# MOT 2312

# Research Methods
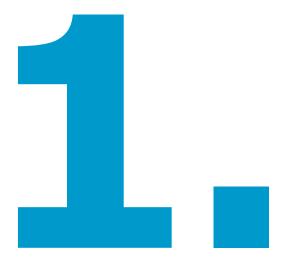
# Hypothesis Testing, *z*-Test, and *t*-Test

# JASP Examples

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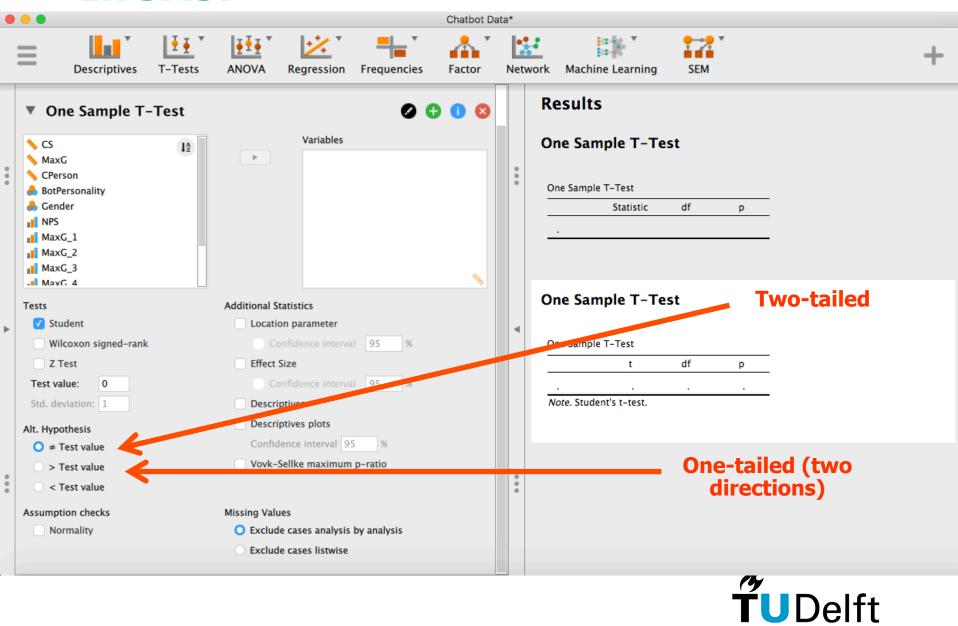
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# NHST

1.

# $H_0$ and $H_a$: two forms

❖ **One-tailed**: Your $H_a$ is formulated in terms of "higher / lower" (thus directional); same follows for the $H_0$

❖ **Two-tailed**: Your $H_a$ is formulated in terms of "differences that exist between groups" (nondirectional); the $H_0$ then states that no differences exist

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# In JASP

# The (single sample) *z*-test and *t*-test

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# Interpretation of a *z*-test vs. *t*-test

❖ What are the different assumptions underlying the two
  tests of variable "CPerson" in the JASP output?

## One Sample T–Test

One Sample T–Test ▼

|  | Test | Statistic | df | p |
|---|---|---|---|---|
| CPerson | Student | 37.51 | 119 | < .001 |
|  | Z | 36.83 |  | < .001 |

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# Answer

❖ **Assumptions z-test**: (1) we have a known CPerson population variance elsewhere; (2) CPerson is normally distributed, (3) the sample size is bigger than 30 (but the output for the z-test itself does not tell us)

❖ **Assumptions (Student) t-test**: (1) we do NOT know the CPerson population variance, (2) Cperson must be an interval/ratio measure, (3) Cperson is symmetrical in distribution but not normally distributed

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# Interpretation of a *z*-test vs. *t*-test

❖ Do you have any idea about the sample size of the Cperson dataset?

**One Sample T–Test**

One Sample T–Test ▼

|  | Test | Statistic | df | p |
|---|---|---|---|---|
| CPerson | Student | 37.51 | 119 | < .001 |
|  | Z | 36.83 |  | < .001 |

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# Answer

❖ 120 (degrees of freedom + 1)

# Interpretation t-test (two-tailed)

❖ I ran a single-sample t-test on CPerson, NPS and Gender. The p-values for all three variables are < .05. They clearly fall in the region of rejection for the $H_0$. Should I be happy, now?



## One Sample T-Test

| | t | df | p |
|---|---|---|---|
| CPerson | 37.505 | 119 | < .001 |
| NPS | 52.249 | 119 | < .001 |
| Gender | 7.859 | 119 | < .001 |

*Note.* Student's t-test.

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# Answer

❖ **Yes** for Cperson: that variable is at interval/ratio scale, and suits this type of t-test. Congrats!

❖ **No** for NPS: that variable is at ordinal scale, which does not fit this type of t-test. You should have run a nonparametric test, instead. Alas!

❖ **No** for Gender: that variable is at nominal scale, which does not fit this type of t-test. You should have run a nonparametric test, instead. Alas!

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# Follow-up question

❖ Let's assume the previous single-sample t-test output on CPerson was based on the following hypotheses:

$H_0$: The sample mean for CPerson is not significantly different from the CPerson population mean

$H_a$: The sample mean for CPerson is significantly different from the CPerson population mean

❖ Did we conduct a one-tailed t-test or a two-tailed t-test, and what makes you say so?

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# Answer

❖ **Two-tailed**: the $H_0$ and $H_a$ were formulated in nondirectional manner. All they predicted was significant vs. nonsignificant differences between sample and population means.

# Final follow-up question

❖ So, the t-test output on CPerson was based on the following hypotheses:

$H_0$: The sample mean for CPerson is not significantly different from the CPerson population mean

$H_a$: The sample mean for CPerson is significantly different from the CPerson population mean

❖ Do we accept or reject the null hypothesis, and what makes you say so?

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# Answer

❖ The result was: $t(119) = 37.51$, $p < .001$. This result is lower than probability value .05, where we had set our critical value. Our result thus falls within the rejection region for $H_0$. **We reject $H_0$ and accept $H_a$.**

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