



Detailed implementation curriculum for the course:

Introduction to Research Methods

Academic year: 2021/2022

Program: Master program "Biotechnology for the Life Sciences"

Course code: BLS101

ECTS credits: 9

Language in which the course is taught: English / Croatian

Course teaching load: 96L + 6S + 15E

Prerequisites for enrolling in the course: none

Course teacher and contact information:

Overall Assist.prof. Christian Reynolds (6L + 2S + 2E)
Department of Biotechnology / Rectorate of the University of Rijeka
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Part 1 Prof. Marta Žuvić (60L)
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Part 2 Prof. Marta Žuvić (60L)
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091 584553, randretic@biotech.uniri.hr

Teaching staff Assist.prof. Nicholas Bradshaw (2L + 4E)
Assoc.prof.. Antonija Jurak Begonja (1L + 4E)
Assoc.prof. Karlo Wittine (2L)
Iva Sorta-Bilajac Turina (4P)
Beti Zaharija (4E)

Consultation time: by appointment

Note that this course consists of two parts, with a separate syllabus provided for each (see below), both of which must be passed. Student's final grade will be an average of those from each part.



Part 1 – Statistics and Analysis

Required reading:

1. B. Petz: Basic statistical methods for non-mathematicians, Naklada Slap, 2002.
2. A. Petrie, C. Sabin: Medical Statistics at a Glance, Blackwell Science 2000.

Recommended additional literature (optional):

1. Harvey Motulsky: Intuitive Biostatistics, Oxford University Press, 2018.

Course description:

The aim of this part of the course is to enable students to acquire the following knowledge and skill:

- Knowledge of the types of research and their characteristics with regard to sampling and features of new information provided by scientific research.
- Distinguishing the types of data and understanding their relationships, knowledge of creating a database, creating a graphical way of displaying data and data distribution.
- Knowledge of the basic concepts of probability theory: random variable, probability distributions of random variable, central limit theorem and consequences.
- Knowledge of the concepts of populations and sample, type and characteristics of samples.
- Knowledge of the concept of statistical hypothesis, null hypothesis and alternative hypothesis and the type of errors in statistical reasoning (errors of type I and II) and the relationship with the strength of the research.
- Knowledge of correct formulation and testing of statistical hypothesis, selection of statistical test and statement, analysis and interpretation of results for: determination of difference of proportions, analysis of contingency tables, determination of data correlation measures, comparison of sample with given measure in population, comparison of central tendency measures of two or more samples, correlation of numerical data (single linear, nonlinear and multiple regression), correlation of numerical and categorical data (logistic regression and ROC analysis) and survival analysis.

Learning outcomes:



1. Express the types and forms of research and their characteristics with regard to sampling and the type of new information provided by scientific research.
2. Distinguish data types and their relationships, correctly classify given data sets, create a database in an appropriate computer application, select and create an appropriate way of graphical data display and data distribution.
3. Correctly interpret the basic concepts of probability theory, give an example of a random variable and how to quantify it, distinguish and determine the type of random variable, distinguish and explain probability distributions, correctly interpret the central limit theorem, make and analyze the probability distribution for selected random variables.
4. Correctly interpret the terms population and sample and give an example, distinguish the types of samples and express their characteristics.
5. Properly express the statistical hypothesis (null-hypothesis and alternative hypothesis), define and distinguish the types of errors in accepting or rejecting the statistical hypothesis and correctly interpret the relationship with the power of research.
6. Independently develop examples of setting and testing statistical hypotheses, differentiate and correctly select the appropriate statistical test with regard to data types, number and type of groups and successfully express, analyze and interpret results for: determining the difference of proportions, analysis of contingency tables, determining measures of categorical data, comparison of the sample with a given measure in the population, comparison of central tendency measures of two or more samples, correlation of numerical data (single linear, nonlinear and multiple regression), correlation of numerical and categorical data (logistic regression and ROC analysis) and survival analysis.

Detailed course content:

Lectures:

- L1. Introduction to the course, contents and learning outcomes, work methodology and evaluation of student work.
- L2. Statistics as a science. From data and facts to information and knowledge. Statistical methods. Types of research and data collection.
- L3. Database design. Data entry method, formatting and verification of input accuracy.
- L4. Types of data and ways of presenting them. Qualitative and quantitative data. Nominal, ordinal, interval and ratio variables. Tabular and graphical presentation of categorical data.
- L5. Numerical variables and description using central tendency measures and scatter measures.
- L6. Probability and statistics. Random variable. Types of random variables. Binomial distribution.



