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Module Title: Introduction to Statistics

Session Title: Hypothesis testing in SPSS

Topic title: Confidence and significance (II)

Learning Outcomes

- To understand the idea of hypothesis testing in science
- To understand the null and the alternative hypotheses

Hypothesis Testing

We will be repeating this procedure for all tests that we will learn in this course!

Step 1: Create the **null** and the **alternative** hypothesis for the population parameter.

Step 2: **Sample** from the population and compute the correct **statistic** to **estimate** the parameter.

Step 3: Create the **sampling distribution** for this statistic, under the null.

Step 4: Find the **rejection area**.

Step 5: Check if your **sampled** value **falls** in the rejection area.

Equality of Means: The One Sample t-test

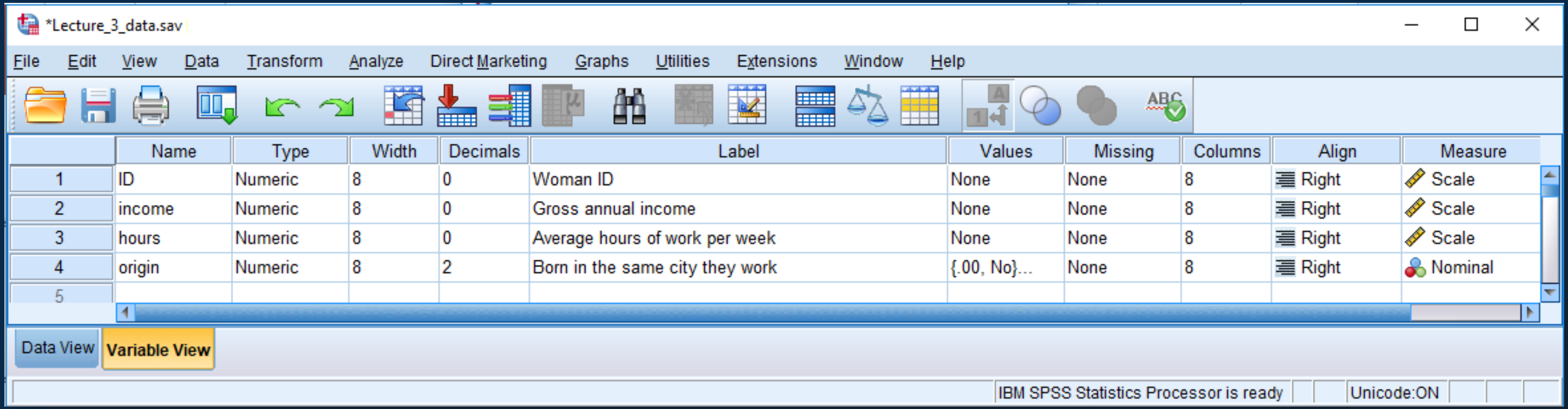
Hypotheses	Suitable test	Decision
H_0: is equal H_a: not equal	*test statistic*	p-value>0.05 do not reject the H_0 p-value≤0.05 reject the H_0

Hypotheses	One sample t-test
H_0: $\mu=\mu_0$ H_a: $\mu\neq\mu_0$	$t=\frac{\bar{x}-\mu_0}{s.e.}$, df=n-1 $s.e.=\sqrt{s^2/n}$

Is the population mean (μ) equal to a certain value (μ_0)?

SPSS Slide: ‘how to’

If you haven’t done already, you can download the data that we are going to use during the lecture. The dataset is the **lecture_3_data.sav**.



	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure
1	ID	Numeric	8	0	Woman ID	None	None	8	Right	Scale
2	income	Numeric	8	0	Gross annual income	None	None	8	Right	Scale
3	hours	Numeric	8	0	Average hours of work per week	None	None	8	Right	Scale
4	origin	Numeric	8	2	Born in the same city they work	{.00, No}...	None	8	Right	Nominal
5										

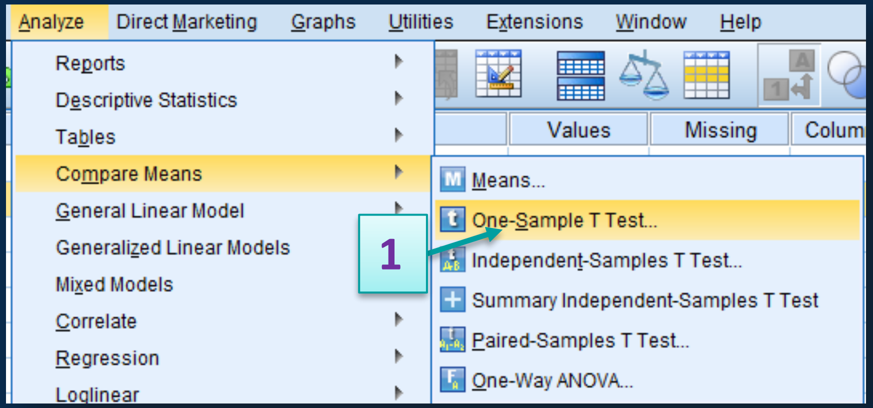
The dataset contains data from 100 women working in a particular industry sector, with respect to

- income: their gross annual income,
- hours: the hours they work each day
- origin: whether the women work in the same city they were born or not

Before anything else, take a minute to think what type of variables you have, compute the descriptive indices and ‘clean the data’.

SPSS Slide: ‘how to’

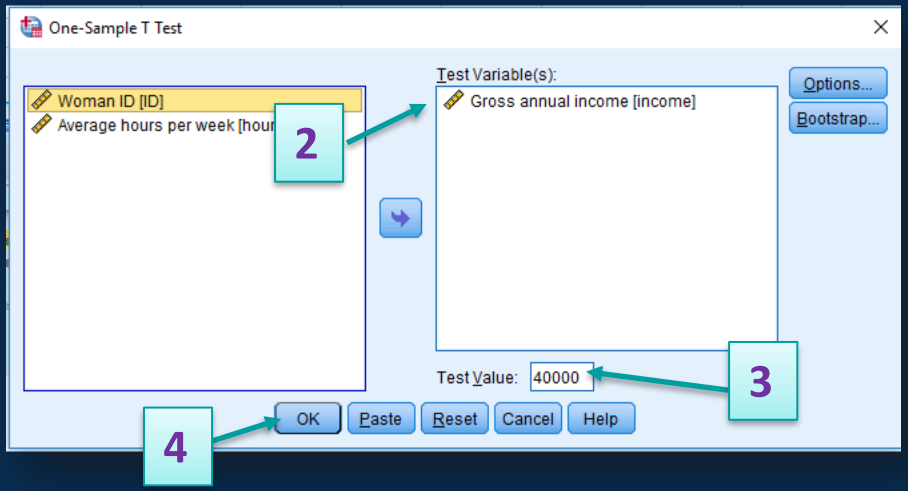
Analyse -> Compare means -> ‘One sample t-test’



Add the variable of interest in the ‘Test Variables’ box (Weight1)

Add in the known test value of interest

Click on ‘OK’



Output and Interpretation

SPSS prints a table with descriptive statistics and one with the one sample t-test

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Gross annual salary	100	35151.85	2011.201	201.120
	N	$\bar{x}$	s	se

mean, sd, and se estimated by the sample

Output and Interpretation

SPSS prints a table with descriptive statistics and one with the one sample t-test

Population mean if the null is TRUE

One-Sample Test

	Test Value = 40000 (μ_0)					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Gross annual salary	-24.106	99	.000	-4848.150	-5247.22	-4449.08

We tested if the difference is zero, rather than if the values are equal.

Now this is for the difference.

H_0: μ=£40000 $\leftrightarrow$ μ-£40000=0

H_α: μ≠£40000 $\leftrightarrow$ μ-£40000 ≠ 0

Output and Interpretation

SPSS prints a table with descriptive statistics and one with the one sample t-test

One-Sample Test

	Test Value = 40000					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Gross annual salary	-24.106	99	.000	-4848.150	-5247.22	-4449.08

Test statistic
$t = \frac{\bar{x}-\mu_0}{s.e.}$

Degrees of freedom: n-1

p-value: $p<0.001$

If we reject the null hypothesis, there is less than 1 chance in a 1000 to be wrong.

If the null hypothesis is true, there would be less than 1 chance in a 1000 to sample the value we did. Thus we feel confident enough to reject the null hypothesis based on our data.

Output and Interpretation

SPSS prints a table with descriptive statistics and one with the one sample t-test

One-Sample Test

	Test Value = 40000					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Gross annual salary	-24.106	99	.000	-4848.150	-5247.22	-4449.08

We infer, the difference between men's and women's incomes is ‘statistically’ significant.

That is, womens' income is statistically different than that of men.

Based on our sample, the expected mean difference in the income between women and men is -£4848.2 (95% CI: [-5247.2,-4449.1]). This difference is statistically significant (t=-24.106, df=99, p<0.001).

Equality of Proportions: The One Sample χ^2-test

Hypotheses

H_0: means are equal
H_a: means are not equal

Suitable test

- *test statistic* and
- *degrees of freedom*

Decision

p-value>0.05 go with H_0
p-value≤0.05 go with H_a

Hypotheses

H_0: $\mu=\mu_0$

H_a: $\mu\neq\mu_0$

One sample t-test

$t = \frac{\bar{x}-\mu_0}{s.e.}$, df=N-1

$s.e. = \sqrt{s^2/N}$

Is the population mean (μ) equal to a certain value (μ_0)?

