307e+07
      835    -4.719274e+05
      892    -9.677291e+05
     1328     1.222749e+07
     1460     1.036827e+07
     1686     1.198891e+07
     1697    -1.088987e+06
     1947     1.073412e+07
```

```
1948      1.034308e+07
Name: Income, dtype: float64
```

```
[18]: # Tampilkan data yang memiliki nilai income negatif
outliers_income_negatif = outliers_income[outliers_income < 0]
outliers_income_negatif
```

```
[18]: 102      -5.235745e+05
453      -6.372663e+05
514      -4.944103e+05
835      -4.719274e+05
892      -9.677291e+05
1697     -1.088987e+06
Name: Income, dtype: float64
```

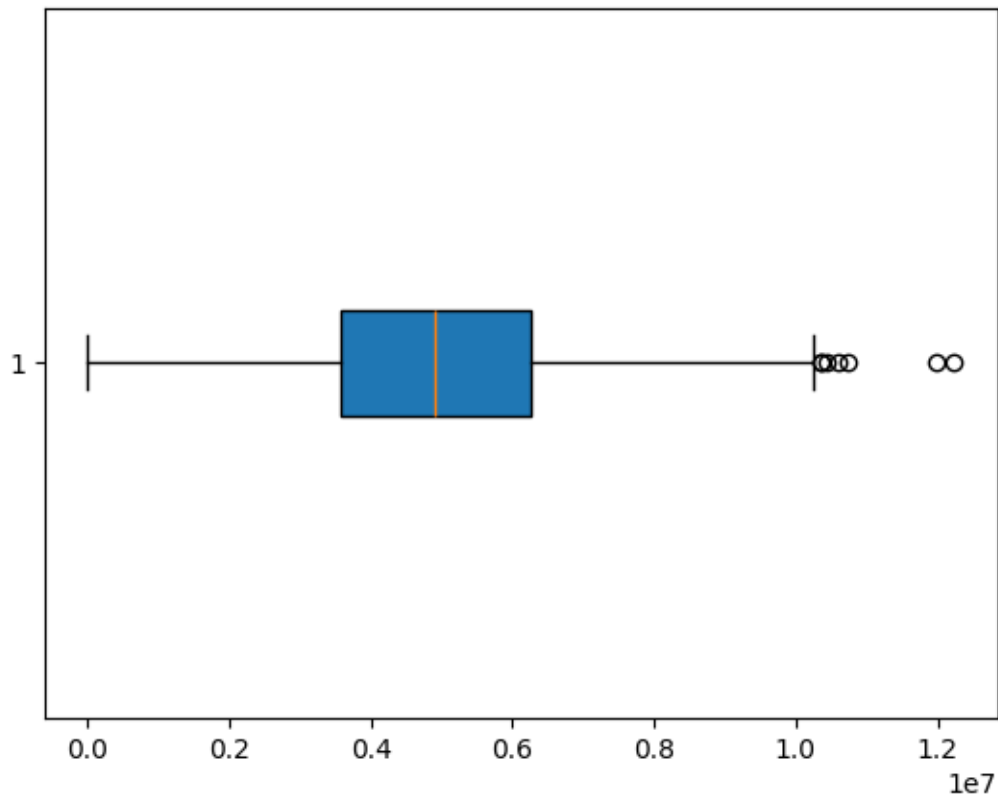
```
[19]: # Replace negative income with 0, use loc to avoid warning message
data.loc[data["Income"] < 0, "Income"] = 0
```

```
[20]: data[data["Income"] < 0]
```

```
[20]: Empty DataFrame
Columns: [Age, Income, Gender, Education, Stress_Level, Exercise_Hours_Per_Week,
Cholesterol_Level, Weight, Height, Blood_Pressure, Health_Status]
Index: []
```

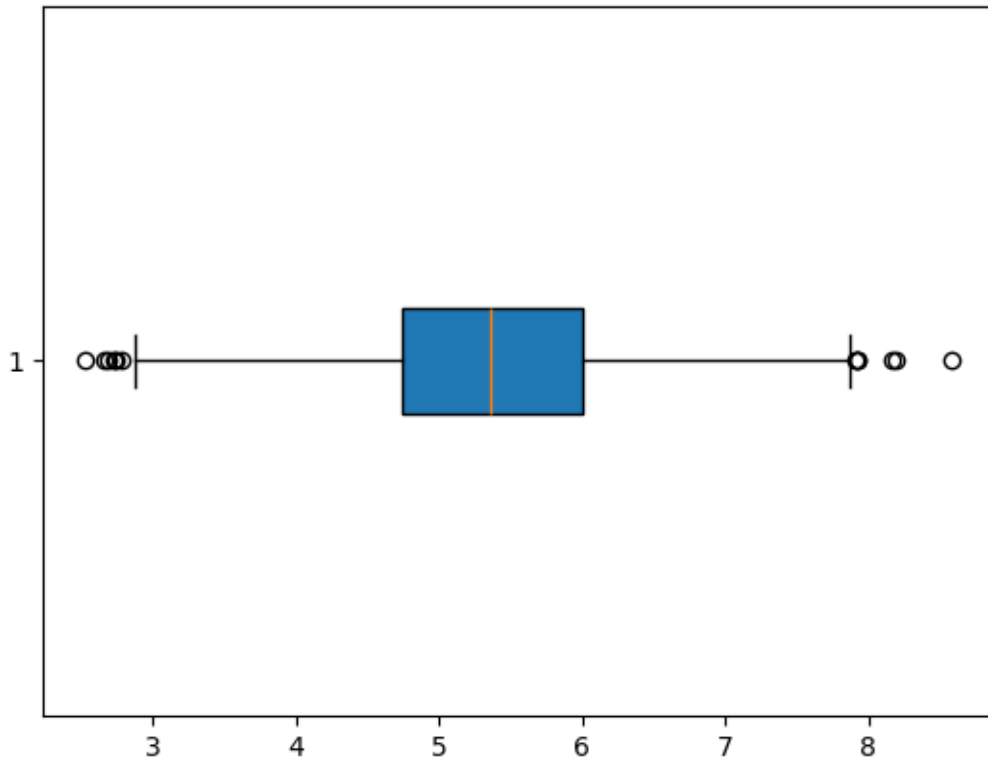
```
[21]: plt.boxplot(income_data, vert=False, patch_artist=True)
```

```
[21]: {'whiskers': [<matplotlib.lines.Line2D at 0x26d0d004fb0>,
<matplotlib.lines.Line2D at 0x26d0d005490>],
'caps': [<matplotlib.lines.Line2D at 0x26d0d006360>,
<matplotlib.lines.Line2D at 0x26d0d0068a0>],
'boxes': [<matplotlib.patches.PathPatch at 0x26d7ff35ee0>],
'medians': [<matplotlib.lines.Line2D at 0x26d0d0060c0>],
'fliers': [<matplotlib.lines.Line2D at 0x26d0d0074d0>],
'means': []}
```



Disini, income yang negatif sudah di set ke 0. Untuk income yang melebihi  $Q3 + 1.5IQR$ , hal tersebut mungkin saja terjadi sehingga tidak diperlukan perubahan untuk outliers yang bernilai  $> Q3 + 1.5IQR$ .

```
[22]: # Stress level
stress_level_data = data["Stress_Level"]
plt.boxplot(stress_level_data, vert=False, patch_artist=True)
plt.show()
```



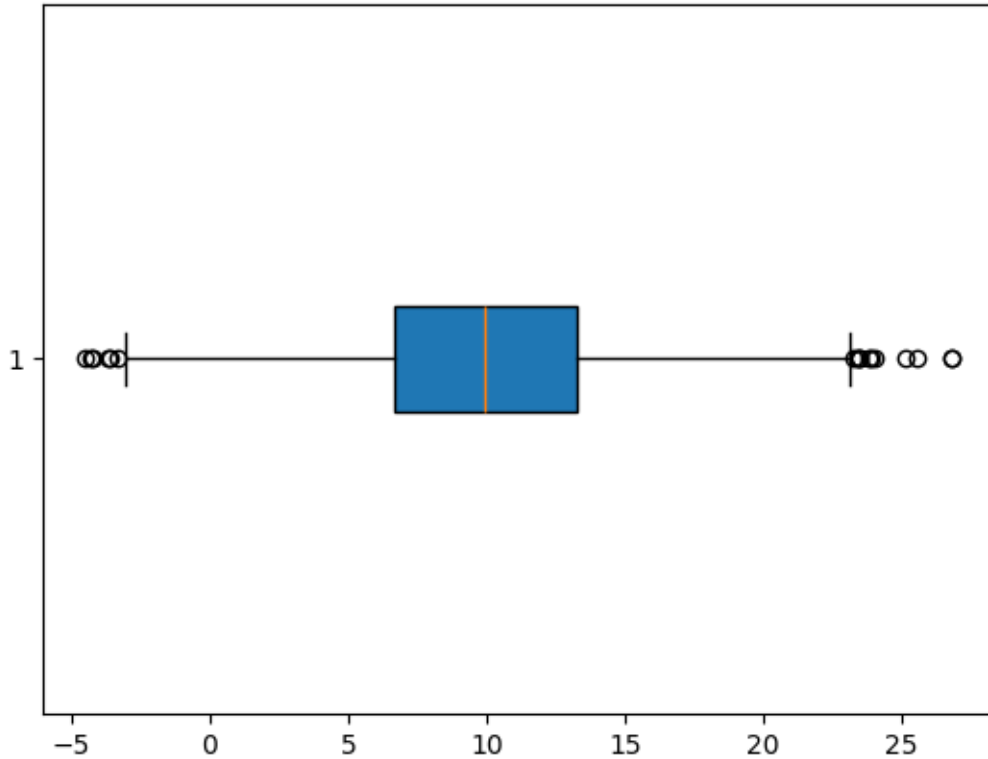
Disini terlihat bahwa kolom stress level juga memiliki outliers sehingga perlu diteliti lebih lanjut.