- L7. Normal distribution. Moments of distribution. Central limit theorem.
- L8. Population and sample. Sample characteristics. Random sample. Independent and dependent data groups.
- L9. Statistical hypothesis and its testing. Parametric and nonparametric statistical tests. Output parameters statistical testing.
- L10. Simple analyzes of qualitative data. Display of qualitative data - frequencies, proportions and percentages shares. Proportion of sample and population. Testing the differences in the proportions of independent samples.
- L11. Contingency tables. χ^2 - test. Conditions for application of χ^2 - test. Fisher's exact test.
- L12. Measures of connection of qualitative data. Relative risk and odds ratio (chances). The connection of qualitative variables in dependent samples. McNemar and Cochran Q test.
- L13. Student's t-test. Conditions for applying the t-test. Types of t-tests. Comparison of the sample with a given measure in the population (sample t-test). Comparison of arithmetic means of two independent groups. Non-parametric version of the t-test for independent groups - Mann Whitney U-test. Effect sizes and their interpretation.
- L14. T-test for dependent data groups. Non-parametric version - Wilcoxon paired values test. Size effects and their interpretation.
- L15. Analysis of variance. Conditions for the application of analysis of variance. Homogeneity tests of variance. Post-hoc tests. Non-parametric version of the test - Kruskal Wallis ANOVA. Effect sizes and their interpretation.
- L16. Analysis of variance on dependent samples - ANOVA for repeated measurements. Odd metric version – Friedman ANOVA. Effect sizes and their interpretation.
- L17. Relationship 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.
- L17. Relationship 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.
- L18. Multiple regression analysis. Partial and semi partial correlation. Meaning of coefficients. Conditions for application.
- L19. Nonlinear regressions. Logistic regression. Logistic regression parameters. Estimation of predictive value variables.
- L20. ROC analysis. ROC analysis parameters and their interpretation. Sensitivity and specificity. Application of ROC analysis. Estimation of the predictive value of a variable.
- L21. Survival analysis. Kaplan-Meier method of constructing life tables. Life table analysis and interpretation. Median survivor.
- L22. Regression analysis for survivor analysis data - Cox regression and Cox proportional hazard model.



L23. Research design, analysis and interpretation. Linking the analysis to the research design.

L24. Research design. Calculate the required sample size. Strategies for analysis.

Obligations, method of monitoring and evaluation of students:

Students are expected to attend classes regularly and have an active attitude towards classes. The obligation of students in the course is to independently create 9 assignments that are submitted for assessment via e-course by the corresponding date (table).

<u>Task</u>	<u>Deadline for submitting the task</u>
Homework 1.	Data display 07.10. 2021 at 23:55
Homework 2.	Binomial and normal distribution 09.10. 2021 at 23:55
Homework 3.	Normality of data distribution 11.10. 2021 at 23:55
Homework 4.	Simple analyzes of categorical data 13.10. 2021 at 23:55
Homework 5.	Simple analyzes of numerical data 15.10. 2021 at 23:55
Homework 6.	Analysis of variances 18.10. 2021 at 23:55
Homework 7.	Correlation analysis 20.10. 2021 at 23:55
Homework 8.	Nonlinear regressions and ROC analysis 22.10. 2021 at 23:55
Homework 9.	Survival analysis 25.10. 2021 at 23:55

Task descriptions and task creation databases are available in the e-course, and data processing is performed using Excel, Statistica, GraphPad Prism and MedCalc software packages. The completed tasks are submitted to form a file named VJ_N_surname.doc (alternatively as a pdf file) via submit activity assignments in e-course. Each task is graded with a maximum of 10 points, and brings a total of 9 graded tasks maximum 70 grade points. Upon completion of classes, provided that 50% of possible grade points are achieved (a total of at least 35 grades), the student takes the final exam in the form of a test, on which can gain a maximum of 30 grade points. If the student is not satisfied with the grade achieved, he can request additional oral examination at the examination period, which must be performed no later than one day after taking the final test.