Hypotheses

H_0: $\pi=\pi_0$

H_a: $\pi\neq\pi_0$

One sample χ^2-test

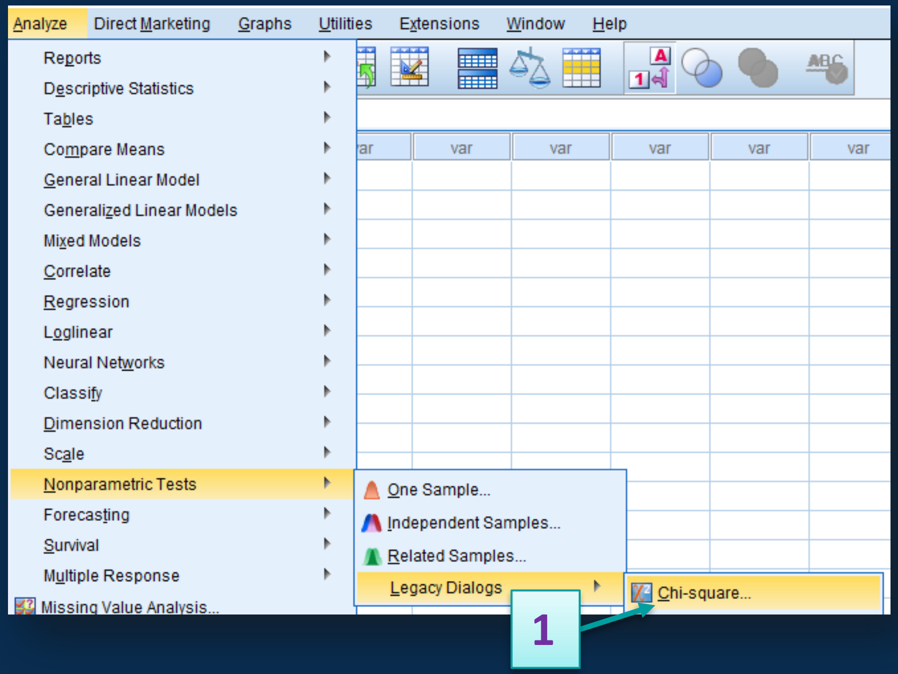
$\chi^2 = \sum \frac{(\mathrm{O}-\mathrm{E})^2}{\mathrm{E}}$, df=c-1

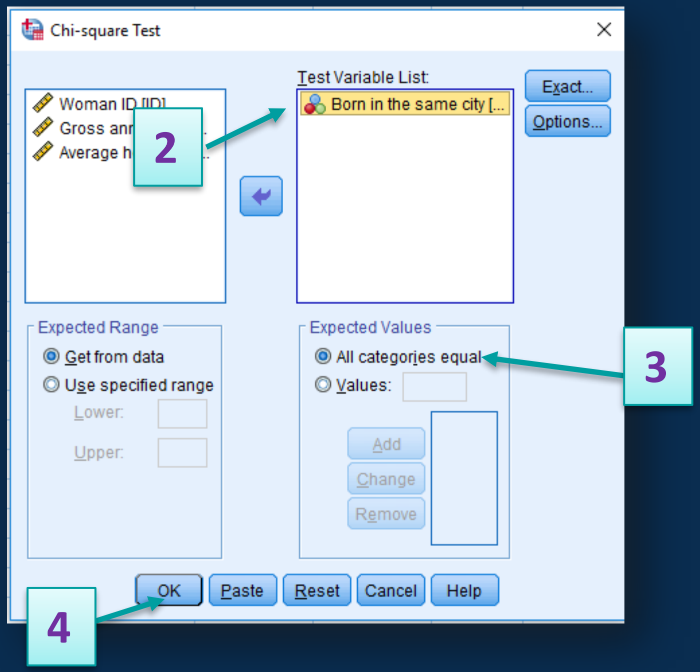
Is the population proportion (π) equal to a certain value (π_0)?

SPSS Slide: ‘how to’

To test if among the women working in this sector the proportion of the women being born in the same city is statistically different than the proportion of the women born in other cities (50%-50%) we will use the ‘one sample χ2-test’.

Analyse -> non parametric tests-> ‘Chi-square’





H_0: $\pi=0.5$

H_a: $\pi\neq0.5$

Equality of Proportions: The One Sample χ^2-test

SPSS prints a table with descriptive statistics and one with the one sample χ^2 -test

Born in the same city

	Observed N	Expected N	Residual
No	81	49.5	31.5
Yes	18	49.5	-31.5
Total	99		

How things are in our sample

How things should be if the null was correct (π=0.5)

Difference $(O - E)$

$H_0: \pi=0.5$
$H_a: \pi\neq0.5$

Test Statistics

	Born in the same city
Chi-Square	40.091[a]
df	1
Asymp. Sig.	.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 49.5.

Test statistic $\sum\frac{(O-E)^2}{E}$

Degrees of freedom: c-1

p-value: $p<0.001$

Based on our sample, among the women working in this industry, the proportion of the women being born in the same city is statistically different than the proportion of the women born in other cities (χ^2=40.091, df=1, p<0.001).

SPSS Slide: 'how to'

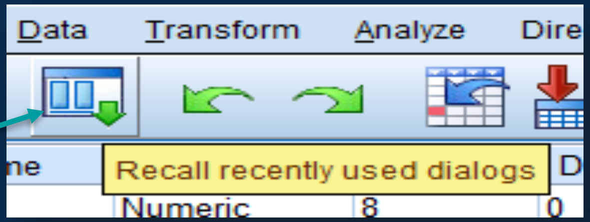
Say now that the proportion of women who work in companies in cities different than those they were born (π) is believed to be 0.2 (20%). Do our data provide evidence against this null hypothesis?

On the command bar press the recall button

H_0: π=0.2

H_a: π≠0.2

1



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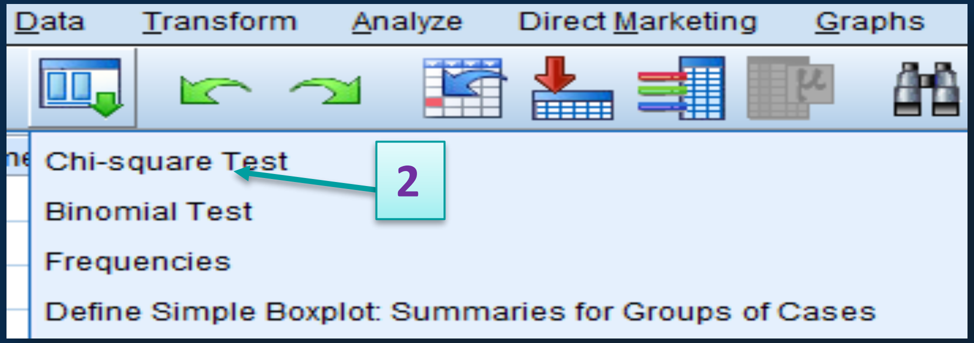
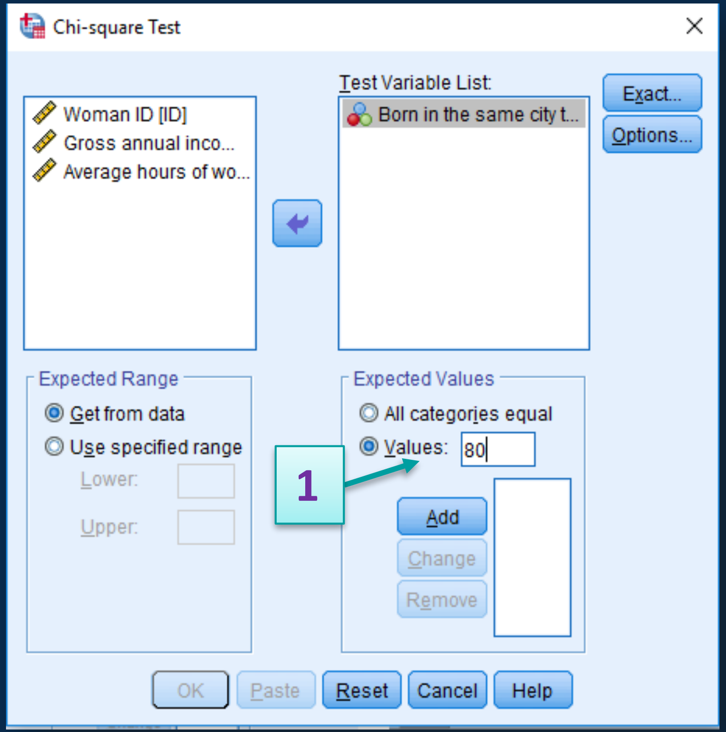
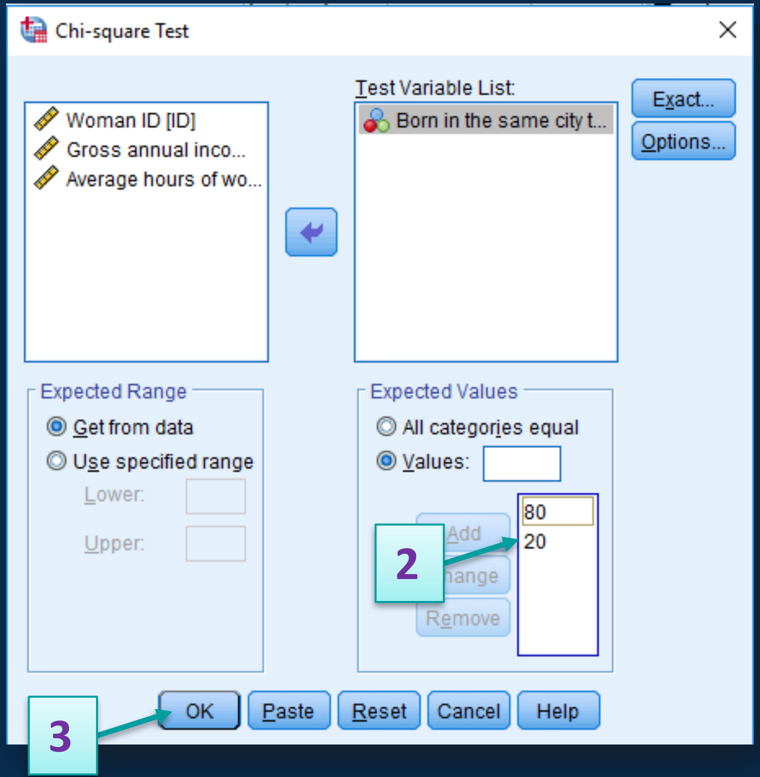


SPSS Slide: ‘how to’

Say now that the proportion of women who work in companies in cities different than those they were born (π) is believed to be 0.2 (20%). Do our data provide evidence against this null hypothesis?

In the expected values, type 80% and then 20%





H_0: $\pi=0.2$

H_a: $\pi\neq0.2$

SPSS wants you to add test values for all categories, in order (0, 1, 2, 3…..)

Equality of Proportions: The One Sample χ^2-test

SPSS prints a table with descriptive statistics and one with the one sample χ^2 -test

Born in the same city they work

	Observed N	Expected N	Residual
No	81	79.2	1.8
Yes	18	19.8	-1.8
Total	99		

How things are in our sample

How things should be if the null was correct (π=0.2)

H_0: π=0.2

H_a: $\pi \neq 0.2$

Difference $(\mathrm{O}-\mathrm{E})$

Test Statistics

	Born in the same city they work
Chi-Square	.205[a]
df	1
Asymp. Sig.	.651

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 19.8.

Test statistic $\sum \frac{(\mathrm{O}-\mathrm{E})^2}{\mathrm{E}}$

Degrees of freedom: c-1

p-value: p=0.651

In our sample, the proportion of the women who work in a company in the same city they were born was NOT statistically different than 0.2 (χ^2=0.205, df=1, p=0.651). There were no sufficient evidence to reject the null hypothesis.

Thank you

Please contact your module leader or the course lecturer of your programme, or visit the module's forum for any questions you may have.

