Detailed curriculum for the course:
Introduction to research methods

Academic year: 2025/2026

Program: "Biotechnology for the Life Sciences"

Code: BLS101

ECTS points: 9

Language of the course: English

Teaching hours: 71L+26S+13V

Pre-requisite for the enrollment: No specific courses required

Course leader and contact information:

Assoc.prof. Rozi Andretić Waldowski
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Contact hours: Course leaders are at the disposal for consultations any time during working hours with previous appointment.

Teaching staff:
Assoc. Prof. Rozi Andretić Waldowski (19L+6S+6E)
Assist.Prof. Christian Raynolds (4L+3E)
Assoc.Prof. Nicholas Bradshaw (2L + 2X2E)
Prof. Antonija Jurak Begonja (1L + 2X2E)
Assit. Prof. Stribor Marković (3L)
Dr.sc. Pegi Pavletić (2L)
Prof Marta Žuvić (40L)
Msc. Marta Medija (20S)

Required reading:

1. A. Petrie, C. Sabin: Medical Statistics at a Glance, Blackwell Science 2000.
3. Other reading materials will be supplied during the class

Suggested reading

1. Vanja Pupovac:"Akademsko pisanje", http://akademsko-pisanje.sz-ri.com/
2. B. Petz: Osnovne statističke metode za nematematičare, Naklada Slap, 2002.
3. Matko Marušić i suradnici: Uvod u Znanstveni rad u medicini, Medicinska Naklada, Zagreb, 2013.
4. Kevin W. Plaxco: The Art of Writing Science, PROTEIN SCIENCE 2010 VOL 19:2261—2266
5. Introduction to Journal-style Scientific Writing, http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWgeneral.html
6. Mimi Zeiger: Essentials of Writing Biomedical Research Papers, 2nd edition, McGraw Hill, 2000.
7. Harvey Motulsky: Intuitive Biostatistics, Oxford University Press, 2018

Course description:

The first part of this course will provide students with the fundamental knowledge necessary for their future work in research laboratories, including how to plan a hypothesis-driven research work based on published scientific literature and developing skills in communicating science to both and laypeople. Emphasis will be on acquiring practical skills in acquiring scientific style of writing that they will later use to write Master thesis. During the course, students will learn the basic concepts about writing a research paper, project proposal, and science outreach article and skills for preparing poster and oral presentation. Students will learn the steps preceding the writing, such as using different literature databases to find relevant scientific papers and using the reference management software to organize and list bibliography. In addition, students will be guided in the skill of writing a CV and a motivational letter. An important part of this course will be education about ethical behavior in research and communication of science, with a special emphasis on the ethical use of Artificial Intelligence platforms in research and writing.

The second part of the course will enable students to acquire knowledge and skills in the areas of types of research and their characteristics, types of data and understanding their relationships, database creation, creation of graphical data presentation and data distribution, types and characteristics of samples, statistical hypothesis testing, types of errors in statistical inference and their connection with research power, appropriate selection of statistical tests and statements, analysis and interpretation of results for: determining the difference in proportions, analysis of contingency tables, determining measures of data association, comparing a sample with a given measure in the population, comparing measures of central tendency of two or more samples, association of numerical data (simple linear, nonlinear and multiple regression), association of numerical and categorical data (logistic regression and ROC analysis), and survival analysis.

Learning outcomes:

1. Form an opinion on the use of appropriate scientific methodology

2. Critically judge the quality of scientific publications
3. Support the importance of bioethics in the implementation of the scientific approach
4. Self-evaluate the quality of scientific writing
5. Support the importance of clear, audience-friendly scientific communication
6. Critically assess the research database, categorize the research, distinguish and classify the types of data collected by the research and present their relationships in an appropriate tabular and graphical presentation.
7. Evaluate the research question and transform it into a statistical hypothesis (null hypothesis and alternative hypothesis), critically assess the types of errors in its acceptance or rejection and discover the suitability of the statistical procedure for testing or modeling.
8. Formulate research questions and independently create examples of setting and testing a statistical hypothesis and successfully express, analyze and interpret the results for:
    a. determining the difference in proportions,
    b. analyzing contingency tables,
    c. determining measures of correlation of categorical data,
    d. comparing a sample with a given measure in the population,
    e. comparing measures of central tendency of two or more samples,
    f. correlation of numerical data (simple linear, nonlinear and multiple regression),
    g. correlation of numerical and categorical data (logistic regression and ROC analysis) and
    h. survival analysis.

