COURSE OUTLINE FOR BIOL 3022, RESEARCH PRINCIPLES AND STUDY DESIGN IN BIOLOGY

Instructor	**Dr. Brian MacPherson**
Email	doxlog1@uwindsor.ca
Virtual office hours/tutorials	Virtual – T, Th 1:00 – 2:00 pm
Collaborate Ultra interactive lectures which will also be recorded	T, Th 11:30 – 12:30 pm
Website	uwindsor.ca/blackboard

COURSE DESCRIPTION FROM COURSE CALENDAR

Introduction to the logic and principles used to develop sound and efficient studies in the biological sciences: generating, testing, and discriminating among hypotheses; dealing with unwanted sources of variation; assumptions and appropriate choice of statistical analysis. Prerequisites: BIOL 2101, BIOL 2111, BIOL 2131 and STAT 2910 or consent of instructor).

COURSE REQUIREMENTS, DUE DATES – REVISED IN LIGHT OF ONLINE TRANSITION

Activity	Value	Date
Project paper	20%	Due Dec. 2, 2021 – **experiential learning component ties together all skills learned**
Midterm # 1 – take-home	20%	Posted Oct. 22, 2021 at 6:00 pm and due on Oct. 24, 2020 at 11:59 pm
Midterm # 2 – take-home	20%	Posted Nov. 19, 2021at 6:00 pm and due on Nov. 22, 2021 at 11:59 pm
Final exam – take-home	25%	Posted 6:00 pm, Dec, 11, 2021 Due Dec. 13, 2020, 11:59 pm
Assignments	10%	Biweekly
Self-reflection exercise	5%	Due at the end of term – **experiential learning component of self-assessment**

TEXTBOOK

Experimental Design and Data Analysis for Biologists, Kinn and Keough, Cambridge Press (paperback, 2002) – pdf posted on website

HOW THE COURSE WILL BE CONDUCTED

How the course/tutorials will be conducted: Lectures and tutorials/office hours in this course will be entirely online in Virtual Classroom on the BB course site. Lectures will be held every T, Th from 11:30 a.m. – 12:30 p.m. and tutorials/office hours will be held every T, Th from 1:00 p.m. – 2:00 p.m.

Course policies: Self-reporting of medical and compassionate absences: Doctor's notes are NOT required for medical absences. You are asked to use **UWinsite Student** to report an illness that will prevent you from completing an assignment on time or taking an exam. For how-to information, please read this **ask.UWindsor article**. Please do NOT come to campus if you are unwell.

ASSIGNMENTS, TEST, FINAL EXAM

1. Project paper – 10 - 12 pages, double-spaced, 12-point font, Times New Roman. You will write a hypothetical research study, propose likely data, and then analyze that data using the various univariate statistical techniques learned in the course. Or, if you are writing an undergrad thesis, you can write a short literature review, methods, results plus your statistical analysis of the results. You can do the statistical analysis by hand if you prefer, or you can use stats programs such as R. If you use a stats program, R is preferred.

2. Midterm tests – These tests will cover material from the course and they will be written in-class. Format involves short and longer answers. Some calculation may be involved.

3. Assignments – The purpose of the assignments is to keep you current with the material in the course. They will also help to prepare you for the in-class tests. They are biweekly.

4. Final exam – This will be written during the final exam period or as take-home, and it will involve tying together the various themes of the course. This is worth 25% of your final grade.

5. Self-refection exercise – This is due at the end of the course. It is a short 2-page statement of the challenges you encountered in the course and how you overcame them, and how this contributed to your learning. It is Pass/Fail and it is worth 5% of your final grade

EXPERIENTIAL LEARNING OUTCOMES

1. Students will learn how to design their own research study which involves tying together all the skills learned in the course including experimental design and statistical techniques along with being able to use R

2. Students will acquire the ability to self-reflect and self-assess their progress in the course as biologists and as researchers.