If you have comments on the materials (spotted typos or missing points) please contact Dr Vitoratou:

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Institute of Psychiatry, Psychology and Neuroscience

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Module Title: Introduction to Statistics

Session Title: Research hypotheses

Topic title: Confidence and significance (II)

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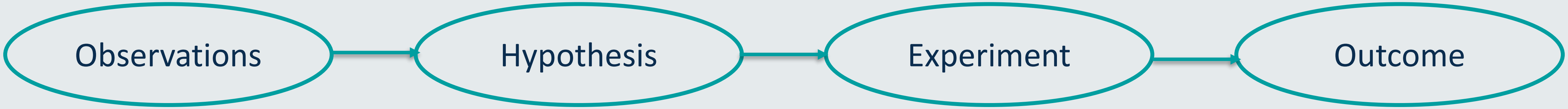
Learning Outcomes

- To understand the idea of stating hypotheses in research
- To understand the null and the alternative hypotheses

Stating Hypotheses



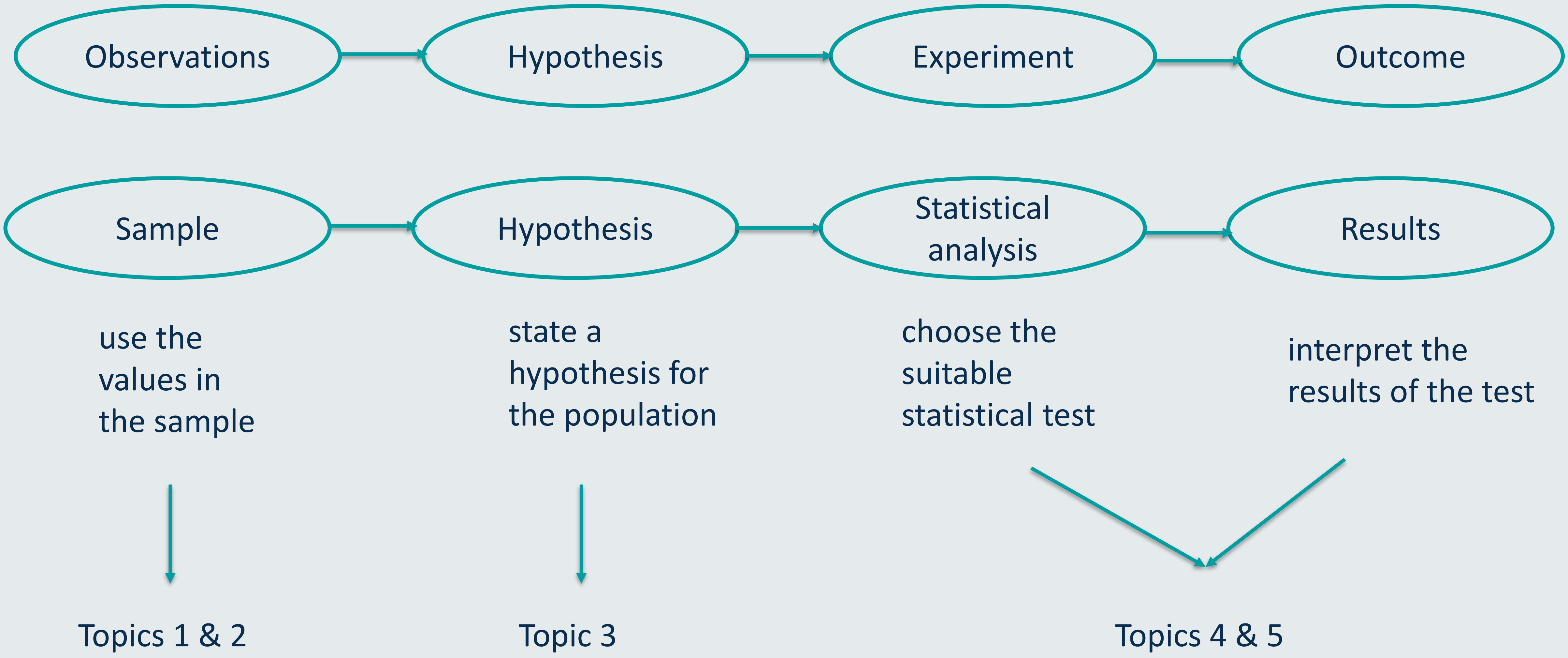
In research, it all begins by making **observations** on our topic of interest.

Based on these observations, we formulate a **hypothesis**, that is, **a testable statement which entails our beliefs about our observations**.

Then, we may **design an experiment** to verify or falsify our hypothesis.

The result of our experiment will be the **outcome** of our research

Stating Hypotheses



Stating Hypotheses

In statistics, we have two hypotheses: the '**null**' and the '***alternative***'.
We always start by stating the **null hypothesis H_0.** It is called **null** because essentially, it states that something '**equals zero**', or in other words there is no finding

H_0: The population mean hours of exercise are **zero**

H_a: The population mean hours of exercise are not zero

H_0: The population mean for **males** is **not different than** that of **females**

H_a: The population mean for males is different than that of females

H_0: The **correlation** of height and weight **is zero**

H_a: The correlation of height and weight is not zero

H_0: There is **no association** between gender and height

H_a: There is association between gender and height.

H_0: The **effect** of smoking in lung cancer is **zero**

H_a: The effect of smoking in lung cancer is non zero

H_0: There is **nothing** there.

H_a: There is something there.

Stating Hypotheses

To summarise, you may remember the two hypotheses as:

H_0: The characteristic I am studying **equals** zero.

H_a: The characteristic I am studying is different than zero.

Two sided test: ≠0, anything different that zero

One sided test: either larger (>0) or smaller (<0) than zero.

Stating Hypotheses

Imagine that you are archaeologists. Say you were given a map, where a treasure might be hidden.

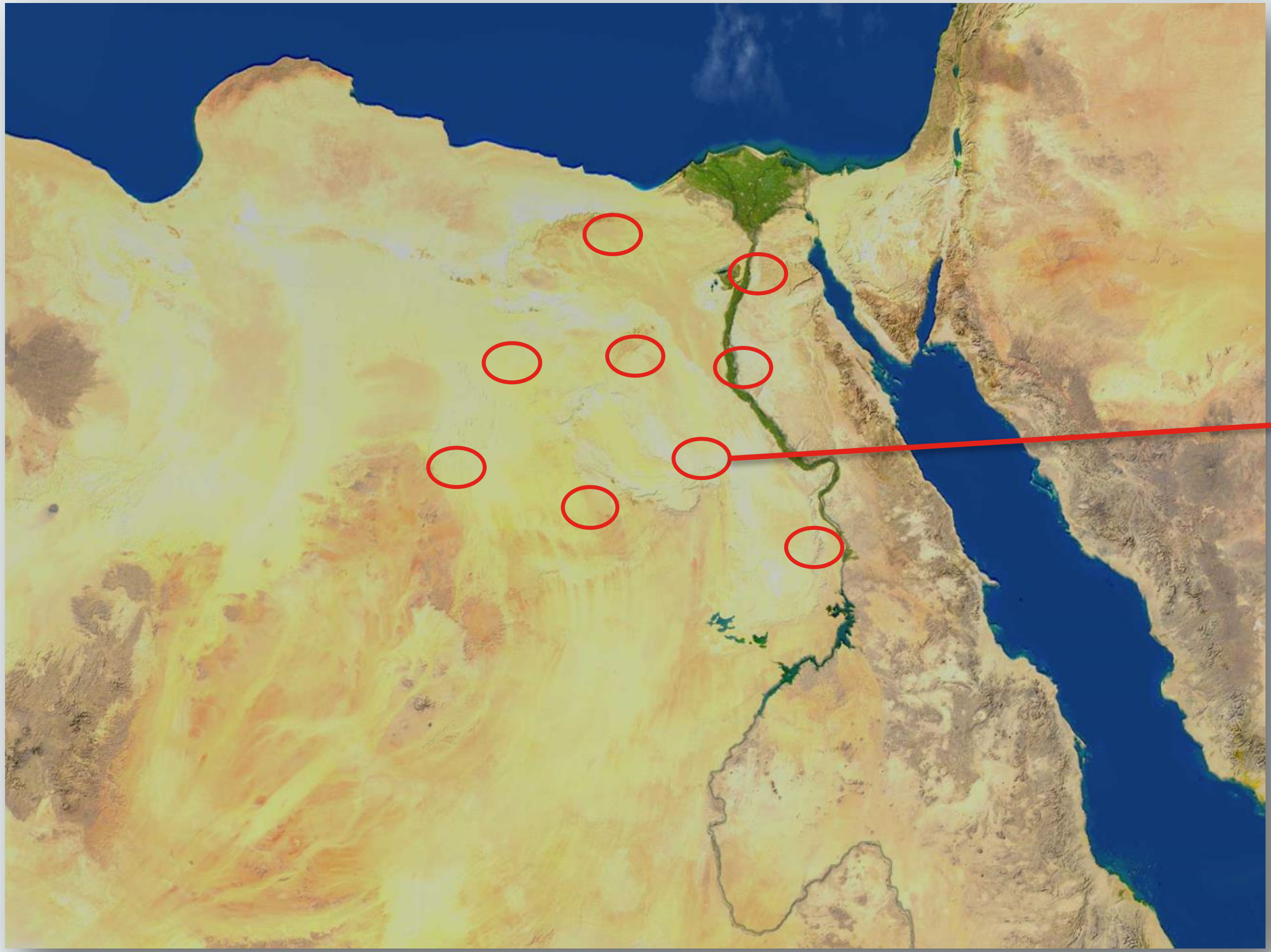
H_0: There is no treasure

H_a: There is a treasure

Stating Hypotheses

You need to start your research, but there are limited resources.

So you can only search (sample) parts of the area.