```
[23]: outliers_stress_level = stress_level_data[(stress_level_data < Q1["Stress_Level"] - 1.5 * IQR["Stress_Level"]) | (stress_level_data > Q3["Stress_Level"] + 1.5 * IQR["Stress_Level"])]
outliers_stress_level
```

```
[23]: 13      2.528057
      170      8.191571
      201      7.908383
      240      2.661764
      306      7.916607
      393      7.927514
      1089     2.782488
      1196     8.168885
      1210     2.728318
      1433     8.581327
      1519     2.745202
      1640     2.686308
      Name: Stress_Level, dtype: float64
```

Dengan asumsi bahwa stress level berada pada interval 1-10, maka data diatas masih masuk dalam kategori wajar sehingga tidak perlu ditangani lebih lanjut

```
[24]: # Exercise_Hours_Per_Week
exercise_hours_per_week_data = data["Exercise_Hours_Per_Week"]
plt.boxplot(exercise_hours_per_week_data, vert=False, patch_artist=True)
plt.show()
```



Disini terlihat bahwa kolom Exercise Hours Per Week juga memiliki outliers sehingga perlu diteliti lebih lanjut.

```
[25]: # Check outliers
outliers_exercise = exercise_hours_per_week_data[(exercise_hours_per_week_data <=
    Q1["Exercise_Hours_Per_Week"] - 1.5 * IQR["Exercise_Hours_Per_Week"]) |
    (exercise_hours_per_week_data > Q3["Exercise_Hours_Per_Week"] + 1.5 *
    IQR["Exercise_Hours_Per_Week"])]
outliers_exercise
```

```
[25]: 48      24.033132
      180      25.530543
      278     -3.632656
      330     -4.499310
      452     23.463102
      479     23.506893
      580     -4.247733
```

```

644      23.269785
893      23.103693
1056     -3.645436
1147      23.883280
1284      26.816358
1599     -3.343693
1677      26.795926
1706     -4.298969
1784      23.432592
1788      25.146327
1853      23.794101
Name: Exercise_Hours_Per_Week, dtype: float64

```

```

[26]: # Check for negative values
negatif_exercice = exercise_hours_per_week_data[exercise_hours_per_week_data < 0]
negatif_exercice

```

```

[26]: 35      -1.927087
53      -0.432964
75      -0.309098
101     -0.950271
162     -3.063739
193     -1.552585
235     -0.064111
258     -0.273152
264     -0.392170
273     -0.764312
276     -0.352699
278     -3.632656
291     -0.342537
328     -2.077250
330     -4.499310
339     -0.757945
366     -1.905777
580     -4.247733
660     -1.218878
742     -0.490524
1056    -3.645436
1068    -0.950923
1143    -1.271801
1176    -1.300274
1207    -1.442528
1211    -0.942582
1250    -2.636253
1293    -2.501845
1319    -0.141838

```

```

1544    -1.669836
1545    -0.379740
1599    -3.343693
1623    -2.688027
1671    -1.207635
1699    -0.804646
1706    -4.298969
1708    -0.325989
1760    -1.326430
1835    -2.636172
1992    -0.954750
1993    -2.087057
Name: Exercise_Hours_Per_Week, dtype: float64

```

```

[27]: # Change negative values to 0
data.loc[data["Exercise_Hours_Per_Week"] < 0, "Exercise_Hours_Per_Week"] = 0

```

```

[28]: data[data["Exercise_Hours_Per_Week"] < 0]

```

```

[28]: Empty DataFrame
Columns: [Age, Income, Gender, Education, Stress_Level, Exercise_Hours_Per_Week, Cholesterol_Level, Weight, Height, Blood_Pressure, Health_Status]
Index: []

```

```

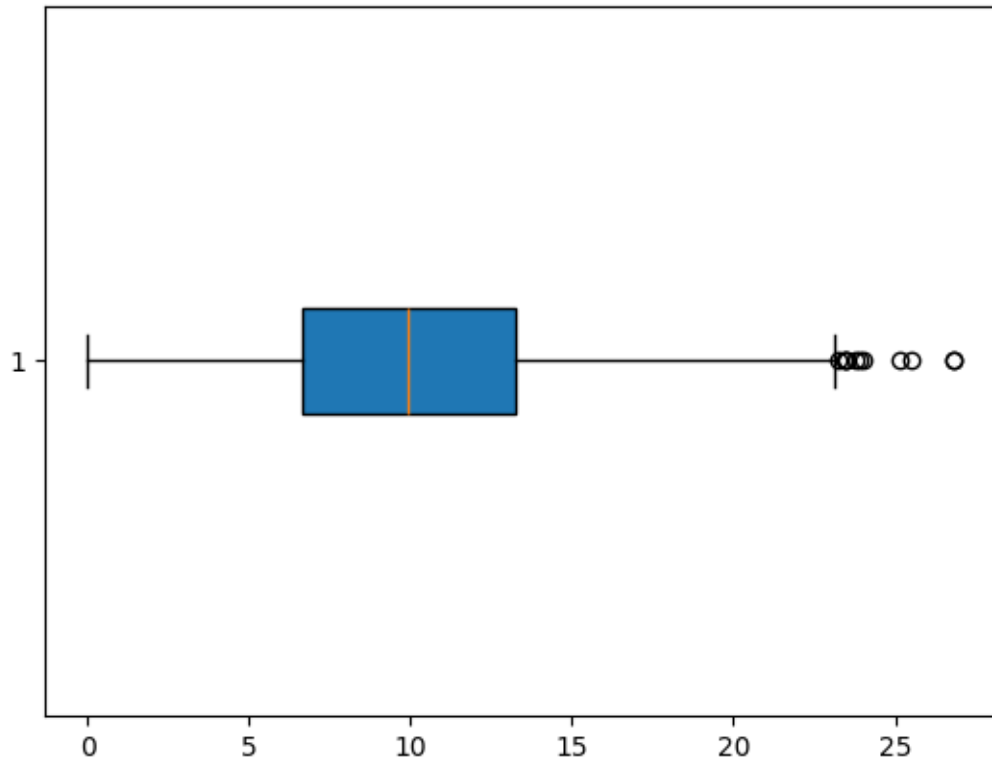
[29]: plt.boxplot(exercise_hours_per_week_data, vert=False, patch_artist=True)

```

```

[29]: {'whiskers': [<matplotlib.lines.Line2D at 0x26d0f3b0260>,
<matplotlib.lines.Line2D at 0x26d0f3b0530>],
'caps': [<matplotlib.lines.Line2D at 0x26d0f3b0710>,
<matplotlib.lines.Line2D at 0x26d0f3b0a10>],
'boxes': [<matplotlib.patches.PathPatch at 0x26d0f384110>],
'medians': [<matplotlib.lines.Line2D at 0x26d0f3b0cb0>],
'fliers': [<matplotlib.lines.Line2D at 0x26d0f3b0f20>],
'means': []}

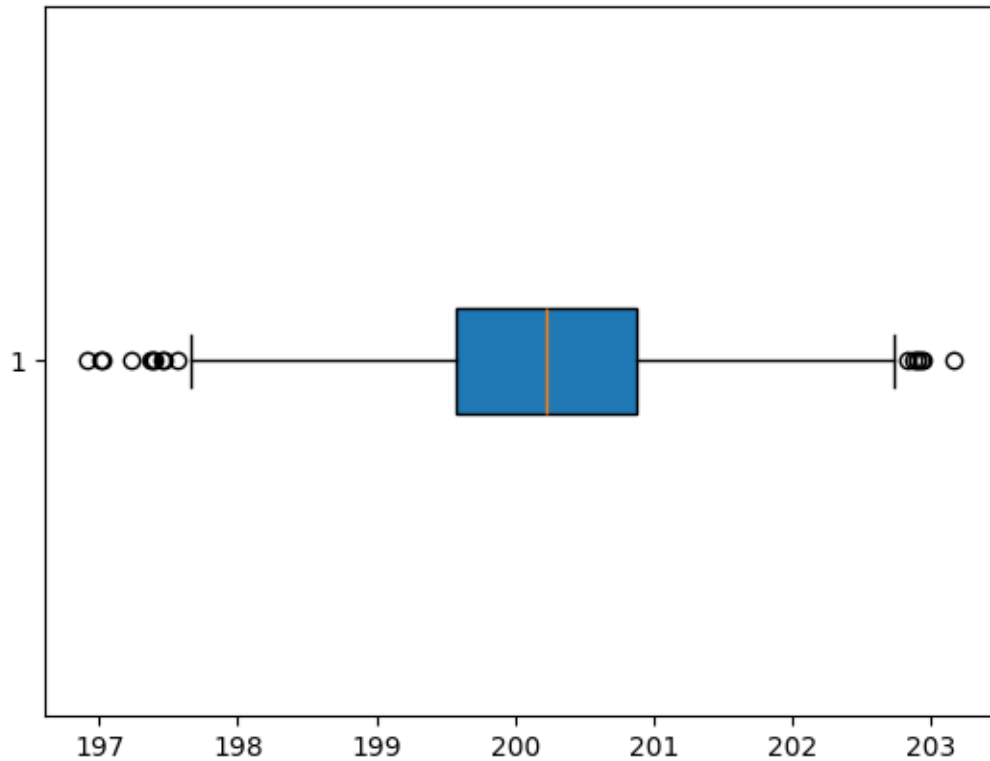
```



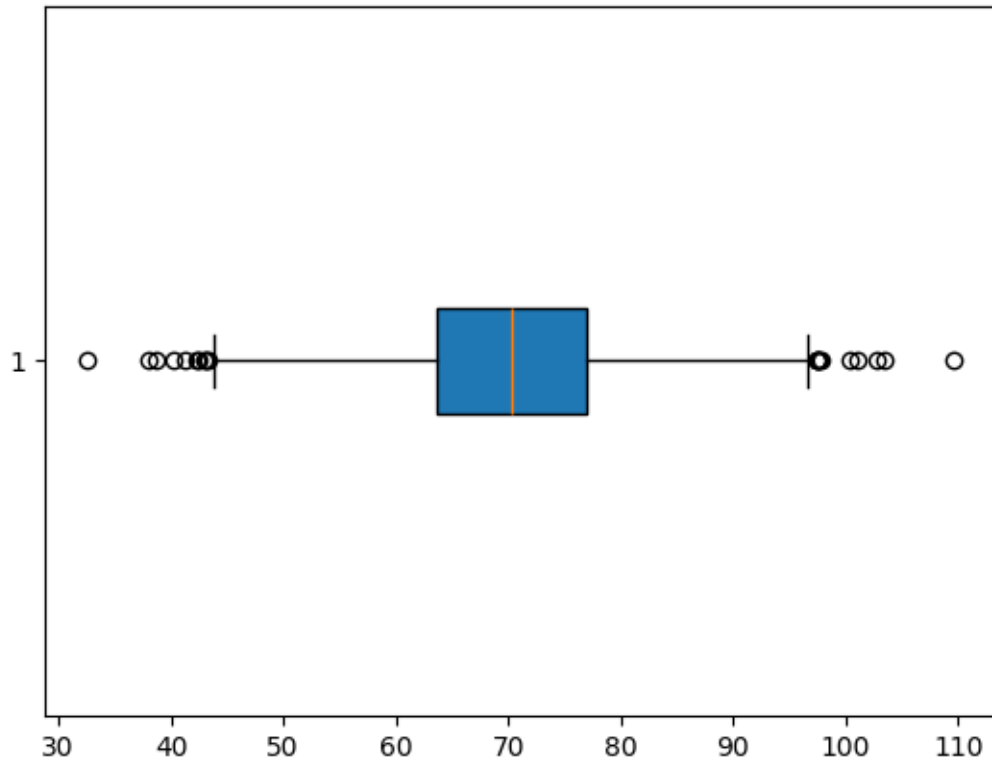
Disini, exercise hour per week yang negatif sudah di set ke 0. Untuk exercise hour per week yang melebihi  $Q3 + 1.5IQR$ , hal tersebut mungkin saja terjadi (masih masuk akal dalam seminggu) sehingga tidak diperlukan perubahan untuk outliers yang bernilai  $> Q3 + 1.5IQR$ .

