Formative Assessment 7

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Independent Samples T-Test: Invisibility Cloak

The dataset “Invisibility Cloak” explores the number of mischievous acts committed by two groups: those with an invisibility cloak and those without. We will perform an independent samples t-test to determine if having an invisibility cloak significantly affects mischievous behavior.

The dataset contains the following variables:

- Participant: Participant identification number.
- Cloak: Experimental group (0 = without a cloak, 1 = with a cloak).
- Mischief: The number of mischievous acts committed.

```
library(tidyverse)
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
## ✔ dplyr     1.1.4     ✔ readr     2.1.5
## ✔ forcats   1.0.0     ✔ stringr   1.5.1
## ✔ ggplot2   3.5.1     ✔ tibble    3.2.1
## ✔ lubridate 1.9.3     ✔ tidyr     1.3.1
## ✔ purrr     1.0.2
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(ggplot2)

# Manually entering the data
data <- data.frame(
  Participant = 1:24,
  Cloak = c(0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1),
  Mischief = c(3, 2, 4, 5, 3, 2, 4, 5, 6, 3, 2, 4, 5, 6, 8, 7, 9, 6, 7, 8, 9, 10, 6, 7)
)

# View the first few rows of the data
head(data)
```

```
##   Participant Cloak Mischief
## 1           1     0        3
## 2           2     0        2
## 3           3     0        4
## 4           4     0        5
## 5           5     0        3
## 6           6     0        2
```

Assumption 1: The Dependent Variable is Continuous

The dependent variable, Mischief, is measured at a continuous level.

Assumption 2: The Independent Variable has Two Categorical Groups

The independent variable Cloak consists of two groups:

1. Without a cloak
2. With a cloak

```
table(data$Cloak)
```

```
##
##  0  1
## 12 12
```

Assumption 3: Independence of Observations

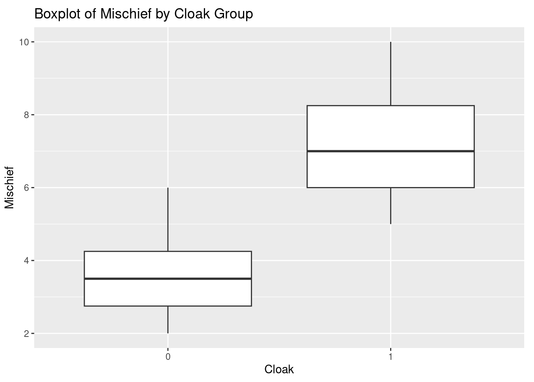
Each participant is assigned to only one group. This assumption is met since no participant appears in both groups.

Assumption 4: No Significant Outliers

We will check for outliers in the Mischief variable using boxplots.

```
# Boxplot to check for outliers
library(ggplot2)

ggplot(data, aes(x = factor(Cloak), y = Mischief)) +
  geom_boxplot() +
  labs(title = "Boxplot of Mischief by Cloak Group", x = "Cloak", y = "Mischief")
```



Based on the visual inspection, we can determine if there are any extreme outliers.

Assumption 5: Normality of the Dependent Variable

We will use the Shapiro-Wilk test to check if the Mischief variable is normally distributed for each group.

```
# Shapiro-Wilk test for normality
shapiro.test(data$Mischief[data$Cloak == 0])  # Without Cloak
```

```
##
##  Shapiro-Wilk normality test
##
## data:  data$Mischief[data$Cloak == 0]
## W = 0.92044, p-value = 0.2896
```

```
shapiro.test(data$Mischief[data$Cloak == 1])  # With Cloak
```

```
##
##  Shapiro-Wilk normality test
##
## data:  data$Mischief[data$Cloak == 1]
## W = 0.95309, p-value = 0.6825
```

If p > 0.05, the data is normally distributed.

Independent Samples T-Test

Finally, we will compute the independent samples t-test to compare the means between the two groups.

```
t.test(Mischief ~ Cloak, data = data, var.equal = TRUE)  # Assuming equal variances
```

```
##
##  Two Sample t-test
##
## data:  Mischief by Cloak
## t = -6.5262, df = 22, p-value = 1.452e-06
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0
## 95 percent confidence interval:
##  -4.941668 -2.558332
## sample estimates:
## mean in group 0 mean in group 1
##        3.583333        7.333333
```

Interpretation

If p < 0.05, we reject the null hypothesis and conclude that there is a significant difference in the number of mischievous acts committed between the two groups.