H_0: There is no treasure

H_a: There is a treasure

Stating Hypotheses

If you find the treasure, you can

reject the null hypothesis & **accept the alternative** hypothesis

~~H_0: There is no treasure~~

H_a: There is a treasure

Stating Hypotheses

If you DO NOT find the treasure, can you

~~**accept the null** hypothesis & reject the alternative hypothesis~~

H_0: **There is no treasure**

H_a: **There is a treasure**

Stating Hypotheses

If you do not find the treasure you cannot say there is not treasure. So **you cannot accept the null hypothesis**, you simply: Do not **reject** the null hypothesis

H_0: There is no treasure

H_a: There is a treasure

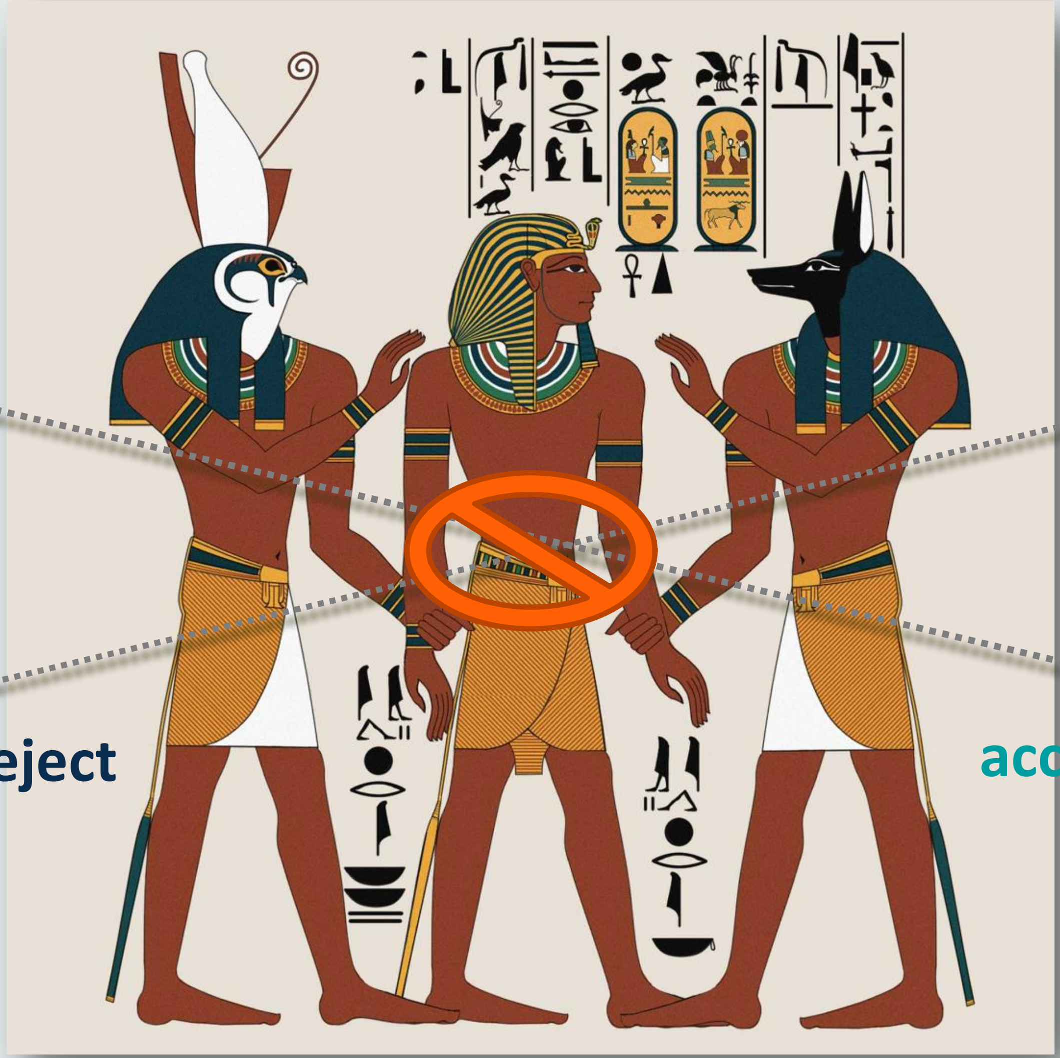
Stating Hypotheses

H_0: There is no treasure

H_a: There is a treasure

Null

Alternative



reject or not reject

accept or not accept

Hypothesis Testing

What can go wrong with your quest?

H_0: There is no treasure
H_a: There is a treasure

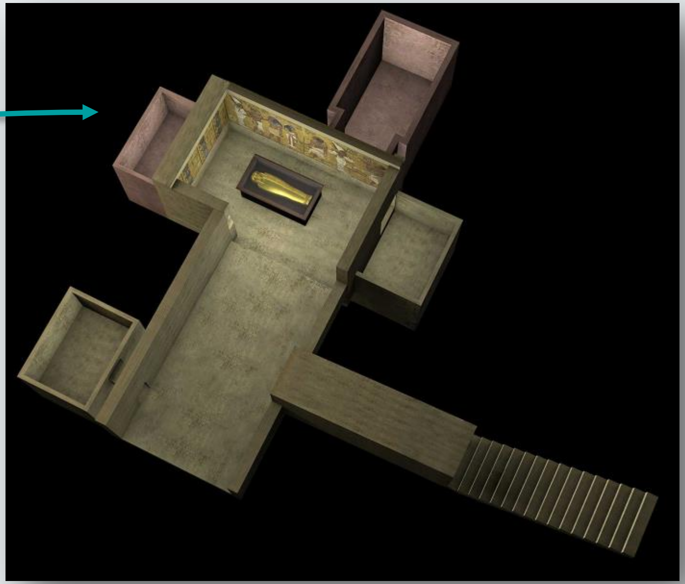
To be under the impression that you found a treasure, but to turn out that the treasure was thin air.

Hypothesis Testing

What can go wrong with your quest?

H_0: There is no treasure
H_a: There is a treasure

To be unable to find the treasure, when in fact there was one (left hidden, undiscovered)



Hypothesis Testing

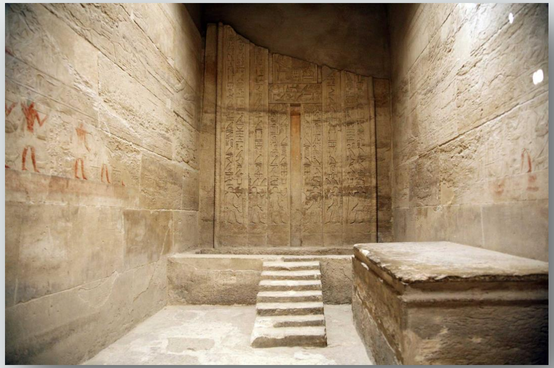
These are the two types of errors in statistics:

H_0: There is no treasure
H_a: There is a treasure

<u>Type I error: treasure was worthless</u>

To think you found a treasure, but to turn out to be wrong.

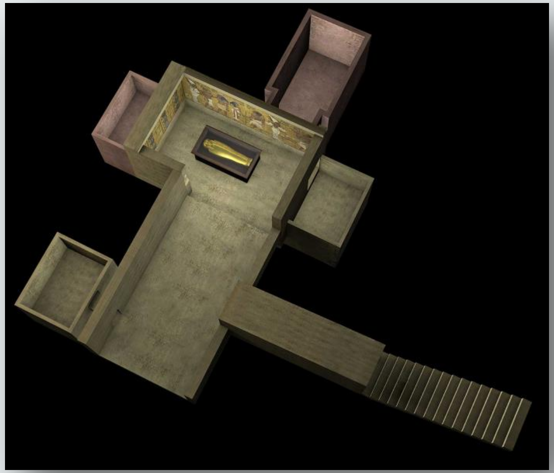
H_0 rejected but was true



<u>Type II error: treasure left hidden</u>

To think that there is no treasure, but in fact there was one.

H_0 not rejected but was false



Hypothesis Testing

H_0: There is no difference **H_a: There is a difference**

		Sample	
		H_0 rejected	H_0 not rejected
Population	H_0 was true	Type I error (**with probability α**)	Correct inference **(1-α)**
	H_0 was false	Correct inference **(1-β)**	Type II error **(with probability β)**

Type I error and significance level α:
By convention the probability of Type I error (α) is set to 0.05, that is: if I say that there is a difference in the population I am at least 95% confident that indeed there is a difference or I allow myself a 5% change to be wrong if I reject the null.

1-Type II error or Power (1-β):
By convention set to 0.80, that is: if there was a difference in the population I am at least 80% confident that I would be able to reveal it.

Hypothesis Testing

What affects our chances to make those errors?

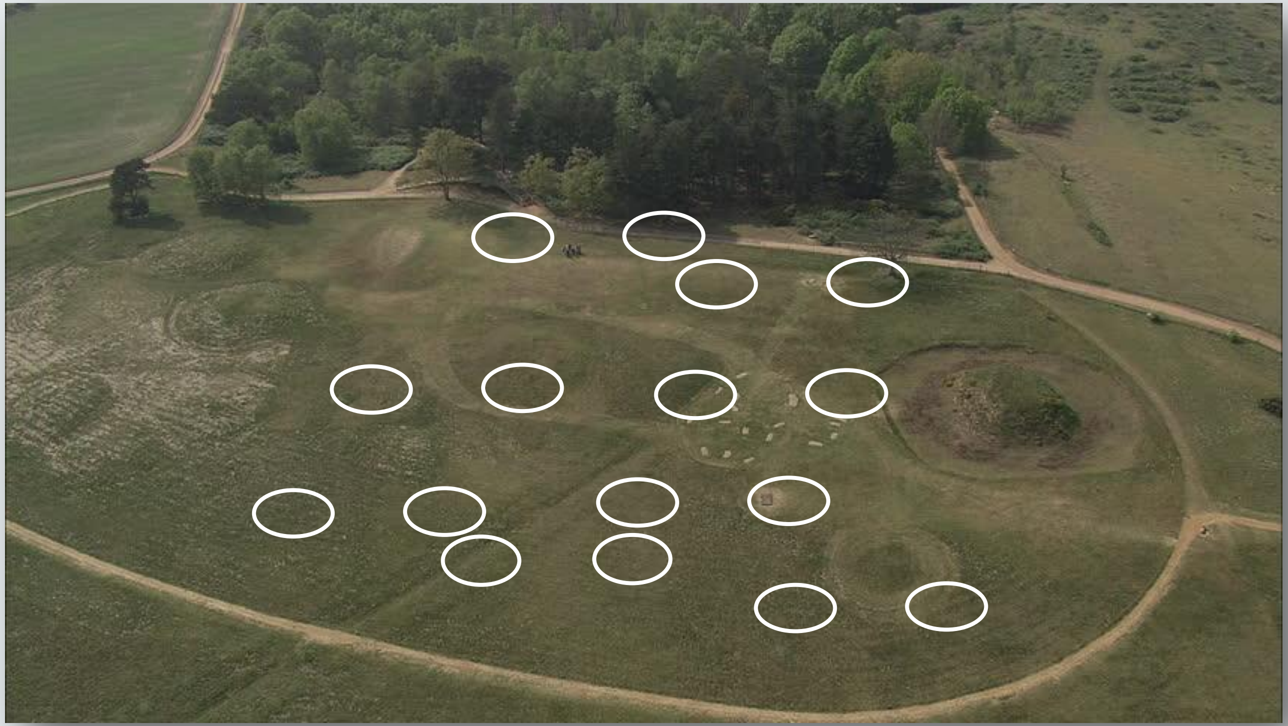
All other things being equal, is your power to find the treasure the same if:

H_0: There is no treasure

H_a: There is a treasure

a) You search 8 areas

b) You search 13 areas



Anglo-Saxon ship burial at Sutton Hoo, Suffolk, one of the most important discoveries in British archaeology

Hypothesis Testing

What affects our chances to make those errors?

