One Sample t-Test

```
wang_class <- c(
  136, 136, 134, 136, 131, 133, 142, 146, 137, 140,
  134, 135, 136, 132, 119, 132, 145, 131, 140, 141
)
t.test(wang_class, mu = 137, alternative = "two.sided")
```

```
##
##  One Sample t-test
##
## data:  wang_class
## t = -0.90834, df = 19, p-value = 0.3751
## alternative hypothesis: true mean is not equal to 137
## 95 percent confidence interval:
##  133.0349 138.5651
## sample estimates:
## mean of x
##     135.8
```

```
t.test(wang_class, mu = 137, alternative = "greater")
```

```
##
##  One Sample t-test
##
## data:  wang_class
## t = -0.90834, df = 19, p-value = 0.8125
## alternative hypothesis: true mean is greater than 137
## 95 percent confidence interval:
##  133.5157      Inf
## sample estimates:
## mean of x
##     135.8
```

```
t.test(wang_class, mu = 137, alternative = "less")
```

```
##
##  One Sample t-test
##
## data:  wang_class
## t = -0.90834, df = 19, p-value = 0.1875
## alternative hypothesis: true mean is less than 137
## 95 percent confidence interval:
##      -Inf 138.0843
## sample estimates:
## mean of x
##     135.8
```

Interpretation of Results

1. One Sample t-test (two-sided)

```
data: wang_class
t = -0.90834, df = 19, p-value = 0.3751
alternative hypothesis: true mean is not equal to 137
95 percent confidence interval:
 133.0349 138.5651
sample estimates:
mean of x
 135.8
```

- **p-value**: Since the p-value (0.3751) is greater than the common significance level (e.g., 0.05), we fail to reject the null hypothesis. This means there is no significant evidence to conclude that the true mean of the population is **different from** 137.
- **Critical Value**: At the common significance level (e.g., 0.05), with $df = 19$, the critical value from the t-table for a two-tailed t-test is $t_{critical} = \pm 2.093$. The calculated sample $t_{statistic} = -0.90834$ (under the assumption that the true mean is 137) satisfies $|t_{statistic}| < t_{critical}$. This indicates $t_{statistic}$ does not fall into the rejection region, meaning we fail to reject the null hypothesis. However, this does not mean we accept the null hypothesis; it simply means there is insufficient evidence to reject it.
- **Confidence Interval**: The 95% confidence interval $[133.0349, 138.5651]$ includes the hypothesized population mean of

  137. This supports the conclusion that we fail to reject the null hypothesis at the 5% significance level.

2. One Sample t-test (right-sided)

```
data:  wang_class
t = -0.90834, df = 19, p-value = 0.8125
alternative hypothesis: true mean is greater than 137
95 percent confidence interval:
 133.5157      Inf
sample estimates:
mean of x
 135.8
```

- **p-value**: Since the p-value (0.8125) is greater than the common significance level (e.g., 0.05), we fail to reject the null hypothesis. This means there is no significant evidence to conclude that the true mean of the population is **greater than** 137.
- **Critical Value**: At the common significance level (e.g., 0.05), with $df = 19$, the critical value from the t-table for a right-tailed t-test is $t_{critical} = 1.729$. The calculated sample $t_{statistic} = -0.90834$ (under the assumption that the true mean is 137) satisfies $t_{statistic} < t_{critical}$. This indicates $t_{statistic}$ does not fall into the rejection region, meaning we fail to reject the null hypothesis. However, this does not mean we accept the null hypothesis; it simply means there is insufficient evidence to conclude that the population mean is **greater than** 137.
- **Confidence Interval**: The 95% confidence interval $[133.5157, \infty]$ includes the hypothesized population mean of 137. This supports the conclusion that we fail to reject the null hypothesis at the 5% significance level. Additionally, since the interval extends to negative infinity, it further indicates that there is no evidence to suggest the true mean is **greater than** 137.

3. One Sample t-test (left-sided)

```
data:  wang_class
t = -0.90834, df = 19, p-value = 0.1875
```

```
alternative hypothesis: true mean is less than 137
95 percent confidence interval:
     -Inf 138.0843
sample estimates:
mean of x
    135.8
```

- **p-value**: Since the p-value (0.1875) is greater than the common significance level (e.g., 0.05), we fail to reject the null hypothesis. This means there is no significant evidence to conclude that the true mean of the population is **less than** 137.
- **Critical Value**: At the common significance level (e.g., 0.05), with $df = 19$, the critical value from the t-table for a left-tailed t-test is $t_{critical} = -1.729$. The calculated sample $t_{statistic} = -0.90834$ (under the assumption that the true mean is 137) satisfies $t_{statistic} > -t_{critical}$. This indicates $t_{statistic}$ does not fall into the rejection region, meaning we fail to reject the null hypothesis. However, this does not mean we accept the null hypothesis; it simply means there is insufficient evidence to conclude that the population mean is **less than** 137.
- **Confidence Interval**: The 95% confidence interval $[-\infty, 138.0843]$ includes the hypothesized population mean of 137. This supports the conclusion that we fail to reject the null hypothesis at the 5% significance level. Additionally, since the interval extends to negative infinity, it further indicates that there is no evidence to suggest the true mean is **less than** 137.

Summary of Analysis

1. p-value Compare the p-value with the significance level (α, commonly 0.05).

- If $p > \alpha$, the result is insignificant, and we fail to reject the null hypothesis.
- If $p \leq \alpha$, the result is significant, and we reject the null hypothesis.

2. Critical Value Compare the calculated t-statistic with the critical value (from the t-distribution table, based on degrees of freedom, DF, significance level, type of the t-test).

- If the t-statistic does not fall into the rejection region, then we fail to reject the null hypothesis.
  - two-sided t-test: $|t_{statistic}| < t_{critical}$
  - right-sided t-test: $t_{statistic} < t_{critical}$
  - left-sided t-test: $t_{statistic} > -t_{critical}$
- Otherwise, we reject the null hypothesis.

3. Confidence Interval Examine whether the hypothesized population mean falls within the confidence interval.

- If the hypthesized population mean is included, we fail to reject the null hypothesis.
- Otherwise, we reject the null hypothesis.