Detailed course content:

A. Lectures 71hrs:

L1.1	Introduction to scientific writing	4h	C.R
L1.2	Experimental design	2h	R.A.W
L1.3	Foundations of the scientific method	2h	R.A.W
L1.4	Critical reading of scientific papers	2h	R.A.W
L1.5	Bioethics in research and writing	2h	R.A.W
L1.6	Ethical use of AI	2h	P.P
L1.7	Literature search and publishing	3h	N.B
L1.8	Writing a scientific paper	3h	R.A.W
L1.9	Communicating science	4h	R.A.W
L1.10	Editing, revising and planning	2h	R.A.W
L1.11	Writing a motivational letter and CV	1h	A.J.B
L2.1	Statistics part 1.1 Familiarization with statistics part of course		M.Ž
L2.2	1.2 Statistics as a science. Data, fact, information, knowledge. Draft research, analysis and interpretation. Research design, sample size. Statistical methods.		M.Ž
L2.3	1.3 Types of data, database, tabular and graphical representation of		M.Ž

	data, population and sample, characteristics of the sample, random sample, independent and dependent data groups		
L2.4	Statistics part 2.1 Statistical hypothesis and its testing		M.Ž
L2.5	2.2 Parametric and nonparametric statistical tests, output parameters, type I and type II errors		M.Ž
L2.6	Statistics part 3. Categorical data analyses 3.1 Sample and population proportion, contingency tables		M.Ž
L2.7	3.2 Proportion difference test, X2 – test, Fisher's exact test		M.Ž
L2.8	3.3 Measures of association of qualitative data, relative risk and odds ratio, correlation of qualitative variables in dependent samples, McNemar and Cochrane Q test		M.Ž
L2.9	Statistics part 4. Simple numerical data analyses 4.1 Student's t-tests, conditions for applying t-tests, types of t-tests		M.Ž
L2.10	4.2 One sample t-test, Comparison of arithmetic means of two independent groups, Mann Whitney U-test, effect sizes and their interpretation		M.Ž
L2.11	4.3 T-test for dependent data groups, Wilcoxon paired value test, effect sizes and their interpretation		M.Ž
L2.12	Statistics part 5. Analysis of variances (ANOVA) 5.1 Conditions for applying variance analysis, tests of homogeneity of variances, post-hoc tests, Kruskal Wallis ANOVA, effect sizes and their interpretation		M.Ž
L2.13	5.2 Analysis of variance on dependent samples, ANOVA for repeated measurements, Friedman ANOVA, effect sizes and their interpretation		M.Ž
L2.14	Statistics part 6. Correlation and regression 6.1 Connection of numerical variables, correlation and regression, single regression analysis, correlation coefficient and its meaning, significance of correlation coefficient, regression direction, coefficient of determination and its interpretation		M.Ž
L2.15	6.2 Multiple regression analysis, partial and semi-partial correlation, meaning of coefficients, conditions for application		M.Ž
L2.16	Statistics part 7. Nonlinear regressions 7.1 Logistic regression, logistic regression parameters, evaluation of the predicative value of a variable		M.Ž
L2.17	7.2 ROC analysis, parameters and their interpretation, sensitivity and specificity, application of ROC, evaluation of the predicative value of a variable		M.Ž
L2.18	Statistics part 8. Survival analysis 8.1 Kaplan-Meier method of constructing life tables, analysis and interpretation of life tables, median survival		M.Ž
L2.19	8.2 Regression analysis for survival data, Cox regression and Cox		M.Ž

	proportional hazards model		
L2.20	Final lecture. Research design, analysis and interpretation, linking analysis to research design and presenting research results. Instructions for the final exam.		M.Ž