All other things being equal, is your power to find the treasure the same if:

H_0: There is no treasure

H_a: There is a treasure

a) the treasure is a buried ship

The imprint of the ship found by Basil Brown and Edith Pretty. Photograph by Charles W Phillips (British museum blog).

b) the treasure is a tiny belt buckle?

Peggy Piggott excavates the gold buckle. Photograph by John Brailsford.

Hypothesis Testing

H_0: There is no treasure

H_a: There is a treasure

The larger the sample size, the more able I am to trace the difference.

vs

The larger the difference, the more able I am to trace the difference.

vs

If the null hypothesis is false (there is a treasure), my power to correctly reject it (1-β), is larger if the treasure is big or if I sample more areas.

Hypothesis Testing: Power Analysis

How do I know the sufficient sample size for a research? We do so using power analysis.

		Sample	
		H_0 rejected	H_0 not rejected
Population	H_0 was true	Type I error **α**	Correct inference **1-α**
	H_0 was false	Correct inference **1-β**	Type II error **β**

Power

a=0.05

(probability of error allowed)

Sample size n

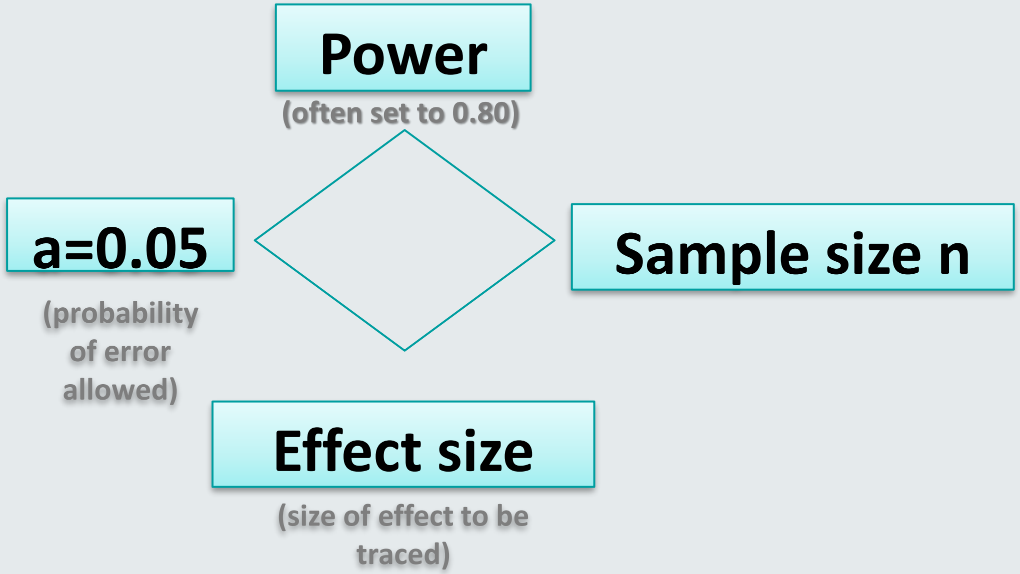
Effect size

(size of effect to be traced)

Closed system of four: when you know 3 of these, you can compute the 4th .

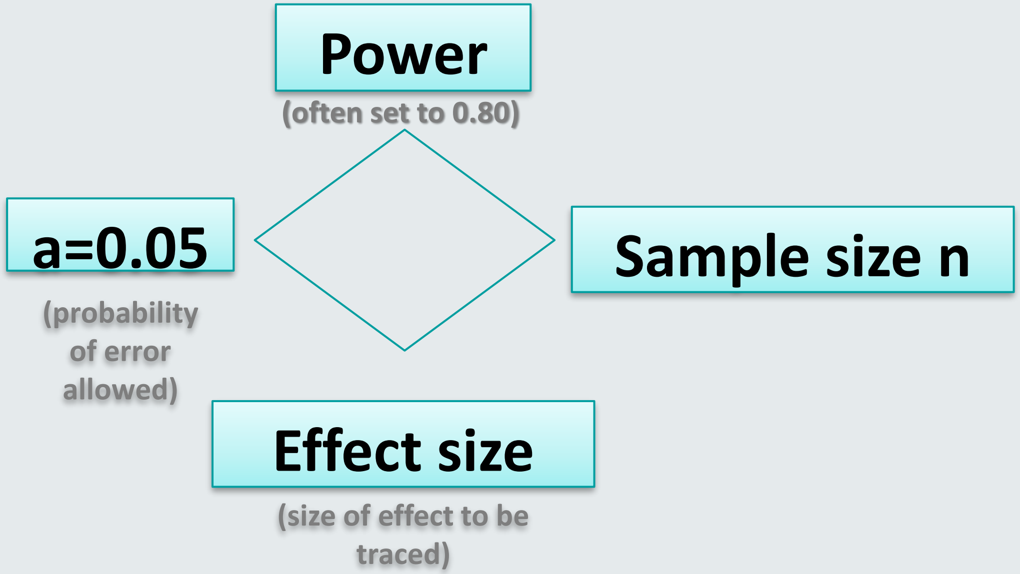
Hypothesis Testing: Power Analysis

A-Priori Power Analysis: before conducting our experiment we compute the sample size needed to have at least 80% power to detect a difference, with error margin of 0.05. We estimate the effect size based on previous knowledge.



Hypothesis Testing: Power Analysis

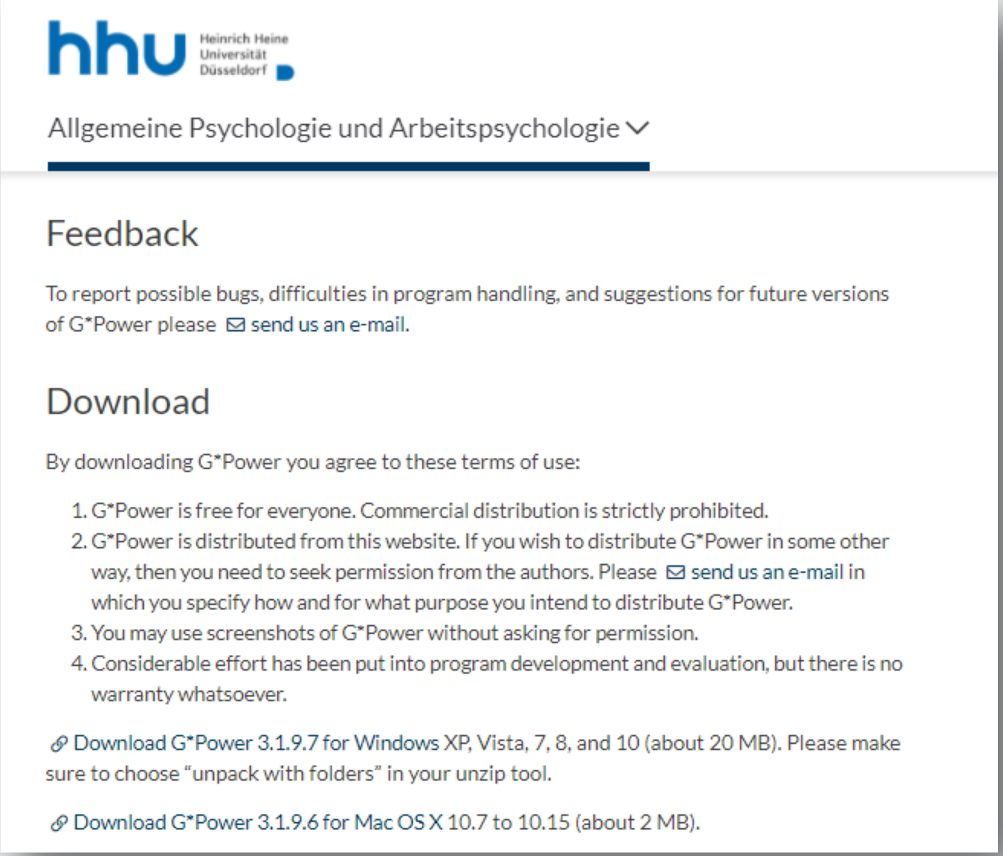
A-Posterior Power Analysis: after conducting our experiment we can compute the power we actually had to detect a difference, with error margin of 0.05, and the sample size and effect size we actually had.



Hypothesis Testing: Power Analysis

Software

Several software exist for the computation of Power. A standalone, freeware software is currently the G*Power, available from the University of Dusseldorf.


hhu Heinrich Heine Universität Düsseldorf

Allgemeine Psychologie und Arbeitspsychologie

Feedback

To report possible bugs, difficulties in program handling, and suggestions for future versions of G*Power please send us an e-mail.

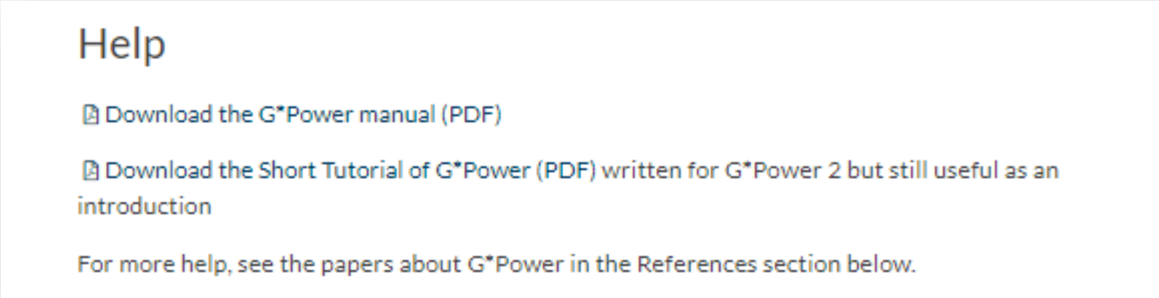
Download

By downloading G*Power you agree to these terms of use:

1. G*Power is free for everyone. Commercial distribution is strictly prohibited.
2. G*Power is distributed from this website. If you wish to distribute G*Power in some other way, then you need to seek permission from the authors. Please send us an e-mail in which you specify how and for what purpose you intend to distribute G*Power.
3. You may use screenshots of G*Power without asking for permission.
4. Considerable effort has been put into program development and evaluation, but there is no warranty whatsoever.

Download G*Power 3.1.9.7 for Windows XP, Vista, 7, 8, and 10 (about 20 MB). Please make sure to choose "unpack with folders" in your unzip tool.