Exam dates:

1st exam deadline will be held on 29.10. 2021 from 2:30 p.m. in computer classroom O-365.

2nd exam period will be held on 12.11. 2021 at 9:00 a.m. in computer classroom O-339.

The 3rd exam deadline will be held in June 2022 as agreed with the students.

The 4th exam deadline will be held in September 2022 as agreed with the students.

Qualification and grades (according to Pravilnik o studijima Sveučilišta u Rijeci):

It is possible to achieve a maximum of 100 grade points in the course. During continuing



education, students can acquire a maximum of 70 grade points through the assessment of completed assignments, and at the final exam the remaining 30 grade points.

Students who achieved during the continuous part of the course:

- from 0 to 34.9 grade points cannot take the final exam
- more than 35 grade points can take the final exam.

At the final exam, the student must have a minimum grade of 50% of the test (at least 15 points).

According to the achieved total number of grade points in the course, the following final grades are awarded:

Final grades:

The following grades will be awarded based on the final score:

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).

Schedule of classes:

Date:	Group	Time	Hours of teaching	Classroom	Type of teaching	Lecturer:
04.10.2021 .	all	17-20 h	4	O-030	L1, L2	Prof. dr. sc. Marta Žuvić
06.10.2021 .	all	17-20 h	4	O-030	L3, L4, L5	Prof. dr. sc. Marta Žuvić
08.10.2021 .	all	17-20 h	4	O-030	L6, L7	Prof. dr. sc. Marta Žuvić
11.10.2021 .	all	17-20 h	4	O-030	L8, L9	Prof. dr. sc. Marta Žuvić



13.10.2021 .	all	17-20 h	4	O-030	L10, L11, L12	Prof. dr. sc. Marta Žuvić
15.10.2021 .	all	17-20 h	4	O-030	L13, L14	Prof. dr. sc. Marta Žuvić
18.10.2021 .	all	17-20 h	4	O-030	L15, L16	Prof. dr. sc. Marta Žuvić
20.10.2021 .	all	17-20 h	4	O-030	L17, L18	Prof. dr. sc. Marta Žuvić
22.10.2021 .	all	17-20 h	4	O-030	L19, L20	Prof. dr. sc. Marta Žuvić
25.10.2021 .	all	17-20 h	4	O-030	L21, L22	Prof. dr. sc. Marta Žuvić
27.10.2021 1.	all	17-20 h	4	O-030	L23, L24	Prof. dr. sc. Marta Žuvić

*Online classes will be held according to epidemiological need

Additional information:

All students are asked to respond to the evaluation of the quality of teaching in order to be able to improve the teaching of this course on the basis of assessments and suggestions. The evaluation of teaching through the ISVU system is carried out with the application "Studomat" on the form defined at the level of the University of Rijeka, and the results are anonymous. More information on every aspects of this process can be found in the Priručnik za kvalitetu studiranja Sveučilišta u Rijeci.

Academic integrity

Students are required to respect the principles of academic integrity and are referred to University documents: Etički kodeks Sveučilišta u Rijeci and Etički kodeks za studente.



Part 2 – Scientific method and communication

Detailed curriculum for the course: **Introduction to the scientific method**

Academic year:	2021/2022
Program:	Master program "Drug Research and Design", "Biotechnology in Medicine" "Medical Chemistry" and The Biotechnology for the Life Sciences“
Code:	IRL202
ECTS points:	7
Language of the course:	English
Teaching hours:	36 L + 6 S + 15 E
Pre-requisite for the enrollment:	No specific courses required
Course leader and contact information:	Assoc.prof. Rozi Andretić Waldowski (20L + 4S + 5E) Address: Department of Biotechnology, University of Rijeka, Radmile Matejčić 2 tel: 584 553 e-mail: randretic@uniri.hr
Contact hours:	Course leader is at the disposal for consultations any time during working hours with previous appointment.

Teaching staff:

Required reading:

1. Kevin W. Plaxco: The Art of Writing Science, PROTEIN SCIENCE 2010 VOL 19:2261—2266
2. Introduction to Journal-style Scientific Writing,
<http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWgeneral.html>



Suggested reading

1. Vanja Pupovac: "Akademsko pisanje", <http://akademsko-pisanje.sz-ri.com/>
2. Matko Marušić i suradnici: Uvod u Znanstveni rad u medicini, Medicinska Naklada, Zagreb, 2013.
3. Mimi Zeiger: Essentials of Writing Biomedical Research Papers, 2nd edition, McGraw Hill, 2000.