B. Seminars:

S1.1	Critical reading of scientific papers	3h	R.A.W
S1.2	Communicating science	3h	R.A.W
S2.1	Data presentation	3h	M.M
S2.2	Categorical data analysis	3h	M.M
S2.3	Simple analysis of numerical data	3h	M.M
S2.4	Analysis of variances (ANOVA)	3h	M.M
S2.5	Correlation analysis	3h	M.M
S2.6	Nonlinear regression and ROC analysis	3h	M.M
S2.7	Survival analysis	3h	M.M

Exercises:

E1	Introduction to scientific writing	4h	C.R
E2	Writing a motivational letter and CV	2h	A.J.B
E3	Literature search	1h	N.B
E4	Writing a scientific paper	6h	R.A.W

Schedule of classes:

Date	Group	Time	Hours	Room	Content	Teacher
2.10.25	All	13:00-16:30	4L	030	Introduction to scientific writing	Reynolds
3.10.25	All	13:00-16:00	3E	030	Introduction to scientific writing	Reynolds
6.10.25	All	13:00-16:30	2L, 2S	030	Experimental design	Andretić Waldowski
7.10.25	All	13:00-18:00	4L	030	Foundations of the scientific method Critical reading of scientific papers	Andretić Waldowski
8.10.25	All	14:30-16:30	2L	030	Bioethics in research and	Andretić

					publishing	Waldowski
	All	16:30-18:30	2L	030	Ethical use of AI	Pavletić
9.10.25	All	13:00-14:30	2L	030	Literature search and publishing	Bradshaw
	Gr1	14:30-16:00	2E	339		
	Gr2	16:00-17:30	2E	339		
10.10.25	All	13:00-16:30	3L, 1E	030	Writing a science paper MIDTERM	Andretić Waldowski
13.10.25	All	13:00-16:30	3S	030	Critical reading of scientific papers	Andretić Waldowski
			1E		Writing a scientific paper	
14.10.25	All	13:00-16:30	4E	030	Writing a scientific paper	Andretić Waldowski
15.10.25	All	13:00-17:30	2L, 2E	030	Communication science Editing, revising and planning	Andretić Waldowski
17.10.25	All	13:00-16:30	3S	030	Communication science	Andretić Waldowski
20.10.25	All	11:30-12:15	1L	030	Writing a motivational letter and CV	Jurak Begonja
	Gr1	12:30-14:00	2E	339		
	Gr2	14:15-15:45	2E	339		
21.10.25	All	13:00-16:30	3L	030	Methodology in drug research	Marković
22.10.25	All	11:00-13:00		030	PART 1 EXAM	Andretić Waldowski

Date	Group	Time	Hours	Room	Content	Teacher
23.10.25	All	15:00-19:00	5L	030	Introduction to statistics	Žuvić
24.10.25	All	13:00-17:00	5L	030	Statistical hypothesis testing Categorical data analyses	Žuvić
	All	23:55*	3	Online	S2.1	Medija
26.10.25	All	23:55*	3	Online	S2.2	Medija
27.10.25	All	15:00-19:00	5	030	Simple data analysis and t-tests	Žuvić
28.10.25	All	23:55*	3	Online	S2.3	Medija
29.10.25	All	15:00-19:00	5	030	ANOVA	Žuvić
30.10.25	All	15:00-19:00	5	030	Correlation and regression	Žuvić
31.10.25	All	23:55*	3	Online	S2.4	Medija
3.11.25	All	15:00-19:00	5	030	Nonlinear regression	Žuvić
	All	23:55*	3	Online	S2.5	Medija
5.11.25	All	15:00-19:00	5	030	Survival analysis	Žuvić
	All	23:55*	3	Online	S2.6	Medija
6.11.25	All	23:55*	3	Online	S2.7	Medija
7.11.25	Gr1	14:00		339	PART 2 EXAM	
	Gr2	15:30		339	PART 2 EXAM	

Statistics seminars are conducted as online teaching activities on the Merlin system in the appropriate e-course.

*Deadline for submitting seminar reports.

