

Syllabus - Introduction to Statistics

Course name	Introduction to Statistics
Course code	424530-B-5/410127-B-5
Number of credits (ects)	5 ECTS
Program(s)	PSY/MAW
Position in the program(s)	Year 1, Semester 2
Academic year	2024-2025
Language of instruction	English

READ THIS SYLLABUS THOROUGHLY BEFORE THE START OF THE COURSE

Minor changes are possible; these changes will be published on Canvas.


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Teaching staff

	Name: Joran Jongerling
	Contact: j.jongerling@tilburguniversity.edu
	Role in course: coordinator and teacher
	Profile: https://www.tilburguniversity.edu/staff/j-jongerling?x=0&lan=nl

Insert Picture	Name: Amirali Rezazadeh
	Contact: S.A.Rezazadeh@tilburguniversity.edu
	Role in course: Tutor

Insert Picture	Name: Anca-Leea Lacatus
	Contact: A.Lacatus@tilburguniversity.edu
	Role in course: Tutor

Insert Picture	Name: Tadas Bernotas
	Contact: T.Bernotas@tilburguniversity.edu
	Role in course: Tutor

Insert Picture	Name: Viktoria Perdikogianni
	Contact: V.Perdikogianni@tilburguniversity.edu
	Role in course: Tutor

Insert Picture	Name: Stefana Vida
	Contact: L.S.Vida@tilburguniversity.edu
	Role in course: Tutor

Insert Picture	Name: Daria Persa
	Contact: D.Persa@tilburguniversity.edu
	Role in course: Tutor

Course description

In this course, you will learn why we need statistics to make sense of data (and the world around us) and become a critical consumer of statistics. The *Introduction to Statistics* course is the basis for future quantitative courses and is an essential part of your degree.

Summary

In this course, you will learn why we need statistics to make sense of data (and the world around us) and become a critical consumer of statistics.

Course learning goals

Upon successful completion of the course, the student will be able:

- identify the type (discrete, continuous) and measurement level (nominal, ordinal, interval, ratio) of variables, and apply that knowledge to determine the type measurement level of given variables
- calculate and interpret descriptive statistics
- recognise and understand the differences between core concepts of inferential statistics: sample distribution and sample means, the standard error, the central limit theorem, statistical significance, significance thresholds, p-values, Type I and Type II errors, statistical power, one-/two-sided testing, point estimates, confidence intervals, effect sizes
- recognise the difference between frequency and probability distributions; apply probability rules (marginal, conditional, and joint probability) to the discrete and normal distribution(s); interpret probability; and name the properties of the following distributions: the standard normal, Bernoulli distribution, binomial distribution, z-distribution, t-distribution, F-distribution, Chi-square distribution
- conduct and interpret the results of statistical hypothesis testing on population means, population variances, population correlations, and on nominal and ordinal data
- calculate confidence intervals and recognise how and why various factors (sample size, confidence level, standard error) affect the confidence interval
- calculate statistical power and recognise how and why various factors affect statistical power (Type I and Type II error, one- and two-sided alternative hypotheses, p-value)
- interpret measures of association between variables, determine which measure of association is appropriate for which measurement level (nominal, ordinal, interval, ratio), and calculate these measures of association
- conduct statistical analysis (descriptive statistics and hypothesis testing) with the software package SPSS and interpret the output thereof

Course material

Compulsory reading

Gravetter, F. J., & Wallnau, L. B. (2017). Statistics for the Behavioral Sciences (10th edition). Cengage Learning. (latere edities zijn ook gepast)

Pallant, J. (2016). SPSS survival manual: A step by step guide to data analysis using IBM SPSS (6th edition). McGraw Hill Education. (latere edities zijn ook gepast)

Study Load

Activity	Assessed number of hours
Lectures	28
Seminars	8
SPSS Labs	6
Weekly revision/self-study/preparation	96
Assessment: SPSS exam	2
Assessment: main exam	3
Total	140 hours

Code of conduct

How to contact us

- Use the in-person time we have during the live sessions. You can always ask questions before, during and after these sessions. Asking a question directly is the quickest way to get an answer.
- You can ask statistical questions on de Canvas discussion boards.