STUDENT ACCESSIBILITY SERVICES

Students with various documented disabilities attend University with success. Student Accessibility Services provides a variety of services and supports to students with documented disabilities (including: learning disabilities, attention deficit/hyperactivity disorder, acquired brain injuries, vision, hearing and mobility impairments, chronic medical conditions and psychiatric issues), who have registered with SDS. If you have, or think you may have a disability, you may wish to visit Student Disability Services to learn how best to meet your academic goals. The SAS office is located in Room 117, Dillon Hall, (519) 253-3000 ext. 3288 or online at http://www.uwindsor.ca/studentaccessibility/

UNIVERSITY OF WINDSOR OFFICIAL GRADING POLICY

The University of Windsor uses a percentage marking and grading scale. Course instructors are to assign and record integer-valued grades, and these grades are to be considered the exact assigned grades earned by the students. For more details on the grading policies, see this link.

http://www.uwindsor.ca/secretariat/sites/uwindsor.ca.secretariat/files/grading_and_averages_amended_april_13_2018.pdf

PLAGIARISM AND EXAMINATION MAKE UP POLICIES

Plagiarism is a serious academic offense because it dishonestly and fraudulently uses someone else's work as one's own. Students are to be evaluated on the basis of their own original work. In the preparation of essays, papers, reports, and any other types of assignments, students must necessarily rely on the work of others. However, it is imperative that the source of any ideas, wording, or data obtained from others be disclosed and properly acknowledged by citations, quotation marks, and bibliographic references in the proper format.

The University of Windsor student code of conduct can be found here:

https://www.uwindsor.ca/secretariat/sites/uwindsor.ca.secretariat/files/student_code_of_conduct_october_18_2016.pdf

COURSE SCHEDULE

Week # 1 (Sept. 9)

Overview of the course.

Week # 2: (Sept. 14, 16)

Popper, Kuhn and Lakatos on scientific method. A discussion of different kinds of variables and the concept of hypothesis testing. Experiments vs. observational studies. Dependent and independent variables. Reading: Chapter 1.

Week # 3: (Sept. 21, 23)

Elementary probability theory. Bayes' theorem and conditional probabilities. Probability distributions for continuous and discrete variables. Statistical distributions. Samples vs. populations. Normal distributions and the central limit theorem. Measures of variability – variance, standard distribution, standard error. Confidence intervals. Bayesian inference – prior knowledge, posterior knowledge and probability. Reading: Chapters 1 and 2.

Week # 4 (Sept. 28, Sept. 30)

Hypothesis testing. Type 1 and type 2 errors. Choosing a level of significance – biological vs. statistical significance. P-values. A refresher on t-tests – null and alternative hypotheses. Parametric vs. non-parametric tests. Non-parametric versions of t-tests. Reading: Chapter 3.

Week # 5 (Oct. 5, 7)

Graphs for plotting data. Box plots, scatter plots. Transforming data – log-normal transformations. Assumptions of parametric tests. Experimental design 1 – sample size, replication, randomization, effect size, power analysis. Reading: Chapters 4 and 7.

Week # 6 (Oct. 12, 14)

Reading week – no lectures

Week # 7 (Oct. 19, 21)

Chi-square analysis goodness of fit and its applications to genetics. Chi-square test of independence. Reading: Chapter 6. Review for midterm. ***Midterm # 1 posted Oct. 22 – covers weeks # 1 – week # 5.***

Week # 8 (Oct. 26, 28)

Correlation analyses and regression analyses. Correlation and regression compared. Simple linear regression. Multiple linear regression. Reading: Chapters 5 and 6.

Week # 9 (Nov. 2, 4)

Single factor analysis of variance – ANOVA. Non-parametric alternatives to ANOVA – Kruskal-Wallis rank test. Reading: Chapter 8.

Week # 10 (Nov. 9, 11)

Using R to do univariate analyses – t-tests, ANOVA, correlation, chi-square and linear regression. Lecture notes.

Week # 11 (Nov. 16, 18)

Multifactorial ANOVA. Analysis of covariance – ANCOVA. Using R to do multifactorial ANOVA. Reading: Chapters 9 and 12. ***Midterm # 2 posted Nov. 19 – covers weeks 7 – 10.***

Week # 12 (Nov. 23, 25)

Meta-analyses as a measure of effect size. A worked-through example of a meta-analysis.

Week # 13 (Nov 30, Dec 2)

Time series analysis in Excel and R. A brief non-technical introduction to multivariate stats. *Project paper due Dec. 3*

Week # 14 (Dec. 8)

Review for final exam