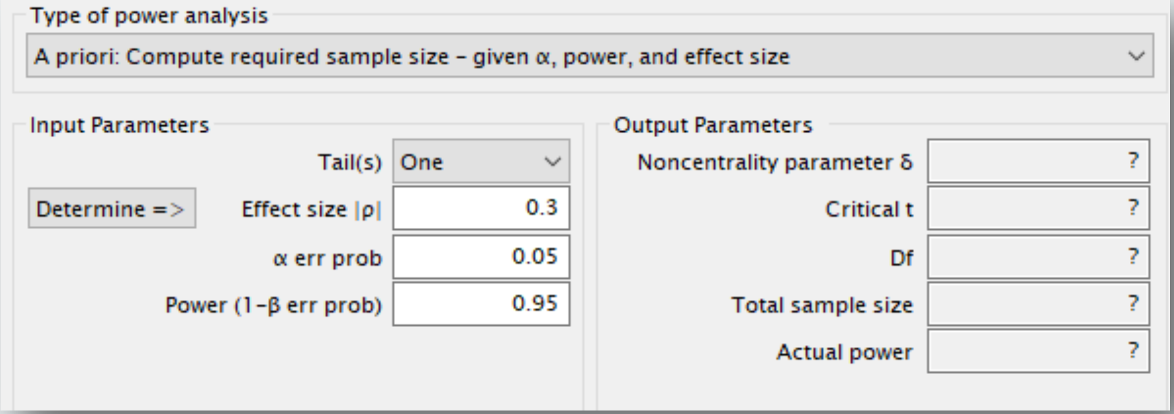
Download G*Power 3.1.9.6 for Mac OS X 10.7 to 10.15 (about 2 MB).


Help

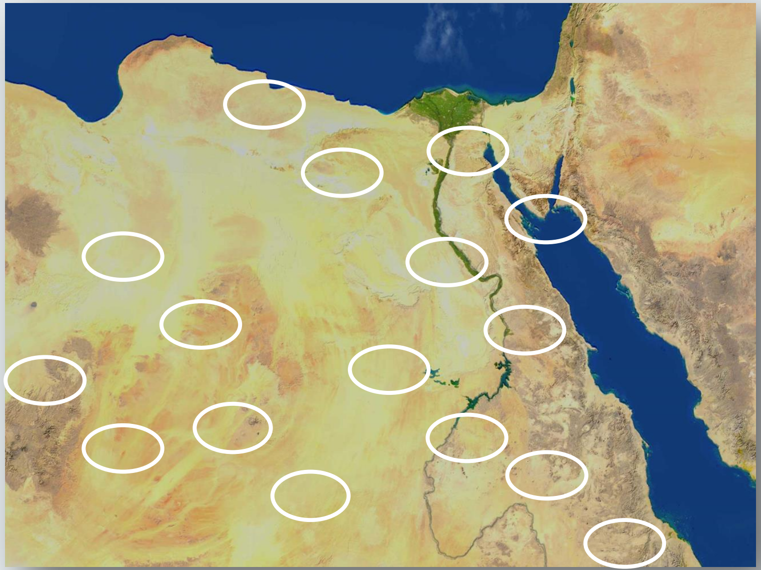
Download the G*Power manual (PDF)

Download the Short Tutorial of G*Power (PDF) written for G*Power 2 but still useful as an introduction

For more help, see the papers about G*Power in the References section below.

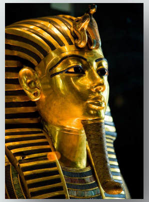


Summarise



H_0: There is no treasure

H_a: There is a treasure



		Sample	
		H_0 rejected	H_0 not rejected
Population	H_0 was true	Type I error **α**	Correct inference **1-α**
	H_0 was false	Correct inference **1-β**	Type II error **β**

Knowledge Check

Please write the null and the alternative hypothesis for the research scenarios below

a) A researcher wants to test if students spend time to watch the independent learning assignment videos.

H_0: The mean hours the students spend watching the videos equal **zero**.

H_a: The mean hours the students spend watching the videos are different than zero.

H_a: The mean hours the students spend is larger than zero (one sided).

b) A researcher wants to test if the proportion of women with PhDs in 2021 has **changed** compared to 2020.

H_0: The proportion of women with PhD in 2020 is equal to the proportion of women with PhD in 2021. The difference between the two proportions is zero.

H_a: The difference between the two proportions is different than zero (two sided).

c) A researcher wants to test if men consume **more** alcohol (units per week) than women.

H_0: The average units of alcohol that men consume is the same as the average units of alcohol than women consume. The difference between the two averages is zero.

H_a: The average units men consume is larger than the average units women consume (one sided).

Knowledge Check Solutions

A research team tested a drug for anxiety against placebo. At the end of the study, they observed that the people who took the drug had the same levels of anxiety as those who used placebo. What should they conclude?

The drug works equally well with the placebo

There is no evidence to suggest that the drug works better than the placebo

Because we cannot accept the null, we simply cannot reject it!

H_0: The drug and the placebo work equally well (zero difference)

H_a: The drug works better than the placebo (there is a difference)

Reflection

Imagine being judges in the court of law ruling about a crime.

What is the null and what is the alternative hypothesis?

Reference List

Kevin R. Murphy, Brett Myors, Allen H. Wolach. Statistical Power Analysis: A Simple and General Model for Traditional and Modern Hypothesis Tests. Routledge, 2009

Thank you

Please contact <u>your module leader</u> or <u>the course lecturer of your programme</u>, or visit the module's <u>forum</u> for any questions you may have.

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KING'S College LONDON

Module Title: Introduction to Statistics

Session Title: Hypothesis testing

Topic title: Confidence and significance (II)

Learning Outcomes

- To understand the idea of hypothesis testing in science
- To understand the role of the sampling distribution

Hypothesis Testing

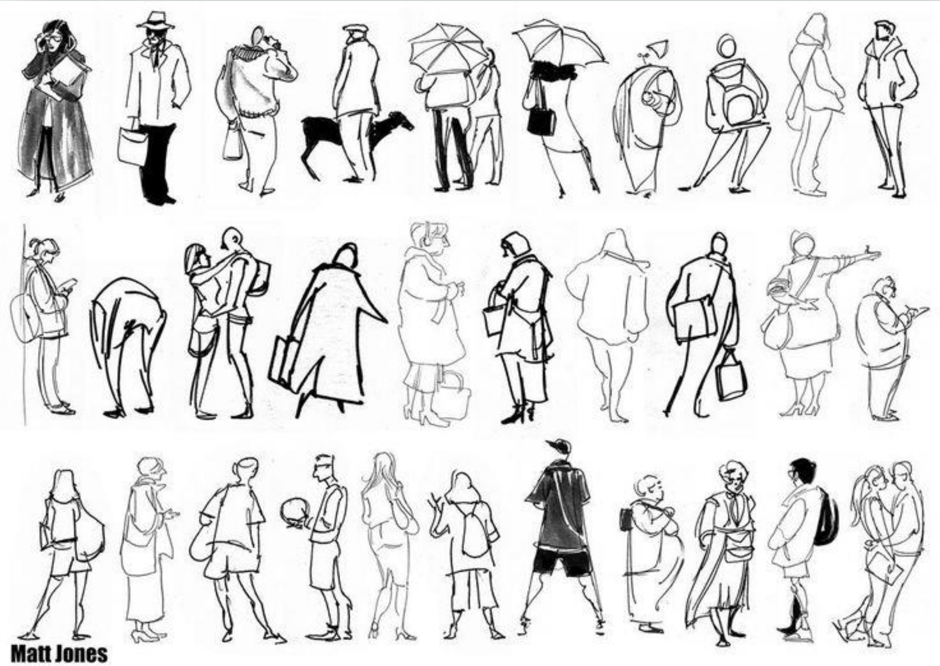
Let us summarise what we have learned so far:

a) To infer about a **parameter** in the population, we compute a **statistic** in a sample

How many hours per week do you exercise?

Population mean μ=?

Sample mean $\bar{x}$=2.72



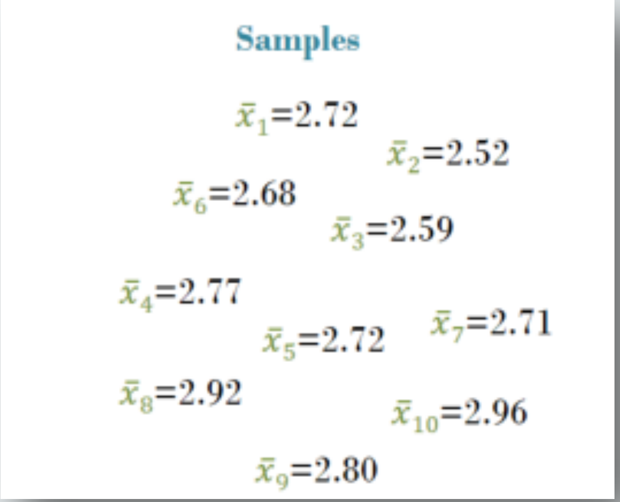
Population

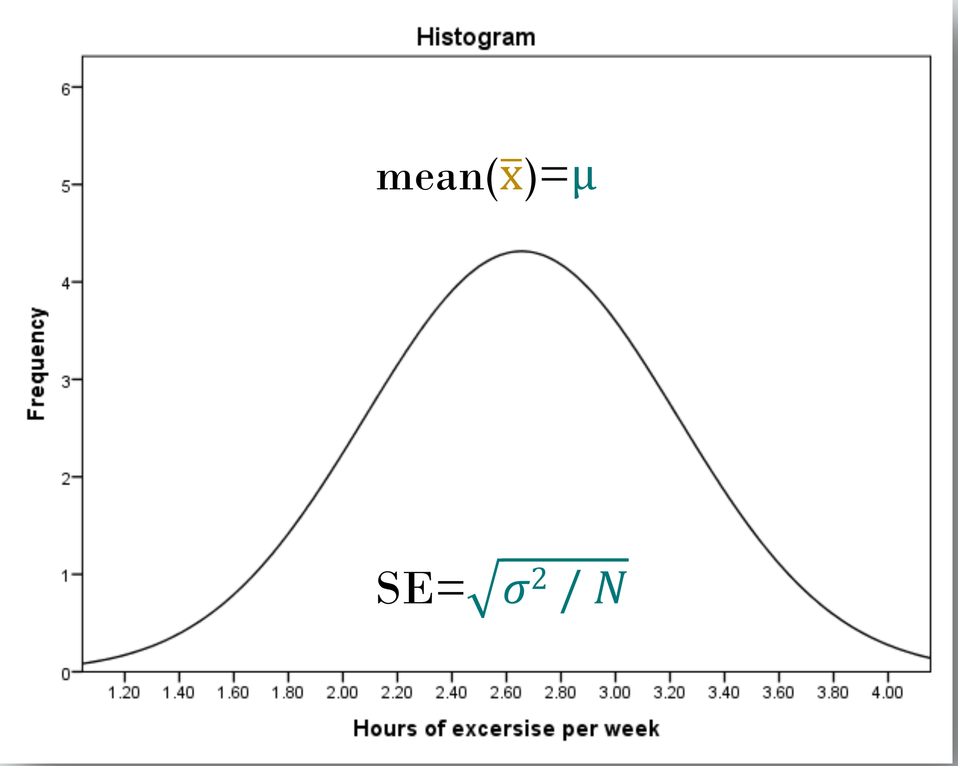
Sample

Hypothesis Testing

b) If we take enough samples from a population, the distribution of the statistic (the **sampling distribution**) will be eventually approximate the normal distribution

How many hours per week do you exercise?