Communication in English

- All instructions in class will be in English;
- Students should speak in English with the lecturer and with each other while being in the classroom;
- E-mails to lecturers should be written in English;
- Speak English with each other when working on assignments as much as you can.

Behavior in class

- Be quiet during lectures! Because we are in a very large group, talking in class easily leads to a lot of noise. Avoid speaking and even whispering with you fellow students.
- Follow up the instructions of your lecturer or instructor. The lecturer can ask you to take another seat, answer a question, put your electronic devices away, etc.
- Do not enter the classroom during lectures or tutorials when you are late, not even if you had a train delay or flat tire. It disturbs many others. The lecturer is allowed to refuse you if you do. You can enter during the break.
- Do not leave the classroom during the lectures and tutorials, even when you have an appointment elsewhere. It is disturbs many others. You can leave during the break.

Canvas

Canvas is used for sharing materials with you and for communication about general matters. In addition, you can use the Canvas discussion boards to ask questions about the course.

Course structure

Working forms

The course consists of various types of learning activities:

1. on-demand video lectures
2. live in-depth sessions (on campus)
3. seminars
4. SPSS labs

We strongly recommend that you prepare, attend and follow all of these activities. We will not record the attendance per session, and it is your responsibility to make up for any missed sessions.

Weekly structure

We recommend you structure your week as follows (in that order):

1. Read (and prepare) the required reading materials (mostly book chapters)
2. Watch the on-demand videos for the week
3. Do the homework
4. Post your questions about the videos and/or homework on the discussion boards (and try to answer other students' questions)
5. Attend the live session for in-depth coverage of material, concepts, and discussion of your questions

Note that in some weeks there is an additional interactive/live component with the seminars or practicals.

On-Demand video lectures

The main content will be delivered through on-demand video lectures. These cover the conceptual and mathematical aspects of statistics (not the implementation thereof with software covered in the SPSS labs - see below). All videos are available to you in advance.

The on-demand video lectures are required preparation for the live sessions.

Live sessions

The scheduled lecture slot (see the timetable) is used for a live session that includes:

- time for your questions about that week's content
 - for example, a step-by-step walk-through of exercises/problems
- where applicable: extra content or more in-depth coverage of content from the lecture

We expect that you have prepared the week's content in advance of the live session (i.e. you read all required material + you watched the video content)

The number of Live sessions: 14.

Seminars

The seminars are there for you to consolidate the content covered in the lectures. The seminars will be held in smaller groups by the teaching assistants of this course. You can find details about the group allocation on Canvas.

Important: all seminars are held on campus.

The number of Seminars: 4.

SPSS labs

Part of an introduction to statistics is to gain experience with software that allows you to run statistical analyses. There are various software packages in varying degrees of sophistication, licensing, and usage frequency in academia and the public and business sectors. A frequently used software in statistical research is [R Studio](#) using the R programming language, while data science research is often done with the python programming language.

This course uses the software SPSS - a GUI (graphical user interface), so you do not have to learn a programming language. SPSS is often used in the public/business sector and is part of the overall learning outcomes of this course and your degree.

The labs are there to guide you in the use of SPSS to solve statistical problems.

Coordinator: Annika Hoekstra

The number of SPSS labs: 3.

Course schedule

Live-sessions (homework for each session is listed below)		
Week	Block	Content
5	3	introduction; frequency distributions
6	3	central tendency; variability
7	3	distributions; z-score; probability
8	3	hypothesis testing; confidence intervals
9	3	t-statistic
11	3	independent t-tests
12	3	dependent t-tests
15	4	Mock exam 1
16	4	effect sizes
17	4	statistical power
18	4	Correlation
19	4	Association (Chi-Square Test)
20	4	Binomial Test
21	4	Mock exam 2
Seminars		
8	3	Seminar 1
15	4	Seminar 2
18	4	Seminar 3
21	4	Seminar 4
SPSS Labs		
9	3	Lab 1
11	3	Lab 2
12	3	Lab 3

Live-sessions per week

Homework: Below, you can find suggested homework for each week. For the odd-numbered problems (i.e., 1, 3, 5, etc.) at the end of each chapter, the solutions are provided in Appendix C. We strongly encourage you to do this homework. If you want to test your understanding further, you can, of course, also do the other odd-numbered problems (with solutions in Appendix C). *Note: the homework is not compulsory, but we assume that you have understood the concepts covered per week. The homework will help you achieve this. Questions about the homework can be posted - and will be answered - on the Canvas Discussion Boards and if needed in the live lectures.*