Student requirements, engagement and scoring:

Classes are organized as a combination of lectures, exercises and seminars. Students are expected to attend classes regularly and take an active role in the course. Knowledge will be continuously assessed through: evaluations of seminar work, activity during exercise session and lectures and homework. Some seminars and exercises will be organized in small groups to increase group collaboration and ensure the development of practical skills. Statistics seminars are available online. Students are required to independently prepare 7 seminar reports that are submitted for assessment via e-course by the appropriate deadline specified for seminar topics (S2.1 - S2.7). The description of the tasks and the method of solving them are given within the appropriate thematic unit. The preparation of reports for each task is submitted in the form of a file via the e-course assignment submission activity. Each report is graded with a maximum of 10 points, and a total of 7 graded seminar reports bring a maximum of 70 grade points. The assistant evaluates and grades the seminar reports. Upon completion of the course, provided that 50% of the possible grade points for the seminar reports have been achieved (a total of at least 35 grade points), the student takes the final exam, in which they can earn a maximum of 30 grade points. If the student is not satisfied with the obtained grade, he/she can request an additional oral examination during the examination period, which must be done no later than one day after taking the final exam.

Examination deadlines:

Final exams are on the following dates:
Part 1 – Monday 22nd October 2025, A second test date will be on Monday 10th of November 2025. Additional test deadlines (maximum two, between January and June) will be arranged with students if needed.
Part 2 – Friday 7th November 2025, 2nd exam date in December 2025 as agreed with students. 3rd exam date in June 2026 as agreed with students.

Method of assessment Part 1

Qualification and grades (according to Pravilnik o studijima Sveučilišta u Rijeci):
Students will be graded continuously during the class for their participation, activity and quality of their work assignments during the course (max 70% of the grade) and for the grade on the final exam (max 30% of the grade). Students must attain a minimum of 35% of the grade during the continuous grading to be allowed to take the final exam.
Continuous grading (70%) consists of the following elements:
Homework (max 30 points) – three assignments with topics on writing a scientific abstract, formulating the title of a figure legend and writing the legend and writing the description of the results.
Midterm (max 20 points) – questions covering the material covered in the first week of class in the form of short answers.
Activity during class (max 20 points) – expressing opinions about reading materials ahead of class or providing answers when questioned.
Final exam (30%)
The final exam will consist of problem-solving and essay questions.

Method of assessment Part 2

Grade formation (according to the Regulations on Studies of the University of Rijeka): A maximum of 100.0 grade points can be achieved in a course. During continuous teaching, students can earn a maximum of 70.0 grade points through the assessment of completed reports, and the remaining 30.0 grade points in the final exam. The condition for taking the final exam is to have earned at least 35.0 grade points in seminar reports. In the final exam, the student must have a minimum success rate of 50% in solving the test (at least 15.0 grade points). The final grade is the sum of the grade points achieved during classes and the grade points in the final exam. According to the total number of grade points achieved, grades in the course are awarded as follows in the table.

Final grades:
The following grades will be awarded based on the sum of achieved scores:

Percentage score	ECTS grade	Numerical grade
90% to 100%	A	Excellent (5)
75% to 89.9%	B	Very good (4)
60% to 74.9%	C	Good (3)

50% to 59.9%	D	Satisfactory (2)
0% to 49.9%	F	Unsatisfactory (1)

The final grade is based on the sum of percentage points accumulated during the course and on the final exam. Passing grades are excellent (5), very good (4), good (3) and satisfactory (2).

Additional information:

Academic integrity

During the class and the exam, students are expected to behave according to the highest standards of integrity and ethical behavior some of which will be discussed in this class. In addition, students can refer to the documents: Etički kodeks Sveučilišta u Rijeci and Etički kodeks za studente.

During classes, students are expected to show fairness in interactions, respect for each other's effort, and fair acknowledgment of the contributions of others. In their homework assignments, students should strictly avoid any form of plagiarism, should properly cite sources they have used for their work, and should present data truthfully. Academic dishonesty, such as presenting the work of others as the student's own, use of AI-generated content without proper acknowledgment, and material produced in collaboration with others (unless explicitly permitted), will be punished by no grade for the given assignment and the breach of ethical conduct will be reported to the Ethical Committee of the FABRI.

Questionnaire:

All students are requested to fill the questionnaire about the satisfaction with the content of the course and the lecturer **in order to improve the future quality of the course**. Valuation is anonymous and is done using ISVU system with „Studomat"application. The questionnaire is defined at the level of the University.