```
[30]: # Cholesterol_Level
cholesterol_level_data = data["Cholesterol_Level"]
plt.boxplot(cholesterol_level_data, vert=False, patch_artist=True)
plt.show()
```





Disini terlihat bahwa kolom Cholesterol level juga memiliki outliers sehingga perlu diteliti lebih lanjut. Namun, berdasarkan artikel pada [```
\[31\]: # Weight
weight\_data = data\["Weight"\]
plt.boxplot\(weight\_data, vert=False, patch\_artist=True\)
plt.show\(\)
```](https://www.healthline.com/health/high-cholesterol/levels-by-age#:~:text=Recommended%20total%20cholesterol%20levels%20are%20under%20200%20milligrams,of%20the%20level normal kolesterol adalah < 200 sehingga semua outlier diatas masih bisa dibilang data yang wajar.</a></p>
</div>
<div data-bbox=)



Disini terlihat bahwa kolom Weight juga memiliki outliers sehingga perlu diteliti lebih lanjut.

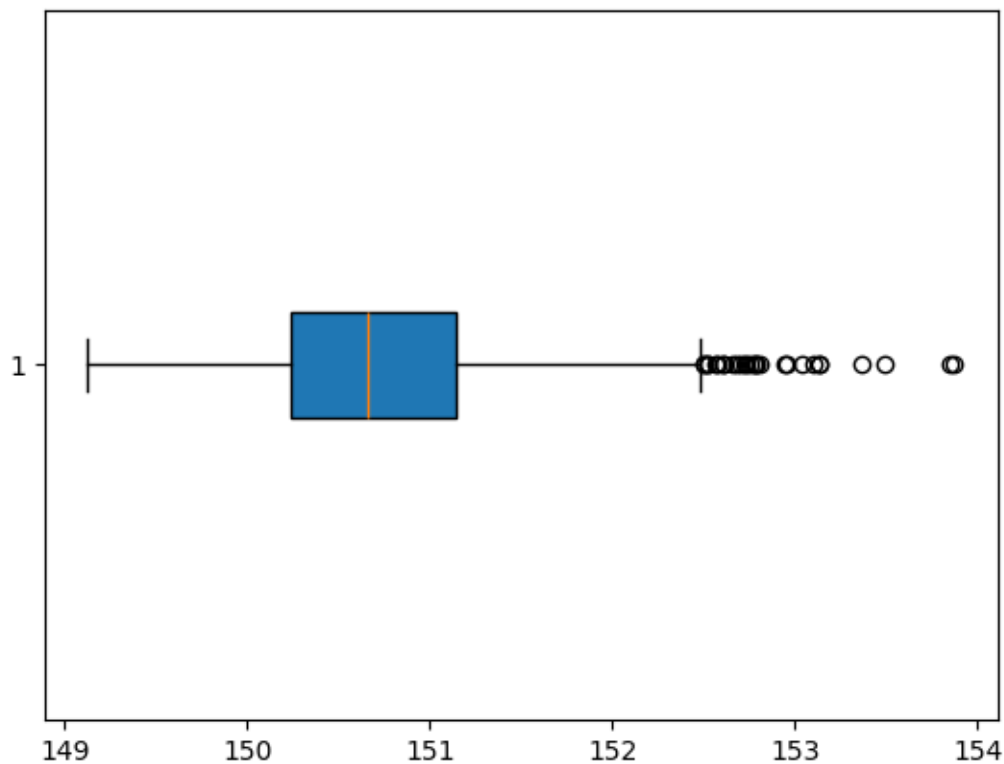
```
[32]: outliers_weight = weight_data[(weight_data < Q1["Weight"] - 1.5 * IQR["Weight"]) | (weight_data > Q3["Weight"] + 1.5 * IQR["Weight"])]
outliers_weight
```

```
[32]: 236      109.609562
      305      103.488182
      397       43.210014
      506      102.708167
      711      100.333305
      747       40.210278
      779       42.428906
      818       42.271182
      887       97.577311
      986       43.381050
     1036       32.581758
     1053       97.444777
     1481       38.022481
     1555       38.666547
     1595       97.456489
     1626       97.474679
```

```
1649    100.976404
1904     41.274350
1948     97.861295
1991     42.931331
Name: Weight, dtype: float64
```

Karena berat badan pada bagian outlier masih merupakan berat badan yang mungkin bagi manusia, maka outliers tersebut tidak perlu ditangani lebih lanjut.

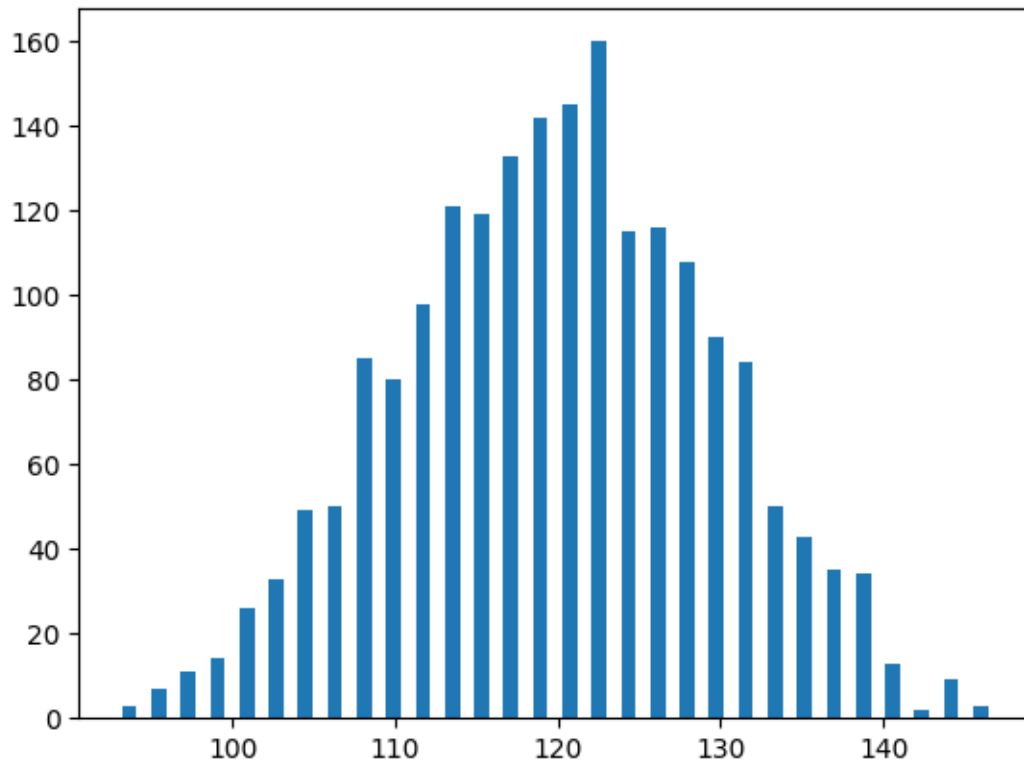
```
[33]: # Height
height_data = data["Height"]
plt.boxplot(height_data, vert=False, patch_artist=True)
plt.show()
```



Disini terlihat bahwa kolom Height juga memiliki outliers sehingga perlu diteliti lebih lanjut. Namun, outliers pada data tersebut masih terbilang wajar untuk menyatakan tinggi manusia sehingga tidak diperlukan penanganan lebih lanjut.