Lecture 1

- Topics covered:
 - Why do we need statistics?
 - Introduction to the course
 - frequency distributions
- Required reading
 - Appendix A: Basic Mathematics Review
 - Chapter 1: Introduction to statistics
 - Chapter 2: Frequency distributions
- Video on-demand preparation
 - Videos 1.1 – 1.5
- Homework:
 - Problems chapter 1: 1, 3, 5, 7, 9, 19, 21, 23
 - Problems chapter 2: 1, 3, 11, 13, 19, 21

Lecture 2

- Topics covered:
 - central tendency of data
 - variability of data
- Required reading
 - Chapter 3: Central tendency
 - Chapter 4: Variability
- Video on-demand preparation
 - Videos 2.1 – 2.2
- Homework:
 - Problems chapter 3: 1, 5, 7, 9, 11, 15, 23, 25
 - Problems chapter 4: 1, 3, 5, 11, 15, 17, 21, 23

Lecture 3

- Topics covered:
 - data as distributions
 - locations in distributions - the z-score
 - probability
- Required reading
 - Chapter 5: z-Scores
 - Chapter 6: Probability
- Video on-demand preparation
 - Videos 3.1 – 3.4
- Homework:
 - Problems chapter 5: 1, 3, 5, 11, 13, 17, 23, 25
 - Problems chapter 6: 1, 3, 7, 9, 11, 15, 17, 19, 25

Lecture 4

- Topics covered:
 - distributions and samples
 - hypothesis testing
 - confidence intervals
- Required reading
 - Chapter 7: Probability and samples
 - Chapter 8: Introduction to hypothesis testing (except: 8.5 and 8.6)
- Video on-demand preparation
 - Videos 4.1 – 4.4
- Homework:
 - Problems chapter 7: 1, 3, 5, 7, 11, 15, 17, 19, 21, 23
 - Problems chapter 8: 1, 3, 5, 7, 9, 11

Lecture 5

- Topics covered:
 - the t-statistic
- Required reading
 - Chapter 9: Introduction to the t-statistic (except 9.3)
- Video on-demand preparation
 - Videos 5.1 – 5.2
- Homework:
 - Problems chapter 9: 1, 3, 5, 9, 11, 13, 15, 21

Lecture 6

- Topics covered:
 - comparing means with the independent t-test
- Required reading
 - Chapter 10: The t-test for two independent samples (except for 10.4)
- Video on-demand preparation
 - Videos 6.1 – 6.2
- Homework:
 - Problems chapter 10: 1, 3, 5, 7, 15, 17, 21

Lecture 7

- Topics covered:
 - repeated-measures tests
 - the dependent t-test
- Required reading
 - Chapter 11: The t-test for two related samples (except for 11.4)
- Video on-demand preparation
 - Videos 7.1 – 7.2

- Homework:
 - Problems chapter 11: 1, 3, 5, 7, 11, 13, 17, 21

Lecture 8

This week is for the first live mock-exam including all content covered in course weeks 1-7

Lecture 9

- Topics covered:
 - effect sizes
 - confidence intervals
- Required reading
 - Chapter 8.5: Measuring effect size
 - Chapter 9.3: Measuring effect size for the t-statistic
 - Chapter 10.4: Effect size and confidence intervals for the independent-measures t
 - Chapter 11.4: Effect size and confidence intervals for the repeated-measures t
 - Paper 1: Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. *Frontiers in psychology*, 4, 863.
 - Paper 2: Lakens, D., Adolphi, F. G., Albers, C. J., Anvari, F., Apps, M. A., Argamon, S. E., ... & Zwaan, R. A. (2018). Justify your alpha. *Nature Human Behaviour*, 2(3), 168-171.
 - Paper 3: Benjamin, D. J., Berger, J. O., Johannesson, M., Nosek, B. A., Wagenmakers, E. J., Berk, R., ... & Johnson, V. E. (2018). Redefine statistical significance. *Nature Human Behaviour*, 2(1), 6-10.
- Video on-demand preparation
 - Videos 9.1 – 9.2
- Homework:
 - Problems chapter 8: 15, 17
 - Problems chapter 9: 19, 23
 - Problems chapter 10: 19, 21, 23
 - Problems Chapter 11: 9