Hypothesis Testing

c) We learned how to state our null and alternative hypotheses

Say, for instance, that for the UK it holds that people exercise on average 2hrs/week. Is this the case for our city?

test value μ_0

How many hours per week do you exercise?

H_0: The mean hours the citizens spend exercising in our city is **equal to the national average: $\mu=\mu_0=2$**.

*H_a: The mean hours the citizens spend exercising in our city is **different than the national average: $\mu \neq \mu_0=2$**.*

Let us know combine all this knowledge to understand hypothesis testing.

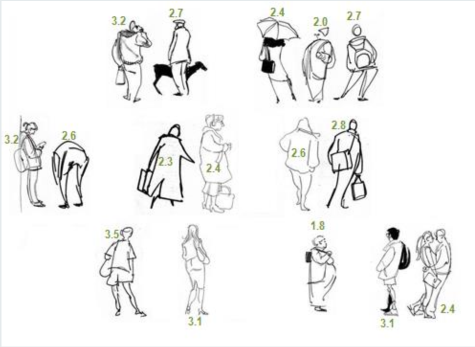
Hypothesis Testing

Step 1: State the hypotheses for the population

City population mean μ=?

H_0: The mean hours the citizens spend exercising is **equal to the national average: $\mu=\mu_0=2$**.
H_a: The mean hours the citizens spend exercising is different than the national average: $\mu \neq \mu_0=2$.

Step 2: Sample from the population and use the correct statistic to estimate the parameter.



Sample mean $\bar{x}=2.66$
Sample stand. dev. $s=0.57$
Sample size $n= 31$

Hypothesis Testing

Step 3: Create the sampling distribution assuming that the null hypothesis is true

To draw a normal distribution, we will need its mean (to see where it is located) and standard deviation (to know how spread it is).

- **mean($\bar{x}$)=μ**

H_0: The mean hours the citizens spend exercising is **equal to the national average: $\mu=\mu_0=2$**.

'Under the null hypothesis' the mean: μ=2

- **SE=$\sqrt{\sigma^2 / n}$**

We can estimate this based on our sample:

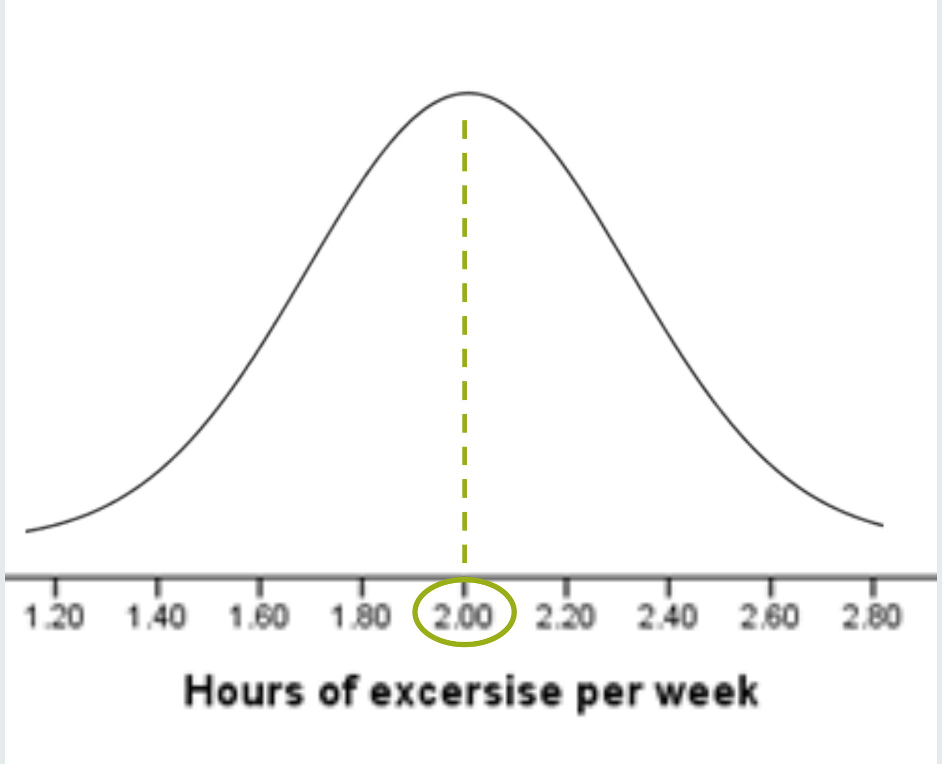
Sample mean	$\bar{x}$=2.66
Sample stand. dev.	s=0.57
Sample size	n= 31

-> $\widehat{SE}=0.57/\sqrt{31} = 0.1$

Hypothesis Testing

Step 3: Create the sampling distribution assuming that the null hypothesis is true

To draw a normal distribution, we will need its mean (to see where it is located) and standard deviation (to know how spread it is).



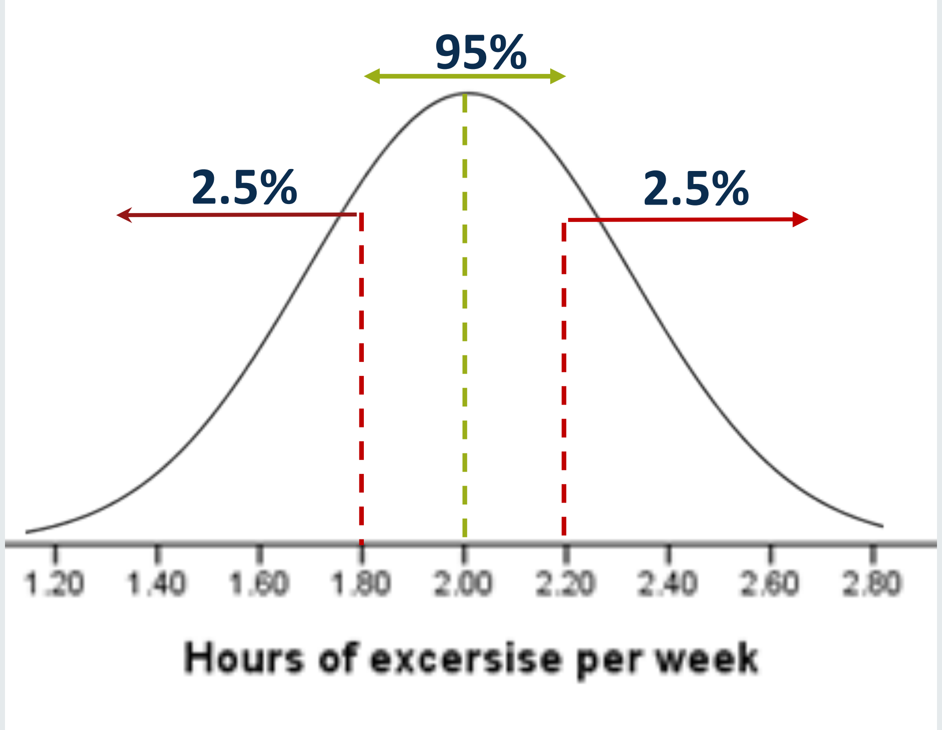
$\mu = \mu_0 = 2$

$\widehat{SE} = 0.1$

Hypothesis Testing

Step 4: Find the rejection area for the null hypothesis.

$\mu = \mu_0 = 2$
$\widehat{SE} = 0.1$



If the null hypothesis is true, then 95% of the values will be between 1.8 and 2.2 (plus-minus 1.96 standard errors from the mean, according to the null).

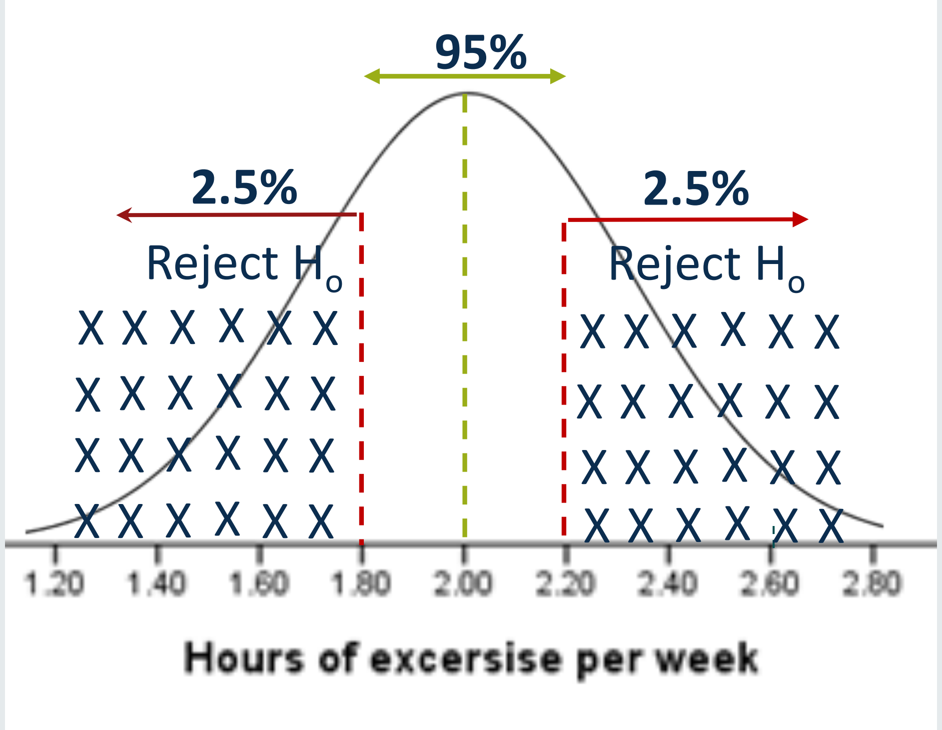
Thus, there is 2.5% chance for values less than 1.8 and 2.5% chance for values higher than 2.2.

Hypothesis Testing

Step 4: Find the rejection area for the null hypothesis.