### 3.1 1. Blood Pressure

```
[34]: plt.hist(data["Blood_Pressure"], bins=30, rwidth=0.5)
plt.show()
print (data["Blood_Pressure"].skew())
print (data["Blood_Pressure"].kurtosis())
stat, p = normaltest(data["Blood_Pressure"])
print('Statistics=%.3f, p=%.3f' % (stat, p))
```



```
-0.03221883639967124
-0.34094189985379897
Statistics=14.132, p=0.001
```

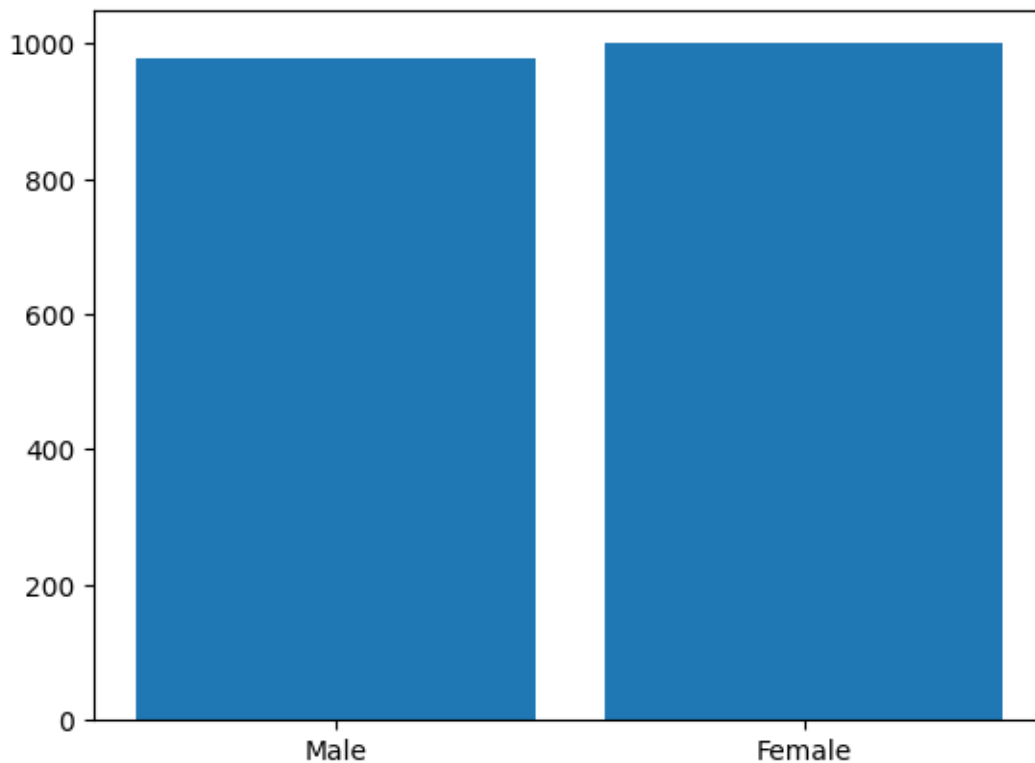
3.1.1 Jika kita tinjau dari skewness, maka data terdistribusi normal karena nilai skewnessnya mendekati 0, tetapi jika kita menguji menggunakan kurtosis (kelancipan dari fdp), data tidak terdistribusi normal karena nilai kurtosisnya jauh dari 3. Jika kita menggunakan uji normal dengan bantuan library normaltest, diperoleh hasil p-value 0.001, karena p-value  $< 0.05$  (nilai alpha), dapat disimpulkan data tidak terdistribusi normal.

## 3.2 2. Gender

```
[35]: # Gender distribution
gender_data = data['Gender']
counts, bins, patches = plt.hist(gender_data, bins=2, rwidth=0.85)

# Menentukan label untuk setiap bin
bin_centers = 0.5 * np.diff(bins) + bins[:-1] # titik tengah bin
labels = ['Male', 'Female'] # label untuk setiap bin

plt.xticks(bin_centers, labels) # menetapkan label pada titik tengah bin
plt.show()
```

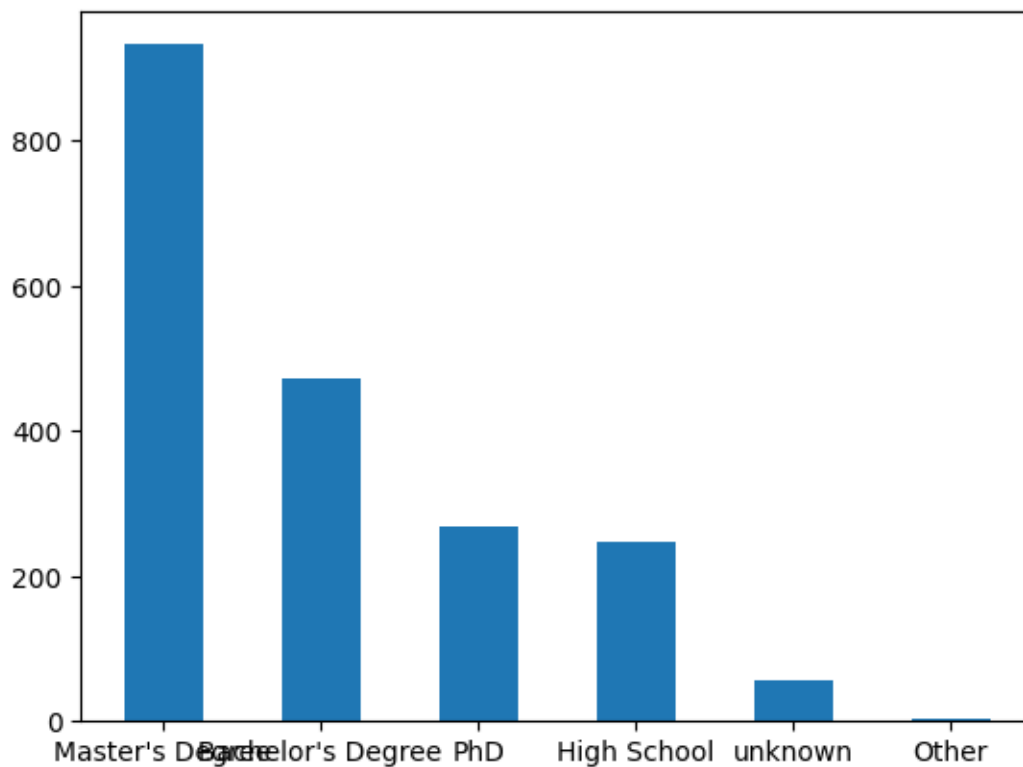


### 3.3 3. Education

```
[36]: # Education distribution
education_data = data['Education']
counts, bins, patches = plt.hist(education_data, bins=6, rwidth=0.5)

# Menentukan label untuk setiap bin
bin_centers = 0.5 * np.diff(bins) + bins[:-1] # titik tengah bin
labels = ['Master\'s Degree', 'Bachelor\'s Degree', 'PhD', 'High School', 'unknown', 'Other'] # label untuk setiap bin

plt.xticks(bin_centers, labels) # menetapkan label pada titik tengah bin
plt.show()
```

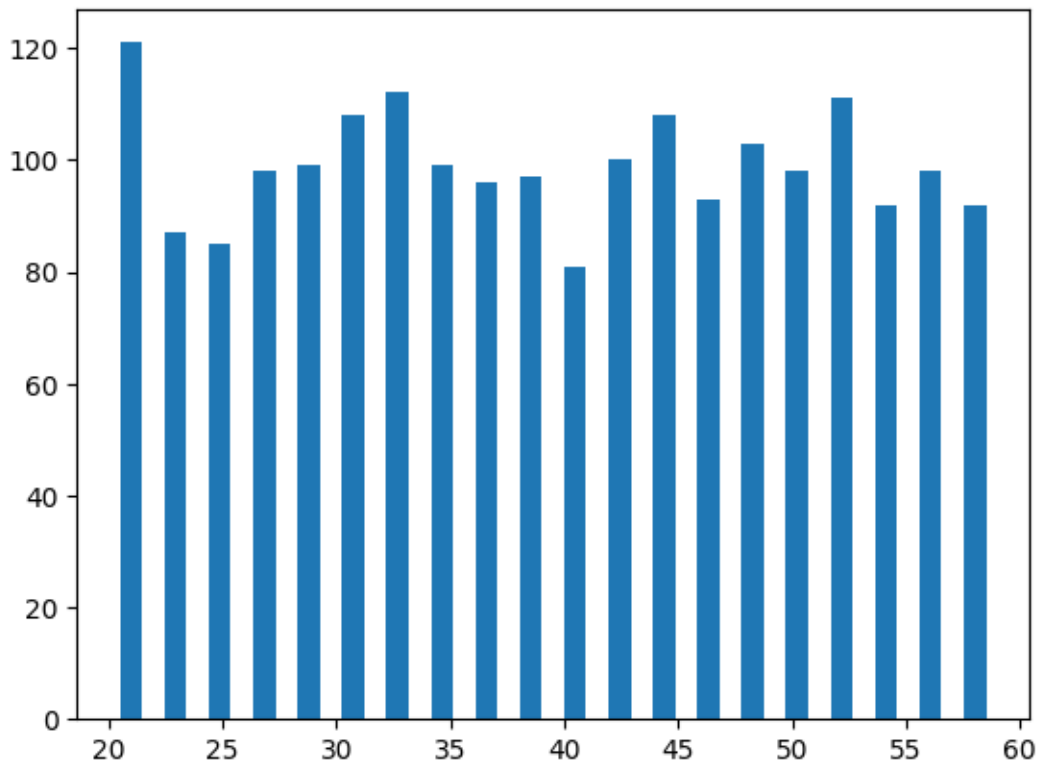


### 3.4 4. Age

```
[37]: # Age distribution
plt.hist(data["Age"], bins=20, rwidth=0.5)
plt.show()

print (data["Age"].skew())
```

```
print (data["Age"].kurtosis())
stat, p = normaltest(data["Age"])
print('Statistics=%.3f, p=%.3f' % (stat, p))
```



```
-0.003669656072957701
-1.1995106304725915
Statistics=1580.199, p=0.000
```