Course description:

This course will give students the basic knowledge required for their future research work in research laboratories, which includes: preparing a hypothesis driven research plan based on scientific evidence in accordance with bioethical standards, and skills in presenting results of their work, writing a CV and project proposal.

In the bioethics part of the course students will learn: to distinguish scientific from non-scientific approaches, explain the characteristics of the scientific method and how it evolved from philosophy of science, understand the importance of ethical approaches in performing scientific research and objectively discuss ethical principles in modern bioscience.

In the science writing part of the course, students will learn to: independently search different literature databases, become proficient in the use of a reference management software, formulate a pertinent scientific question based on researched literature, formulate a hypothesis, understand the difference between different types of research methods, acquire skills in scientific writing, be able to write a Master thesis, research paper and be able to present their work in oral or poster form to either expert or lay audience.

Learning outcomes:

1. Gain general knowledge about the scientific method process and hypothesis-driven research
2. Gain general knowledge about types of scientific investigation and its structure
3. Gain general knowledge about the characteristics and types of scientific literature
4. Gain practical skills related to using different search databases for literature searches and references management
5. Gain general knowledge about the elements and practical skills involved in formatting a Master Thesis
6. Gain general experience in scientific writing
7. Gain specific experience in poster and oral communication
8. Gain general knowledge of bioethics as it applies to research work and publication.
9. Gain specific experience about writing a project proposal
10. Gain general knowledge about communicating science to experts and lay audiences

Detailed course content:



A. Lectures:

TITLE	HOURS AND LECTURER
L1 Philosophy of science	(1 H) RAW
L2 History of science	(1 H) RAW
L3 What is science	(1 H) RAW
L4 Science vs pseudoscience	(1 H) RAW
L5 Scientific publishing process	(2 H) NB
L6 Types of research methodology	(3 H) RAW
L7 Science methodology and hypothesis testing	(1 H) RAW
L8 Critical reading – Journal club	(2 H) RAW
L9 Writing motivational letter and a CV	(1 H) AJB
L10 Preparing a poster and oral presentation	(2 H) RAW
L 11 Time management	(1 sat) RAW
L12 Bioethics in research	(2 H) TBA
L13 Bioethics in publishing and communicating science	(2 H) TBA
L14 Science outreach	(2 H) RAW
L15. Preparing figures and legends	(2 H) RAW
L16 Introduction to scientific writing	(2H) CR
L17 Writing a research paper I	(2H) CR
L18 Writing a research paper II	(2H) CR
L19 Writing a project proposal	(2 H) RAW
L20 Writing research papers in chemistry	(2 H) KW
L21 Editing a paper	(1 H) RAW

B. Seminars:

TITLE	HOURS AND LECTURER
S1. Critical thinking vs pseudoscience	(1 H) RAW
S2. Writing a research paper	(2 H) CR
S3. Poster presentations	(3 H) RAW

C. Exercises:

TITLE	HOURS AND LECTURER
E 1 Literature search	(2x2) NB
E 2 Mendeley reference manager	(2x2) BZ
E3. Journal Club – critical reading	(1 X 1) RAW



E4. Writing motivational letter and a CV	(2 X 2) AJB
E5. Figures and legends	(2 X 1) RAW
E6. Writing a research paper	(2 X 1) CR
E7. Results: description vs interpretation	(2 X 1) RAW
E8. Title abstract and aim	(2 X 1) RAW
E9. Editing	(1 X 1) RAW

Schedule of classes:

