T-Test Example

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22 Oct 2025

COMP 3100/4100: Human-Computer Interaction

Data from Bay Air Center.

In [1]:
```
import numpy as np
from scipy.stats import ttest_ind, levene, shapiro # for t-tests and checking a
import pandas as pd
import matplotlib.pyplot as plt # for visualization
```

In [2]:
```
# read data
df = pd.read_csv('air_quality.csv')
```

t-test (two samples/student's)

Is there a difference in air quality between East Palo Alto and Palo Alto?

factor: city levels: {East Palo Alto ("EPA or BH"), Palo Alto ("PA or MP")}

In [3]:
```
aqi_epa = df[df['city'] == "EPA or BH"]['aqi']
aqi_paly = df[df['city'] == "PA or MP"]['aqi']
```

In [4]:
```
t_statistic, p_value = ttest_ind(aqi_epa, aqi_paly)
p_value
```

Out[4]:
```
1.8768108496139391e-23
```

In [5]:
```
# AQI: higher means worse air quality
print(aqi_epa.mean())
print(aqi_paly.mean())
```

```
36.02056277056277
30.97697922515441
```

=> the air quality in East Palo Alto is significantly worse than the air quality in Palo Alto

Testing Assumptions

In [6]:
```
# test for homoscedacity https://docs.scipy.org/doc/scipy/reference/generated/s
statistic, pvalue = levene(aqi_epa, aqi_paly)
pvalue # if <0.05, then fails homoscedacity
```

Out[6]:
```
0.02242654010431343
```

In [7]:
```
# Test for normality
test_statistic, pvalue = shapiro(df["aqi"])
pvalue # if <0.05, then fails Shapiro-Wilks test and data not normal
```

Out[7]:
```
4.207258509288831e-41
```

Effect Size

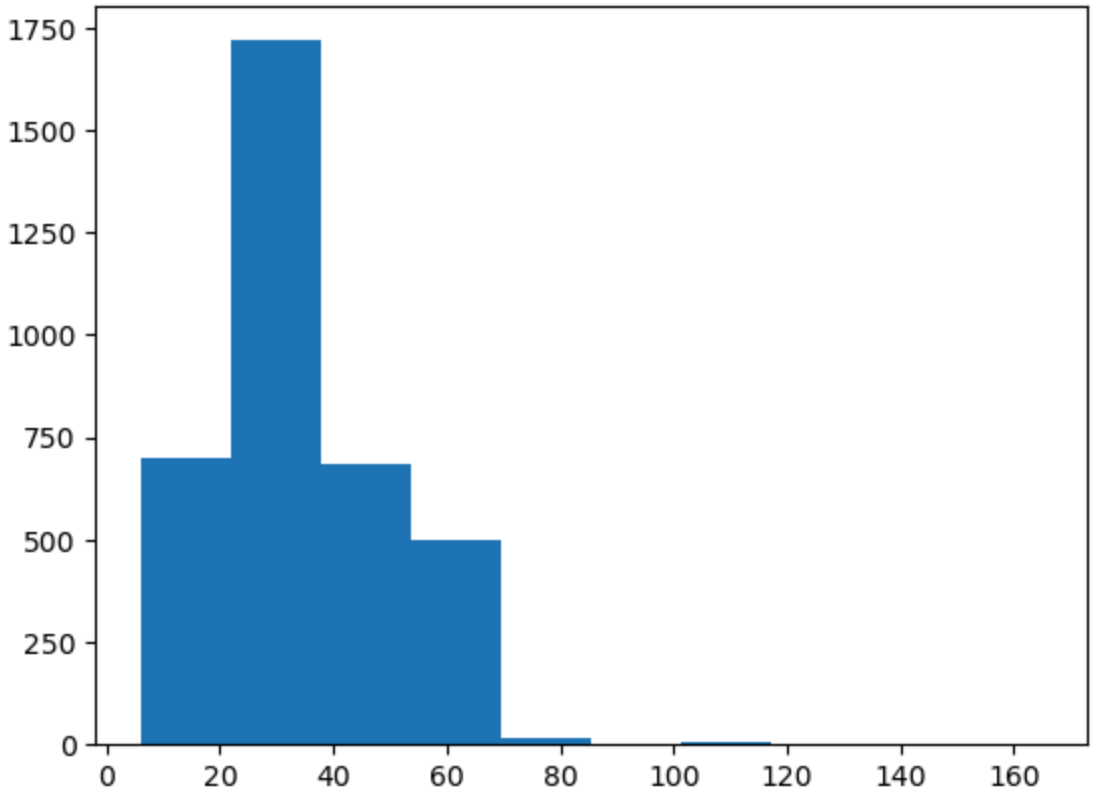
In [8]:
```
# https://www.askpython.com/python/examples/cohens-d-python
def cohens_d(group1, group2):
    # Calculating means of the two groups
    mean1, mean2 = np.mean(group1), np.mean(group2)

    # Calculating pooled standard deviation
    std1, std2 = np.std(group1, ddof=1), np.std(group2, ddof=1)
    n1, n2 = len(group1), len(group2)
    pooled_std = np.sqrt(((n1 - 1) * std1 ** 2 + (n2 - 1) * std2 ** 2) / (n1 +

    # Calculating Cohen's d
    d = (mean1 - mean2) / pooled_std

    return d

effect_size = cohens_d(aqi_epa, aqi_paly)
effect_size
```

Out[8]:
```
0.33368085404049663
```

Visualize your data

In [9]:
```
plt.hist(df['aqi'])
```

Out[9]:
```
(array([7.000e+02, 1.718e+03, 6.840e+02, 4.990e+02, 1.600e+01, 2.000e+00,
        7.000e+00, 2.000e+00, 0.000e+00, 1.000e+00]),
 array([  6. ,  21.9,  37.8,  53.7,  69.6,  85.5, 101.4, 117.3, 133.2,
        149.1, 165. ]),
 <BarContainer object of 10 artists>)
```


1750
1500
1250
1000
750
500
250
0
0
20
40
60
80
100
120
140
160