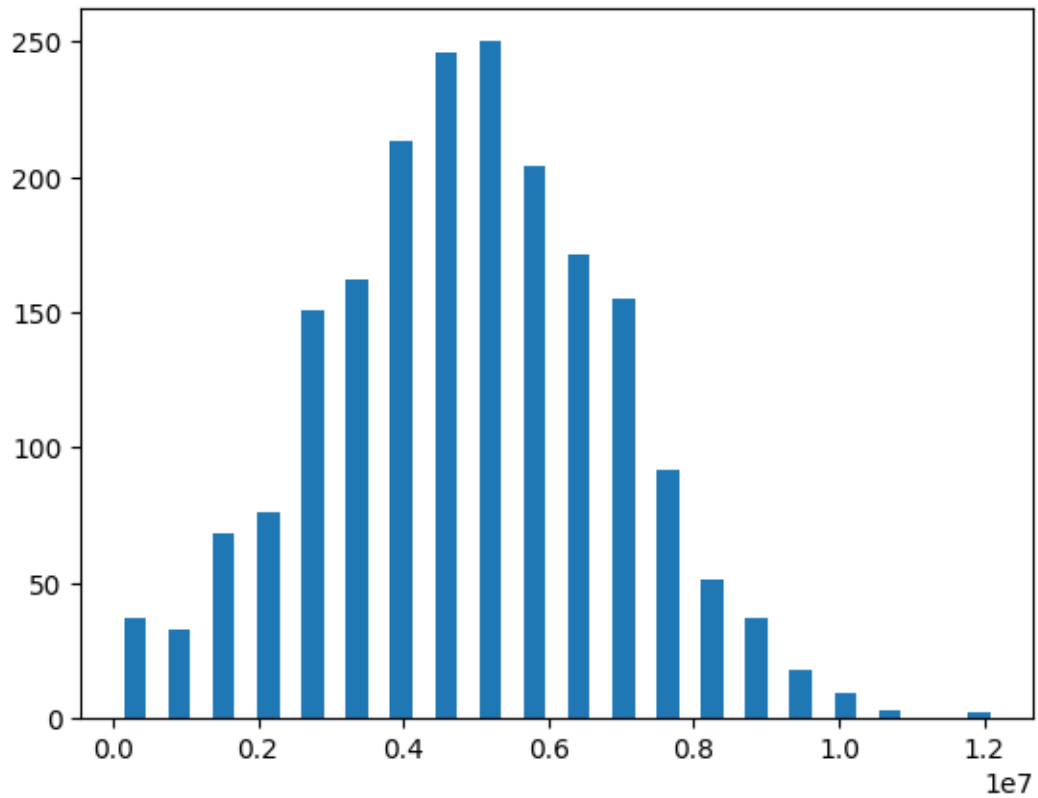
3.4.1 Jika kita tinjau dari skewness, maka data terdistribusi normal karena nilai skewnessnya mendekati 0, tetapi jika kita menguji menggunakan kurtosis (kelancipan dari fdp), data tidak terdistribusi normal karena nilai kurtosisnya jauh dari 3. Jika kita menggunakan uji normal dengan bantuan library normaltest, diperoleh hasil p-value 0.000, karena p-value  $< 0.05$  (nilai alpha), dapat disimpulkan data tidak terdistribusi normal. Dan data juga terlihat terdistribusi uniform.

### 3.5 5. Income

```
[38]: # Income distribution
plt.hist(data["Income"], bins=20, rwidth=0.5)
plt.show()

print (data["Income"].skew())
```

```
kurt = data["Income"].kurtosis()
excess_kurt = kurt - 3
print (excess_kurt)
stat, p = normaltest(data["Income"])
print('Statistics=%.3f, p=%.3f' % (stat, p))
```



```
0.016751269910332222
-3.0736705938092954
Statistics=0.508, p=0.776
```

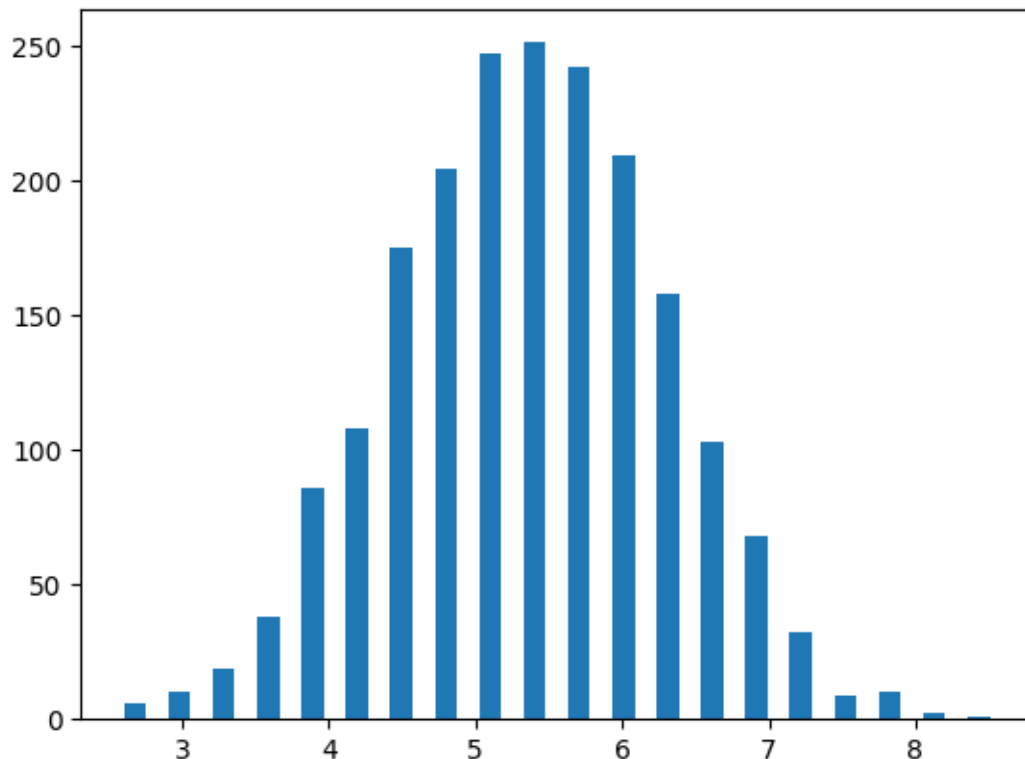


3.5.1 Jika kita tinjau dari skewness, maka data terdistribusi normal karena nilai skewnessnya mendekati 0, tetapi jika kita menguji menggunakan kurtosis (kelancipan dari fdp), data tidak terdistribusi normal karena nilai kurtosisnya jauh dari 3. Jika kita menggunakan uji normal dengan bantuan library normaltest, diperoleh hasil p-value 0.776, karena p-value  $> 0.05$  (nilai alpha), dapat disimpulkan data terdistribusi normal.

### 3.6 6. Stress Level

```
[39]: # Stress level distribution
plt.hist(data["Stress_Level"], bins=20, rwidth=0.5)
plt.show()

print (data["Stress_Level"].skew())
print (data["Stress_Level"].kurtosis())
stat, p = normaltest(data["Stress_Level"])
print('Statistics=%.3f, p=%.3f' % (stat, p))
```



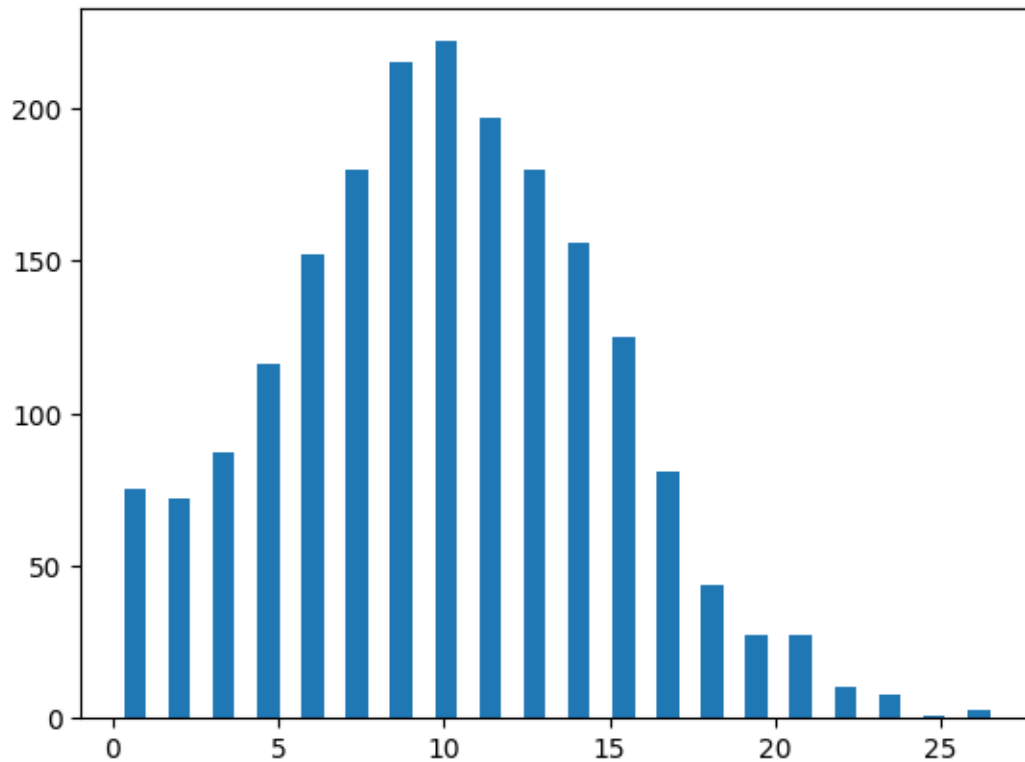
```
-0.01783091456783804
-0.12406333384333745
Statistics=1.436, p=0.488
```

3.6.1 Jika kita tinjau dari skewness, maka data terdistribusi normal karena nilai skewnessnya mendekati 0, tetapi jika kita menguji menggunakan kurtosis (kelancipan dari fdp), data tidak terdistribusi normal karena nilai kurtosisnya jauh dari 3. Jika kita menggunakan uji normal dengan bantuan library normaltest, diperoleh hasil p-value 0.488, karena p-value  $> 0.05$  (nilai alpha), dapat disimpulkan data terdistribusi normal.