Lecture 10

- Topics covered:
 - statistical power
- Required reading
 - Chapter 8.6: Statistical power
- Video on-demand preparation
 - Videos 10.1 – 10.2

- Homework:
 - Problems chapter 8: 21, 23

Lecture 11

- Topics covered:
 - measures of association I
 - correlation
- Required reading
 - Chapter 15: Correlation
- Video on-demand preparation
 - Videos 11.1 – 11.2
- Homework:
 - Problems chapter 15: 1, 9, 13, 15, 21

Lecture 12

- Topics covered:
 - measures of association II
 - the Chi-square statistic
- Required reading
 - Chapter 17: The Chi-square statistic
- Video on-demand preparation
 - Videos 12.1 – 12.2
- Homework:
 - Problems chapter 17: 1, 3, 9, 11, 13, 19, 23

Lecture 13

- Topics covered:
 - binomial data
 - the binomial test
- Required reading
 - Chapter 18: The Binomial test
- Video on-demand preparation
 - Video 13.1
- Homework:
 - Problems chapter 18: 1, 3, 9, 17, 19, 23, 25

Lecture 14

This week is for the second live mock-exam including all content covered in course weeks 9-13

Seminars per week

In total, there are four seminars. Attendance is not compulsory, but we strongly advise you to use the opportunity to cover this course's material in-depth in these sessions.

Seminar 1

- Covers lectures: 1-4
- Seminar will cover: frequency distributions, central tendency, variability, data as distributions, the z-score, basic probability

Seminar 2

- Covers lectures: 5-8
- Seminar will cover: hypothesis testing basics, confidence intervals, independent t-tests, dependent t-tests

Seminar 3

- Covers lectures: 9-11
- Seminar will cover: effect sizes, statistical power

Seminar 4

- Covers lectures: 12-14
- Seminar will cover: correlation, the χ^2 -test, the binomial test

Assessment

The grading of the course consists of two parts:

- the exam (graded 1-10)
- the SPSS practical (graded as PASS/FAIL)

A student passes the course and receives the corresponding ECTS when i) their exam grade is at least 6.0 and ii) they pass the SPSS practical. Both partial results remain valid after the academic year in which they were obtained.

For the exam, the final grade will be rounded to the nearest half-valued grade with an exception for 5.5. If the final grade is lower than a 5.5, the final grade will be rounded to a 5.0; if the final grade is higher than or equal to a 5.5, the final grade will be rounded to a 6.0.

The exam

The exam consists of 30 multiple-choice questions and takes 3 hours. For each question, you will have to select the correct option to obtain the points for that question. A guessing-level correction is applied.

The general rule for content included in the exam is as follows:

- everything that was covered in the (required reading of the) **book**, the video **lectures**, the **live sessions** and the **seminars** is part of the exam
- if there is a topic that was not covered in either of these, it is not part of the exam
- there are a few exceptions: these are topics that were part of the reading in the book but are *not part of the exam* - these are listed below

Exceptions (=content that was contained in the reading but is not part of the exam):

- the effect size r^2 for the t-test (page 281-284)
- Hartley's F-max test (314-315)
- the "alternative to pooled variance" (Box 10.2 on page 315)
- regression towards the mean (Box 15.3 on page 501)
- partial correlations (page 502-505)
- the "special formula" for the Spearman correlation (page 514)
- testing significance of the Spearman correlation (page 515-516)
- the point-biserial correlation (page 516-517)
- special applications of the Chi-Square tests (page 587-591)
- "more about the binomial test..." (page 612-617)
- the articles from week 9: Lakens, D. (2013), Lakens et al. (2018) and Benjamin et al. (2018)

SPSS test

This test is a computer exam where you will be tested in your ability to run statistical analyses in SPSS.

If you have obtained a "PASS" grade for the SPSS part of this course, you do not need to re-take the SPSS test.

Practice exam

There will be two practice exams to get an idea of the kind of questions you can expect in the exam.