$\mu = \mu_0 = 2$

$\widehat{SE} = 0.1$

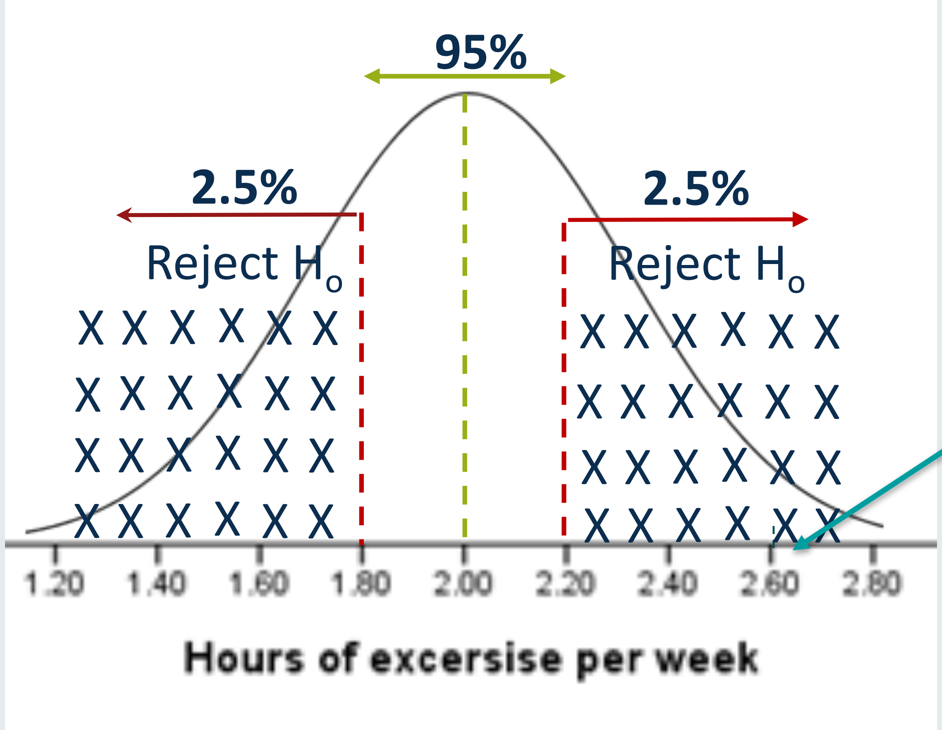


If the value of the statistic (here the sample mean) is not in the 95% interval, then I reject the null hypothesis, as the probability of observing this value if the null hypothesis is true is small.

Hypothesis Testing

Step 4: Find the rejection area for the null hypothesis.

$\mu = \mu_0 = 2$
$\widehat{SE} = 0.1$



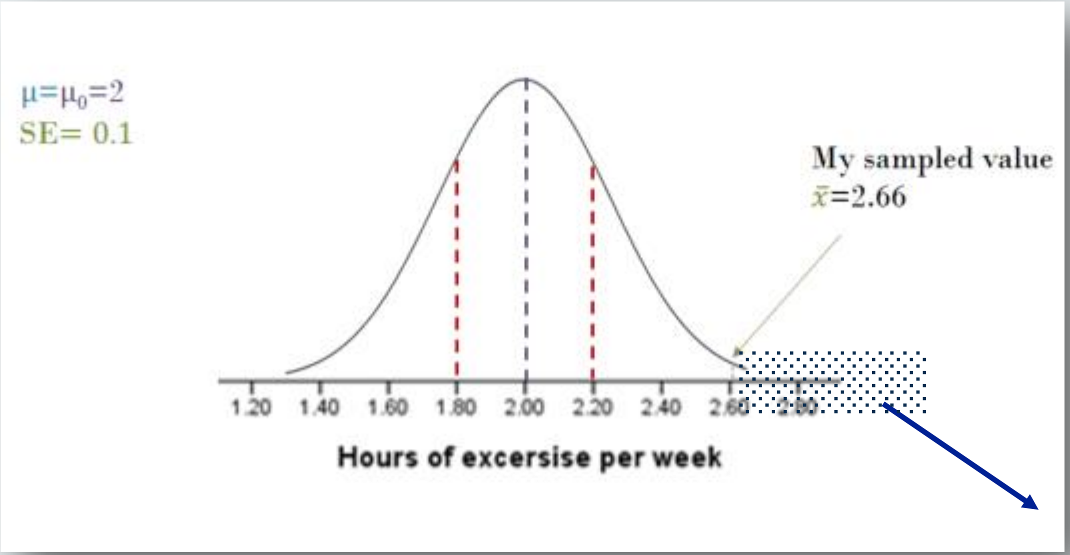
My sampled value $\bar{x}$=2.66

If the null was true, most likely (95% of the times), we wouldn't observe such a value.

If the value of the statistic (here the sample mean) is not in the 95% interval, then I reject the null hypothesis, as the probability of observing this value, if the null hypothesis is true, is small.

Hypothesis Testing

If fact, what we do is to compute **the probability of observing a value equal or more extreme than our sampled value**, under the null hypothesis. This probability is called the **p-value**.



observing a value of 2.66 or larger

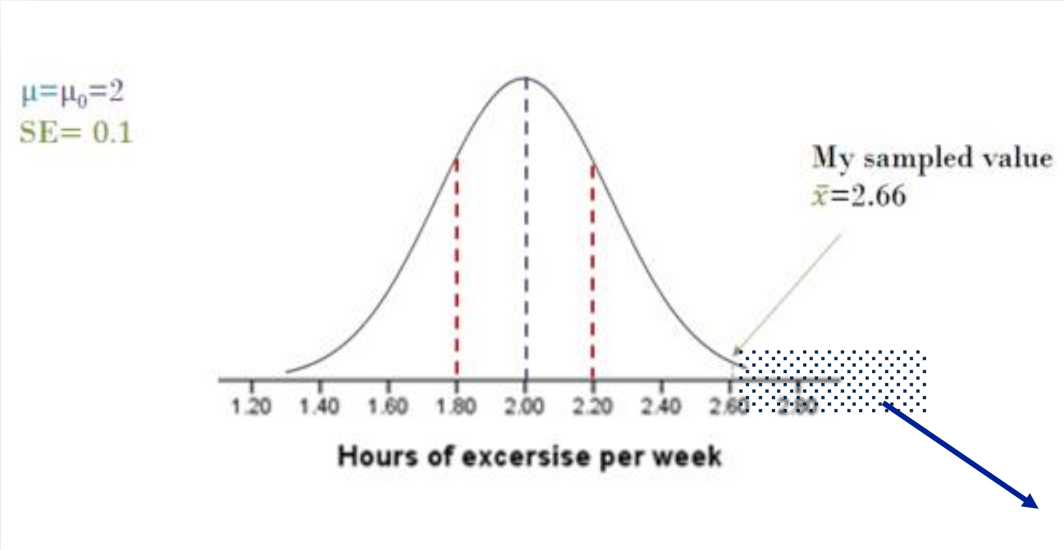
Based on the p-value, we decide if we will reject the null or not.

If the p-value is equal or less than 0.05, we reject the null hypothesis (our value is in the rejection area).

If the p-value is larger than 0.05, we do not reject the null hypothesis (our value is NOT in the rejection area).

Hypothesis Testing

If fact, to make things easier and quicker, what we do is to compute **the probability of observing a value equal or more extreme than our sampled value**, under the null hypothesis. This probability is called the **p-value**.



observing a value of 2.66 or larger

The p-value is the **probability** P-value=P($\bar{x}$≥=2.66| Ho is true)

The p-value estimates the probability of **type 1 error**.

That is why we want the p-value to be small: to be able to reject the null with low risk.

Hypothesis Testing

We will be repeating this procedure for all tests that we will learn in this course!

Step 1: Create the **null** and the **alternative** hypothesis for the population parameter.

Step 2: **Sample** from the population and compute the correct **statistic** to **estimate** the parameter.

Step 3: Create the **sampling distribution** for this statistic, under the null.

Step 4: Find the **rejection area**.

Step 5: Check if your **sampled** value **falls** in the rejection area.

Knowledge Check

The average income in a field for men is £40000 per year. A researcher wants to test if that is the case for women as well. She estimated values in a sample of 100 women being $\bar{x}$=£35.2K and SD=£2K.

a) State the null and the alternative hypothesis.

H_0: $\mu = \mu_0$ =£40000 $\leftrightarrow$ μ-£40000=0

H_α: $\mu \neq \mu_0$ =£40000 $\leftrightarrow$ μ-£40000 $\neq$ 0

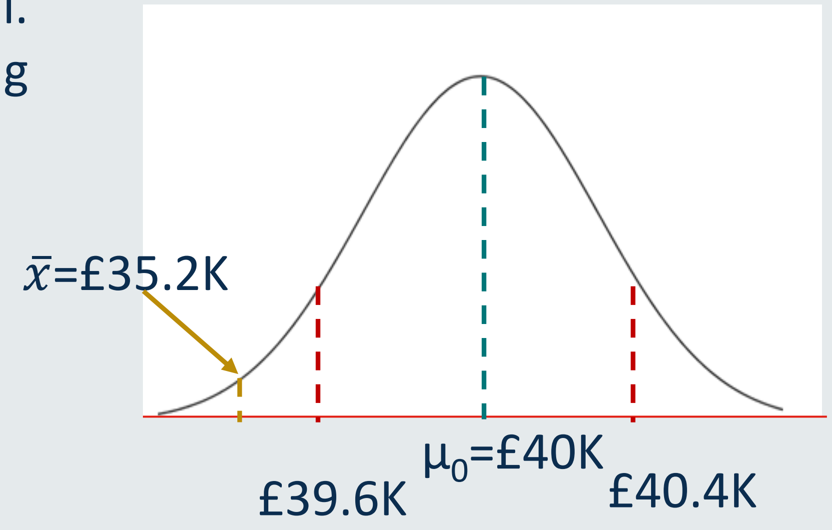
b) Using the sample values, compute the rejection area.

$$\mu_0 = £40000 \quad se = \frac{2000}{10} = £200$$

$$LL: \mu_0 - 1.96 * se = £39.6K$$
$$UL: \mu_0 + 1.96 * se = £40.4K$$

c) Are the average income for men and women statistically different?

The sampled value was in the rejection area, so we reject the null hypothesis in favour of the alternative.



Under the null hypothesis, the 95% CI is [39.6, 40.4]. Our sampled average income is outside this internal, therefore we reject the null hypothesis.

Reflection

Reflecting on your own research projects

What is your main variable of interest in your project?
How would you summarise this variable?
What would be the hypotheses you want to test?
What would you expect for your sample statistics (mean, median, proportion) in order to reject your null hypothesis?

Thank you

Please contact your module leader or the course lecturer of your programme, or visit the module's forum for any questions you may have.

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