### 3.7 7. Exercise Hours per Week

```
[40]: # Cholesterol level distribution
plt.hist(data["Exercise_Hours_Per_Week"], bins=20, rwidth=0.5)
plt.show()

print (data["Exercise_Hours_Per_Week"].skew())
print (data["Exercise_Hours_Per_Week"].kurtosis())
stat, p = normaltest(data["Exercise_Hours_Per_Week"])
print('Statistics=%.3f, p=%.3f' % (stat, p))
```



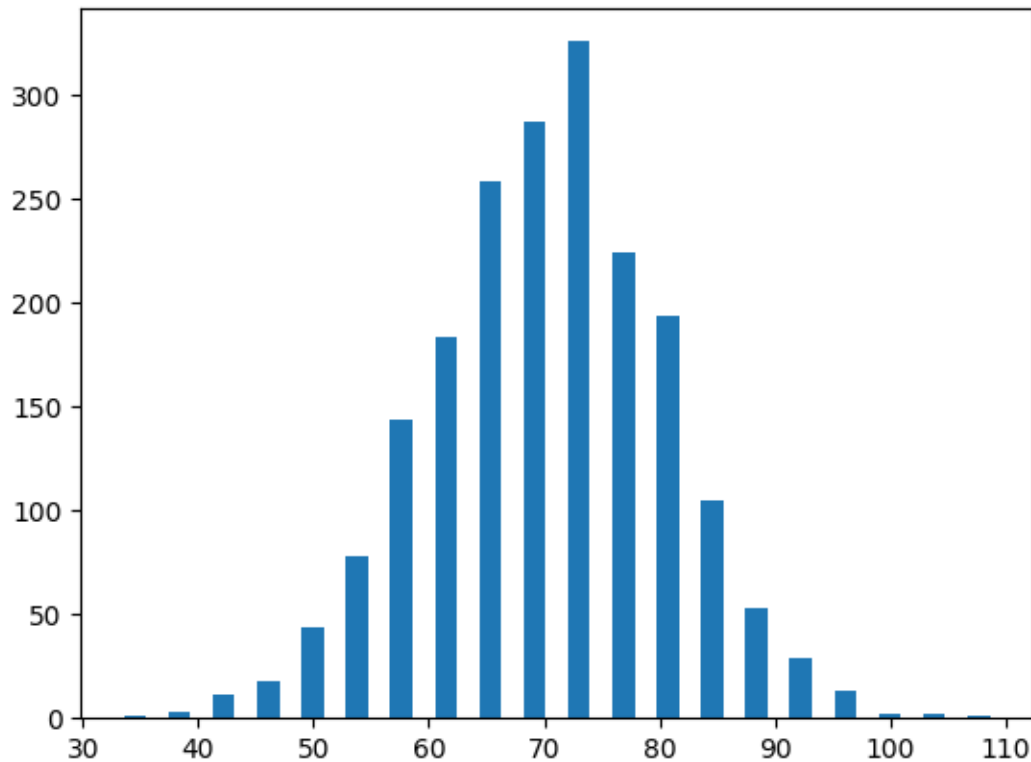
```
0.1525871203236051
-0.15376819384934848
Statistics=9.786, p=0.007
```

3.7.1 Jika kita tinjau dari skewness, maka data terdistribusi normal karena nilai skewnessnya mendekati 0, tetapi jika kita menguji menggunakan kurtosis (kelancipan dari fdp), data tidak terdistribusi normal karena nilai kurtosisnya jauh dari 3. Jika kita menggunakan uji normal dengan bantuan library normaltest, diperoleh hasil p-value 0.523, karena p-value  $> 0.05$  (nilai alpha), dapat disimpulkan data terdistribusi normal.

### 3.8 8. Weight

```
[41]: # Weight distribution
plt.hist(data["Weight"], bins=20, rwidth=0.5)
plt.show()

print (data["Weight"].skew())
print (data["Weight"].kurtosis())
stat, p = normaltest(data["Weight"])
print('Statistics=%.3f, p=%.3f' % (stat, p))
```



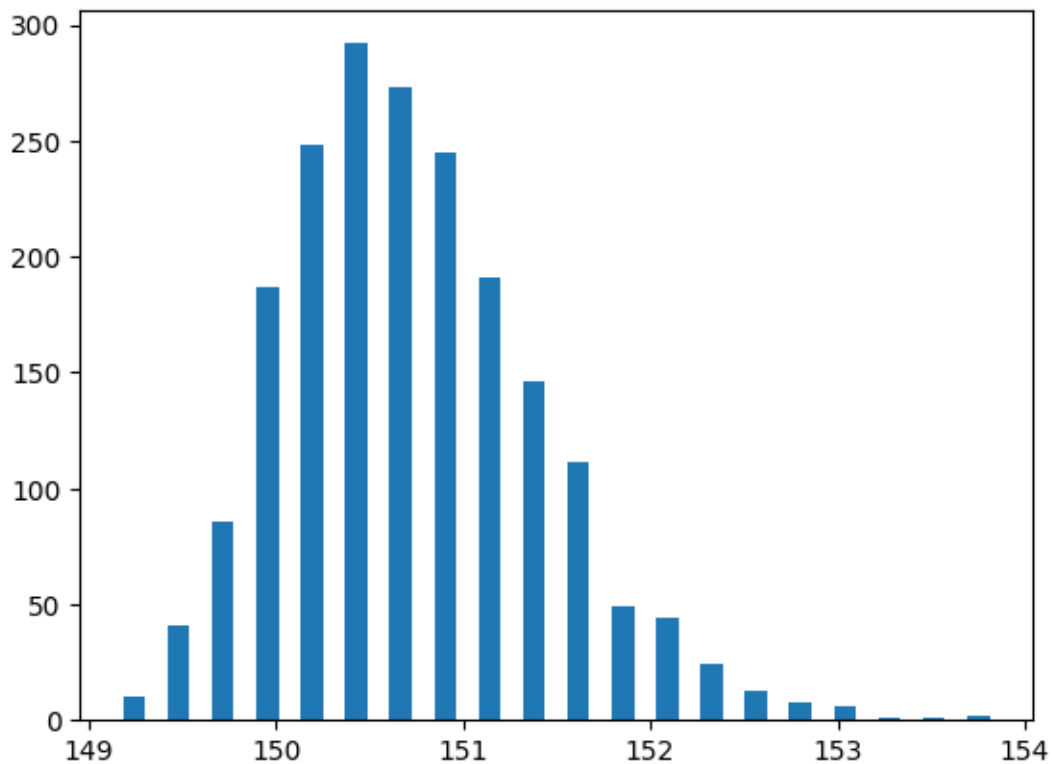
```
-0.055145554642524186
0.11260679516068262
Statistics=2.065, p=0.356
```

3.8.1 Jika kita tinjau dari skewness, maka data terdistribusi normal karena nilai skewnessnya mendekati 0, tetapi jika kita menguji menggunakan kurtosis (kelancipan dari fdp), data tidak terdistribusi normal karena nilai kurtosisnya jauh dari 3. Jika kita menggunakan uji normal dengan bantuan library normaltest, diperoleh hasil p-value 0.356, karena p-value  $> 0.05$  (nilai alpha), dapat disimpulkan data terdistribusi normal.

### 3.9 9. Height

```
[42]: # Height distribution
plt.hist(data["Height"], bins=20, rwidth=0.5)
plt.show()

print (data["Height"].skew())
print (data["Height"].kurtosis())
stat, p = normaltest(data["Height"])
print('Statistics=%.3f, p=%.3f' % (stat, p))
```



```
0.6555089940792477
0.7091281485649175
Statistics=143.721, p=0.000
```

3.9.1 Jika kita tinjau dari skewness, maka data tidak terdistribusi normal karena nilai skewnessnya jauh dari 0, tetapi jika kita menguji menggunakan kurtosis (kelancipan dari fdp), data tidak terdistribusi normal karena nilai kurtosisnya jauh dari 3. Jika kita menggunakan uji normal dengan bantuan library normal-test, diperoleh hasil p-value 0.000, karena  $p\text{-value} < 0.05$  (nilai alpha), dapat disimpulkan data tidak terdistribusi normal. Karena nilai skew positif, maka data ini memiliki distribusi right-skeewed.