Date:	Type of teaching:	Title:	# of hours/ groups	Lecturer:	Time and place:
02.11. TUE	L1 L2 L3 L4	Organizacija kolegija Phylosophy of science History of science What is science Science vs pseudoscience	1 / 1 1 / 1 1 / 1 1 / 1	RAW	030 16:00 – 19:30
03.11. WED	L5 E1	Scientific publishing process Literature search	2 / 1 2 / A 2/ B	NB NB NB	030 13:00-14:45 339 15:00-16:30 339 16:30-18:00
04.11. THU	E2	Mendeley reference manager	2 / A 2/ B	BZ BZ	339 16:00-17:30 339 17:30-19:00
05.11 FRI	L6	Types of research methodology	3 / 1	RAW	030 17:00-19:45
08.11. MON	L7 L8 E3	Science methodology and hypothesis testing Critical reading – Journal club Journal Club – critical reading	1/ 1 2/ 1 1/1	RAW	030 11:00 – 15:00
09.11. TUE	L9 E4	Writing motivational letter and a CV Writing motivational letter and a CV	1/ 1 2 / A 2/B	AJB AJB AJB	030 11:00-12:00 339 12:00-13:30 339 13:30-15:00



10.11. WED	L10	Preparing a poster and oral presentation	2/1	RAW	030 13:15-17:30
	L19	Writing a project proposal	2/1	RAW	
	S1	Critical thinking vs pseudoscience	1/1	RAW	
12.11. FRI		MIDTERM		RAW	030 14:15 – 16:00
	L11	Time management	1/1		
15.11. MON	L16	Introduction to scientific writing	2 / 1	CR	030 08:30-12:30
	L17	Writing a research paper I	2 / 1	CR	
16.11. TUE	L18	Writing a research paper II	2 / 1	CR	ON LINE
	E6	Writing a research paper	2/1	CR	
17.11. WED	S3	Poster presentations	3 / 1	RAW	030 11:00-14:00
18.11. THU		NATIONAL HOLIDAY			
23.11 TUE	S2	Writing a research paper	2 / 1	CR	030 16:15-20:00
	L15	Preparing tables and legends	2 / 1	RAW	
24.11. WED	L14	Science outreach	2 / 1	RAW	ON LINE
	E5	Figures and legends	2 / 1	RAW	
25.11. THU	L12	Bioethics in research	2/1	CR	ON LINE
	L13	Bioethics in publishing and communicating science	2/1	RAW	
26.11. FRI	E7	Results: description vs interpretation	2/1	RAW	030 10:00-12:00
	L20	Writing research papers in chemistry	2/1	KW	
29.11. MON	L21	Editing a paper	1/1	RAW	030 13:00-15:45
	E9	Editing	1/1		
	E8	Title abstract and aim	1/1		
01.12. WED		FINAL EXAM		RAW	030 10:00-12:00

Required student's engagement and scoring :



Classes are organized as a combination of lectures, exercises and seminars according to the above schedule. Due to the epidemiological situation, the schedule of classes is subject to changes with possibility of switching to on-line platforms such as MS Teams or zoom.

Knowledge will be continuously assessed through one midterm exam, evaluations of seminar work and activity during exercise session. Some parts of seminars and exercises will be organized in small groups to increase group collaboration and ensure the development of practical skills.

Examination deadlines:

The final exam will be Wednesday 1st of December 2021.

If necessary, a second test date will be Thursday 10th of February 2021.

Additional test deadlines (maximum two, between March and June) will be by arrangement with the students if needed.

Qualification and grades (according to Pravilnik o studijima Sveučilišta u Rijeci):

- Assessment during the course (70%)

Students will obtain score during the course, in the following areas:

Seminar work (25%) – Students will be assessed based on their contributions to the debates (S1 – 7 %). For S3 students will be assessed for the content of their presentations (7 %), presentation delivery (6 %) and their involvement in both asking and answering questions during the discussion phase (5%).

Practical work (25%) – Students will be assessed based on both their results and understanding shown during the practical tasks and for quality of their homeworks. There will be 2 homeworks: Preparing a research plan (10%) and Preparing figure and legends (10%).

Some assignments will be done in a small group and the lecturer can assess individual contribution and understanding of each member of the group.

- Midterm exam will consist of multiple choice questions and short answer questions (20%).
- Final exam (30%)

The final exam will consist of short answer questions and multiple choice questions.

Eligibility to sit the final exam will be based on scores achieved during the course (out of a maximum of 70%):

- from 0 to 34.9 grade points can not take the final exam
- more than 35 grade points can take the final exam.

Final grades:

The following grades will be awarded based on the final score:

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



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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

Students are required to respect the principles of academic integrity and refer to the documents: Etički kodeks Sveučilišta u Rijeci and Etički kodeks za studente.

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.