The Goodman
Faculty of Life Sciences
Bar-Ilan University

Last updated:

Biostatistics

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Academic year: 2021-2022 Semester: 2 Hours/credits: 3

Mandatory / elective (mark the relevant)

Prerequisites: none

Year in program & how often given, if relevant

Course Overview – Short abstract:

During the course, the student will receive tools, both in theory and practice, in order to carry out scientific research work in the life science.

In the course, the students will learn the processes of planning and carrying out research from the stage of defining the research problem to analyzing the results and drawing conclusions.

the course will provide students with robust knowledge of basic statistics to carry out common statistical analyses used in life science. The students will be required to solve exercises in statistics and understand outputs produced in the SPSS software.

Learning outcomes – short descriptions

The purpose of the course is to give the students a basic understanding of data processing methods used in life science research today. The intention is to bring the students to a level of understanding, that will allow them the following:

- explain the concept of random variation in biological phenomena and how it is related to scientific observation studies and experimental studies
- describe appropriate statistical methods to quantify random and systematic effects in biological data
- discuss (at elementary level) the relevance of statistical inference for empirical research
- understand the statistical measures and analyses that appear in scientific texts in life science
- describe empirical distributions of data
- extract information from theoretical probability distributions
- describe basic probability rules
- construct and interpret point estimates and confidence intervals
- formulate and conduct test of hypothesis
- explain the type of errors associated with statistical inference
- compare two or more populations
- describe, carry out, calculate and interpret common types of statistical analyses of continuous and categorical data
- choose and apply fitting statistical methods for research hypothesis

Assessment: Coursework and Grade structure

1. Submission of four exercises.

2. Score composition:

    A. Exercises (15%)

    B. Final exam (85%)

Week-by-Week content, assignments and reading

Lesson #	Subject	
1	The scientific research process - characteristics and principles. statistics - description and inference. Types of variables (dichotomous, continuous, nominal, categorical, ordinal, etc.)	
2	dependent and independent variables, population, sample, measurement scales, methods of description and presentation of a variable - series of values, frequency table, graphic presentation.	
3	measures of central tendency - mean, median, and mode	
4	measures of dispersion - range, extreme values, percentiles, Interquartile range (IQR), variance, and standard deviation	
5	Z score theoretical probability distributions (normal, binomial, Chi-square, right-tailed, left-tailed); central limit theorem; type I error, type II error, power, confidence level normal distribution and its application in biology: calculation of probability and percentages	
6	Hypothesis testing (null and alternative hypotheses, one-sided and two-sided tests) Elementary hypothesis testing: Z-tests, t-tests. Elementary considerations concerning power and samples size.	
7		
8	quantification of statistical uncertainty: standard error and confidence intervals (Z and T distributions)	
9	Independent samples T test	
10	Paired samples T test	
11	Chi square Test (Phi and Cramer's V)	
12	measures of linear association (Pearson and Spearman correlation)	

13	Correlation and simple linear regression. Statistical models. Verification of model assumptions.	
14	difference among more than 2 means (ANOVA - Analysis of variance, F-test, ; non-parametric statistics)	

Required text:

Students will not be required to read texts independently. Below are several texts on which the material in the course is based:

Abramovich, A. and Ritov, Y. (2013) Statistical Theory: A Concise Introduction, CRC Press. ISBN 978-1-4398-5184-5

Fleiss, J.L., Levin, B., and Paik, M.C. (2003). Statistical Methods for Rates and Proportions, 3rd ed. Wiley, Hoboken NJ

George Casella and Roger Berger (2002) Statistical Inference (2nd edition), Duxbury. ISBN 978-0-5342-4312-8

Sundaram, K.R.(2010) Medical Statistics-Principles & Methods, BI Publications, New Delhi

Useful external lecture videos (strongly recommended for students with difficulties in calculus or basic probability theory) :

MIT single-variable calculus:
https://www.youtube.com/watch?v=7K1sB05pE0A&index=1&list=PL590CCC2BC5AF3BC1

MIT Open: Probabilistic systems analysis and applications:

https://www.youtube.com/watch?v=j9WZyLZCBzs&list=PLUl4u3cNGP60A3XMwZ5sep719_nh95qOe

Eran Altzik - Confidence interval (Heb.)

https://youtu.be/a7X81QhgckQ