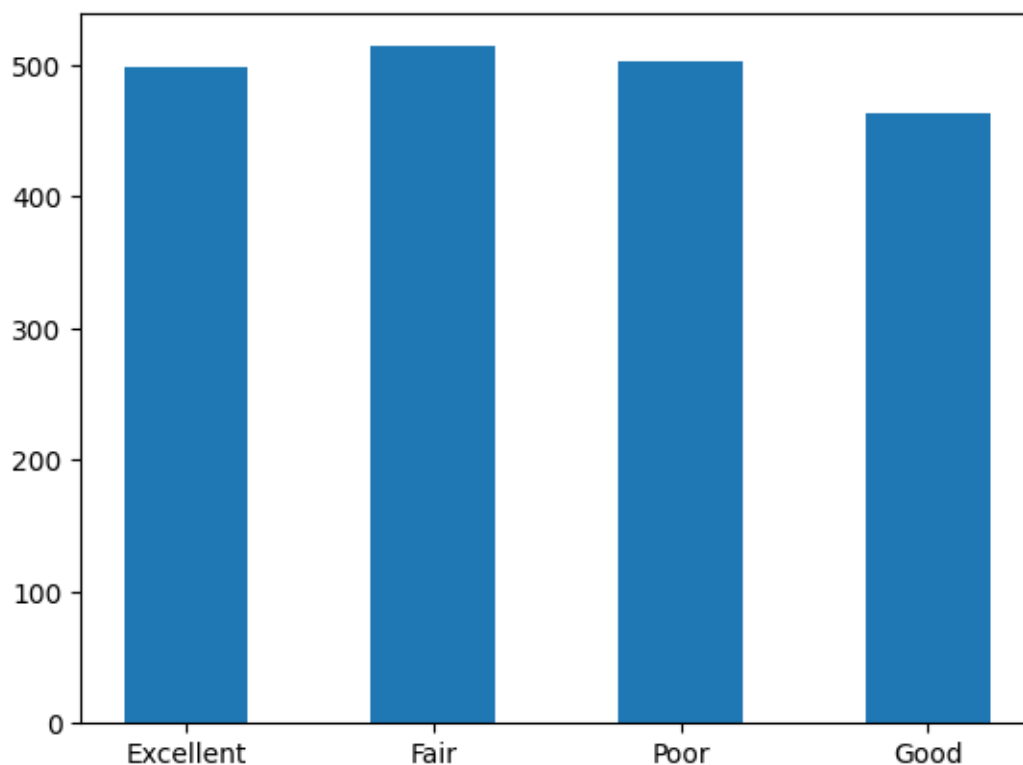
### 3.10 10. Health Status

```
[43]: # Health Status
health_status_data_data = data['Health_Status']
counts, bins, patches = plt.hist(health_status_data_data, bins=4, rwidth=0.5)

# Menentukan label untuk setiap bin
bin_centers = 0.5 * np.diff(bins) + bins[:-1] # titik tengah bin

plt.xticks(bin_centers) # menetapkan label pada titik tengah bin

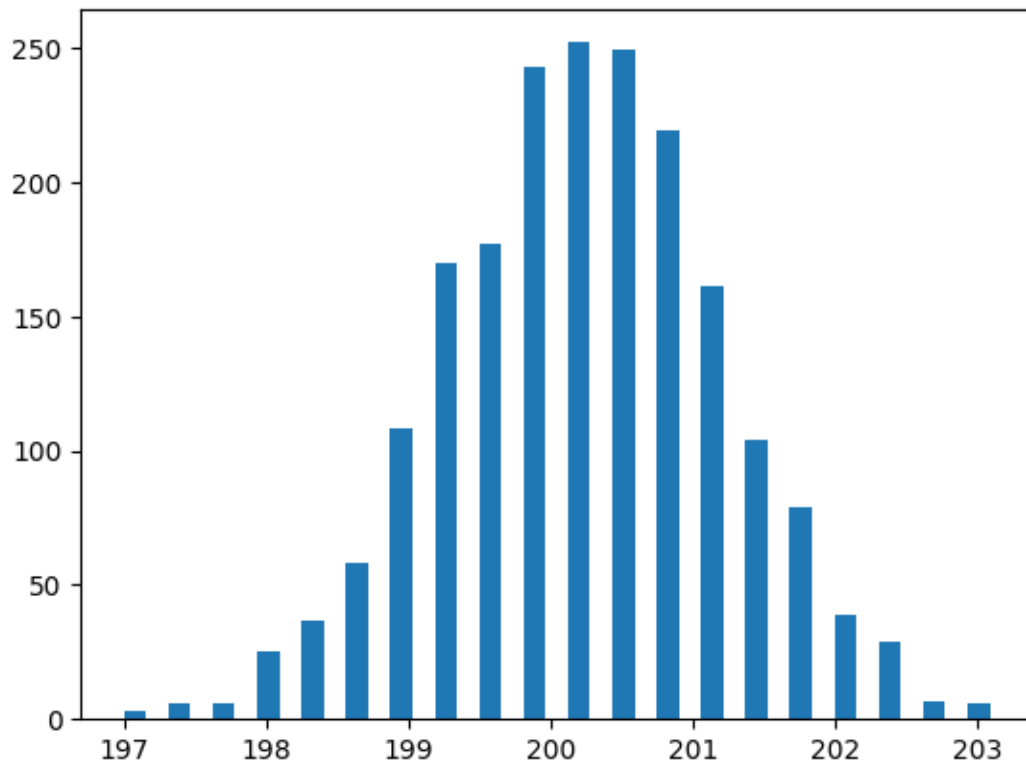
plt.show()
```



### 3.11 11. Cholesterol Level

```
[44]: # Cholesterol Level
cholesterol_level_data = data['Cholesterol_Level']
counts, bins, patches = plt.hist(cholesterol_level_data, bins=20, rwidth=0.5)
print (data["Cholesterol_Level"].skew())
print (data["Cholesterol_Level"].kurtosis())
stat, p = normaltest(data["Cholesterol_Level"])
print('Statistics=%.3f, p=%.3f' % (stat, p))
plt.show()
```

```
-0.06927019917155477
0.011699808555181157
Statistics=1.613, p=0.446
```



- 3.11.1 Jika kita tinjau dari skewness, maka data terdistribusi normal karena nilai skewnessnya mendekati 0, tetapi jika kita menguji menggunakan kurtosis (kelancipan dari fdp), data tidak terdistribusi normal karena nilai kurtosisnya jauh dari 3. Jika kita menggunakan uji normal dengan bantuan library normaltest, diperoleh hasil p-value 0.446, karena p-value  $> 0.05$  (nilai alpha), dapat disimpulkan data terdistribusi normal.

## 4 One-Sample Hypotesis

1. Lembaga riset saat ini sedang mempertanyakan data berat badan individu yang disimpan untuk kepentingan riset lanjutan. Identifikasilah apakah rata-rata berat badan pasien diatas 65 kg?

1.  $H_0$  : Mean of weight = 65
2.  $H_1$  : Mean of weight  $> 65$
3. Significance level = 0.05
4. One-tailed test (greater than)
5. p-value: 0.00012148092594777005
6. Kesimpulan: Reject  $H_0$

```
[45]: # H0 : Mean of weight = 65
# H1 : Mean of weight > 65
# Significance level = 0.05
# One-tailed test (greater than)

# Collect the sample and calculate sample statistics
weight_sample = data["Weight"].sample(n=100, random_state=1)
sample_mean = weight_sample.mean()
sample_std = weight_sample.std(ddof=1)
population_mean = 65
n = 100

# Calculate the z-value
z_value = (sample_mean - population_mean) / (sample_std / np.sqrt(n))

# Calculate the p-value
p_value = 1 - stats.norm.cdf(z_value)

# Compare the p-value to the significance level
alpha = 0.05
reject_null = p_value < alpha

print(f"z-value: {z_value}")
print(f"p-value: {p_value}")

if reject_null:
    print("Reject H0")
else:
```

```
print("Fail to reject H0")
```

z-value: 3.669566792638645

p-value: 0.00012148092594777005

Reject H0

Karena p-value < 0.05, maka H0 ditolak dan rata-rata badan pasien di atas 65 kg

**2. Tekanan darah yang normal berada pada rentang 120 mmHg. Lembaga riset perlu untuk memastikan apakah data individu yang diukur cukup normal. Periksalah apakah rata-rata tekanan darah sistole bernilai 120 mmHg?**

1. H0 : Rata-rata tekanan darah sistole bernilai sama dengan 120 mmHg
2. H1 : Rata-rata tekanan darah sistole bernilai tidak sama dengan 120 mmHg
3. Significance level = 0.05
4. Two-tailed test
5. p-value: 0.30781486174797523
6. Kesimpulan: Fail to reject H0

```
[46]: # H0 : Rata-rata tekanan darah sistole bernilai sama dengan 120 mmHg
# H1 : Rata-rata tekanan darah sistole bernilai tidak sama dengan 120 mmHg
# Significance level = 0.05
# Two-tailed test

# Collect the sample and calculate sample statistics
blood_pressure_sample = data["Blood_Pressure"].sample(n=100, random_state=1)
sample_mean = blood_pressure_sample.mean()
sample_std = blood_pressure_sample.std(ddof=1)
population_mean = 120
n = 100

# Calculate the z-value
z_value = (sample_mean - population_mean) / (sample_std / np.sqrt(n))

# Calculate the p-value
p_value = 2 * (1 - stats.norm.cdf(np.abs(z_value)))

# Compare the p-value to the significance level
alpha = 0.05
reject_null = p_value < alpha

print(f"z-value: {z_value}")
print(f"p-value: {p_value}")

if reject_null:
    print("Reject H0")
else:
    print("Fail to reject H0")
```



z-value: -1.0198178377574048  
p-value: 0.30781486174797523  
Fail to reject H0

Karena  $p\text{-value} > 0.05$ , maka gagal menolak H0 dan rata-rata tekanan darah sistole bernilai 120 mmHg

### 3. Periksalah apakah data 200 individu pertama pengujian (baris teratas) memiliki rata-rata waktu olahraga per minggu tidak sama dengan 15 jam?

1. H0 : Data 200 individu pertama memiliki rata-rata waktu olahraga per minggu sama dengan 15 jam
2. H1 : Data 200 individu pertama memiliki rata-rata waktu olahraga per minggu tidak sama dengan 15 jam
3. Significance level = 0.05
4. Two-tailed test
5. p-value: 0
6. Kesimpulan: Reject H0

```
[47]: # H0 : Data 200 individu pertama memiliki rata-rata waktu olahraga per minggu
      ↪ sama dengan 15 jam
      # H1 : Data 200 individu pertama memiliki rata-rata waktu olahraga per minggu
      ↪ tidak sama dengan 15 jam
      # Significance level = 0.05
      # Two-tailed test

      # Collect the sample and calculate sample statistics
      exercise_hours_per_week_sample = data["Exercise_Hours_Per_Week"].head(200)
      sample_mean = exercise_hours_per_week_sample.mean()
      sample_std = exercise_hours_per_week_sample.std(ddof=1)
      population_mean = 15
      n = 200

      # Calculate the z-value
      z_value = (sample_mean - population_mean) / (sample_std / np.sqrt(n))

      # Calculate the p-value
      p_value = 2 * (1 - stats.norm.cdf(np.abs(z_value)))

      # Compare the p-value to the significance level
      alpha = 0.05
      reject_null = p_value < alpha

      print(f"z statistic: {z_value}")
      print(f"p-value: {p_value}")

      if reject_null:
          print("Reject H0")
```

```
else:
    print("Fail to reject H0")
```

```
z statistic: -14.823803025227171
p-value: 0.0
Reject H0
```

Karena  $p\text{-value} < 0.05$ , maka  $H_0$  ditolak dan rata-rata waktu olahraga per minggu tidak sama dengan 15 jam

#### 4. Apakah penduduk dengan pendapatan yang lebih besar dari Rp 7.500.000,00 tidak sama dengan 30% dari data keseluruhan individu?

1.  $H_0$  : Jumlah penduduk dengan pendapatan > 7,5 juta sama dengan 30% dari jumlah data keseluruhan
2.  $H_A$  : Jumlah penduduk dengan pendapatan > 7,5 juta tidak sama dengan 30% dari jumlah data keseluruhan
3. Significance level = 0.05
4. Two-tailed test
5. p-value: 0
6. Kesimpulan: Reject  $H_0$

```
[48]: # H0 : Jumlah penduduk dengan pendapatan > 7,5 juta sama dengan 30% dari jumlah
      ↪ data keseluruhan
# HA : Jumlah penduduk dengan pendapatan > 7,5 juta tidak sama dengan 30% dari
      ↪ jumlah data keseluruhan
# Significance level = 0.05
# Two-tailed test

# Find the sample proportion for people with income > 7,500,000
income_more_than_75 = data[data["Income"] > 7500000]
p_hat = len(income_more_than_75) / len(data)

# Given population proportion
p = 0.3
n = len(data)

# Calculate the standard error under H0
SE = np.sqrt(p * (1 - p) / n)

# Calculate the Z statistic
Z = (p_hat - p) / SE

# Calculate the p-value for a two-tailed test
p_value = 2 * (1 - norm.cdf(abs(Z)))

print(f"Z statistic: {Z}")
print(f"p-value: {p_value}")
```

```

# Compare the p-value to the significance level
alpha = 0.05
reject_null = p_value < alpha

if reject_null:
    print("Reject H0")
else:
    print("Fail to reject H0")

```

Z statistic: -20.038395423663218  
 p-value: 0.0  
 Reject H0

Karena  $p\text{-value} < 0.05$ , maka  $H_0$  ditolak dan jumlah penduduk yang memiliki pendapatan yang lebih besar dari Rp 7.500.000,00 tidak sama dengan 30% dari jumlah data keseluruhan individu

## 5 Two-Sample Hypotesis

**5.0.1** Lembaga riset membagi data individu menjadi dua bagian, yaitu data individu yang lebih awal masuk data penelitian (bagian atas) dan yang baru saja (bagian bawah).

```

[49]: # Top data
top_data = data.head(100)

# Bottom data
bottom_data = data.tail(100)

```

**1. Periksa apakah rata-rata berat badan individu yang lebih awal masuk data penelitian sama dengan rata-rata berat badan individu yang masuk baru saja?**

1.  $H_0$  : Average of weight in top data = Average of weight in bottom data
2.  $H_A$  : Average of weight in top data  $\neq$  Average of weight in bottom data
3. Significance level = 0.05
4. Two-tailed test
5. p-value: 0.5491277875257794
6. Kesimpulan: Fail to reject  $H_0$

```

[50]: # H0 : Average of weight in top data = Average of weight in bottom data
# HA : Average of weight in top data != Average of weight in bottom data
# Significance level = 0.05
# Two-tailed test

# Sample mean
top_weight_mean = top_data["Weight"].mean()
bottom_weight_mean = bottom_data["Weight"].mean()

```

```

# Sample standard deviation
top_weight_std = top_data["Weight"].std()
bottom_weight_std = bottom_data["Weight"].std()

# Sample size
top_weight_n = len(top_data)
bottom_weight_n = len(bottom_data)

# Calculate the Z value
Z = (top_weight_mean - bottom_weight_mean) / np.sqrt((top_weight_std**2 /
↳ top_weight_n) + (bottom_weight_std**2 / bottom_weight_n))

# Calculate the p-value
p_value = 2 * (1 - norm.cdf(abs(Z)))

print(f"Z statistic: {Z}")
print(f"p-value: {p_value}")
# Make a decision based on the p-value
if p_value < 0.05:
    print("Reject H0")
else:
    print("Fail to reject H0")

```

Z statistic: -0.5990676284535051

p-value: 0.5491277875257794

Fail to reject H0

Karena p-value > 0.05, maka gagal menolak H0 dan rata-rata berat badan individu yang lebih awal masuk data penelitian sama dengan rata-rata berat badan individu yang baru masuk

**2. Bagaimana dengan pendapatan individu, apakah pendapatan sistole individu yang lebih awal masuk data penelitian lebih besar Rp 1.250.000,00 dari yang baru saja masuk?**

1. H0 : average income of top data - average income of bottom data = 1250000
2. HA : average income of top data - average income of bottom data != 1250000
3. Significance level = 0.05
4. Two-tailed test
5. p-value: 3.6964486245016914e-05
6. Kesimpulan: Reject H0

```

[51]: # H0 : average income of top data - average income of bottom data = 1250000
# HA : average income of top data - average income of bottom data != 1250000
# Significance level = 0.05
# Two-tailed test

# Sample mean
top_income_mean = top_data["Income"].mean()

```

```

bottom_income_mean = bottom_data["Income"].mean()

# Sample standard deviation
top_income_std = top_data["Income"].std()
bottom_income_std = bottom_data["Income"].std()

# Sample size
top_income_n = len(top_data)
bottom_income_n = len(bottom_data)

# Calculate the Z value
Z = (top_income_mean - bottom_income_mean - 1250000) / np.
    sqrt((top_income_std**2 / top_income_n) + (bottom_income_std**2 /
    bottom_income_n))

# Calculate the p-value
p_value = 2 * (1 - norm.cdf(abs(Z)))

print(f"Z statistic: {Z}")
print(f"p-value: {p_value}")
# Make a decision based on the p-value
if p_value < 0.05:
    print("Reject H0")
else:
    print("Fail to reject H0")

```

Z statistic: -4.12567755915035  
 p-value: 3.6964486245016914e-05  
 Reject H0

Karena  $p\text{-value} < 0.05$ , maka  $H_0$  ditolak dan pendapatan sistole individu yang lebih awal masuk data penelitian lebih besar Rp 1.250.000,00 dari yang baru masuk

**3. Lembaga riset ingin membandingkan kondisi kesehatan individu dari dua bagian data. Apakah variansi tekanan darah individu yang lebih awal masuk data penelitian sama dengan yang baru saja masuk?**

1.  $H_0$  : variance blood pressure of top data = variance blood pressure of bottom data
2.  $H_A$  : variance blood pressure of top data  $\neq$  variance blood pressure of bottom data
3. Significance level = 0.05
4. Two-tailed test
5. p-value: 0.3590528867528784
6. Kesimpulan: Fail to reject  $H_0$

[52]:

```

# H0 : variance blood pressure of top data = variance blood pressure of bottom
    data
# HA : variance blood pressure of top data != variance blood pressure of bottom
    data

```

```

# Significance level = 0.05
# Two-tailed test

# Sample variance
top_blood_pressure_var = top_data["Blood_Pressure"].var()
bottom_blood_pressure_var = bottom_data["Blood_Pressure"].var()

# Sample size
top_blood_pressure_n = len(top_data)
bottom_blood_pressure_n = len(bottom_data)

# Calculate the F value
F = top_blood_pressure_var / bottom_blood_pressure_var

# Calculate the degrees of freedom
df_top = top_blood_pressure_n - 1
df_bottom = bottom_blood_pressure_n - 1

# Calculate the p-value
p_value = 2 * min(f.cdf(F, df_top, df_bottom), 1 - f.cdf(F, df_top, df_bottom))

print(p_value)
# Make a decision based on the p-value
if p_value < 0.05:
    print("Reject H0")
else:
    print("Fail to reject H0")

```

0.3590528867528784

Fail to reject H0

Karena p-value > 0.05, maka gagal menolak H0 dan variansi tekanan darah individu yang lebih awal masuk data penelitian sama dengan yang baru masuk

**4. Apakah proporsi waktu olahraga yang lebih dari 8 jam per minggu pada data individu awal lebih besar daripada kuantitas proporsi pada data individu akhir dengan waktu olahraga yang sama?**

1.  $H_0$  : Exercise hours per week of top data > 8 = Exercise hours per week of bottom data > 8
2.  $H_A$  : Exercise hours per week of top data > 8 > Exercise hours per week of bottom data > 8
3. Significance level = 0.05
4. One-tailed test (less than)
5. p-value: 0.5575051193299
6. Kesimpulan: Fail to reject H0

[53]: `#  $H_0$  : Exercise hours per week of top data > 8 = Exercise hours per week of bottom data > 8`

```

# HA : Exercise hours per week of top data > 8 > Exercise hours per week of
↳bottom data > 8

# Significance level = 0.05
# One-tailed test (less than)

# Collect the sample and calculate sample statistics
top_exercise_hours_per_week_more_than_eight =
↳top_data[top_data["Exercise_Hours_Per_Week"] > 8]
bottom_exercise_hours_per_week_more_than_eight =
↳bottom_data[bottom_data["Exercise_Hours_Per_Week"] > 8]

# Sample proportion
top_p = len(top_exercise_hours_per_week_more_than_eight) / len(top_data)
bottom_p = len(bottom_exercise_hours_per_week_more_than_eight) /
↳len(bottom_data)

# Pooled proportions
p = (len(top_exercise_hours_per_week_more_than_eight) +
↳len(bottom_exercise_hours_per_week_more_than_eight)) / (len(top_data) +
↳len(bottom_data))

# Calculate the standard error under H0
SE = np.sqrt(p * (1 - p) * (1 / len(top_data) + 1 / len(bottom_data)))

# Calculate the Z statistic
Z = (top_p - bottom_p) / SE

# Calculate the p-value for a one-tailed test
p_value = 1 - norm.cdf(Z)

print(f"Z statistic: {Z}")

print(f"p-value: {p_value}")

# Compare the p-value to the significance level
if p_value < 0.05:
    print("Reject H0")
else:
    print("Fail to reject H0")

```

Z statistic: -0.14464677894104197

p-value: 0.5575051193299

Fail to reject H0

Karena hasil p-value > alpha (0.05), maka kita gagal menolak H0.