UNIVERSITY OF CALGARY
FACULTY OF SCIENCE

Department of Biological Sciences
BI 186
403 220-3140
biosci@ucalgary.ca

COURSE OUTLINE

1. **Course:** BIOL 315, Quantitative Biology I - Fall 2020

   Lecture 01: MWF 14:00 - 14:50 - Online

Instructor	Email	Phone	Office	Hours
Colby Regel	ceregel@ucalgary.ca			By appointment

Online Delivery Details:

Some aspects of this course are being offered in real-time via scheduled meeting times. For those aspects you are required to be online at the same time.

Lectures will be pre-recorded and available on the D2L course site for students to view at their own convenience. There will be live lecture review sessions during the scheduled lecture time for students who want to interact in real-time to review the lecture notes and ask questions. These sessions will be recorded and posted for later review. These sessions will occur from 14:00 – 15:00 on September 30, October 14, October 28, and November 18, 2020 via Zoom (meeting details provided on D2L).

Labs will occur live via Zoom during regularly scheduled section times (excluding the weeks of October 19 and November 9, 2020). Students must attend their designated lab section to ensure continuity and team accountability. Expected absences and section change requests should be brought to the Instructor for approval at least 2 days in advance to allow for accommodations. Laboratories will typically not be recorded by a TA unless a student's absence has been approved.

Quizzes and Discussion Topics will be available between 08:00 – 18:00 on scheduled days (see Course Schedule). Quizzes will be closed-booked, timed (40 min. + 20 min. buffer), and written individually. Time will be adjusted for SAS students if needed and accommodations for students will be done on a case-by-case basis. A student's lowest quiz grade will be dropped and excluded from their final grade calculation. Discussion Topics will be collaborative and focus on applying concepts to real datasets.

Textbook readings are required and short personal reflections are due at 11:59 pm the day preceding a quiz (reading guides and reflection prompts provided on D2L).

In addition to the outlined technology requirements, students must have **R and RStudio** installed on their computer to complete the laboratory component of the course.

Course Site:

D2L: BIOL 315 L01-(Fall 2020)-Quantitative Biology I

Note: Students must use their U of C account for all course correspondence.

The instructor also wants your feedback on how the course is going; while I welcome your feedback to me directly, I will also be meeting with class representatives regularly during the term and you can submit your feedback about the course to these class representatives. More information about class representatives is provided on D2L.

2. **Requisites:**

   See section 3.5.C in the Faculty of Science section of the online Calendar.

   Prerequisite(s):
   Biology 241 and 243.

3. **Grading:**

   The University policy on grading and related matters is described in F.1 and F.2 of the online University Calendar.

   In determining the overall grade in the course the following weights will be used:

Component(s)	Weighting %	Due Date
Quizzes (7 total, 6 x 5% each)	30%	See D2L for details
Lab Assignments (5 x 5% each)	25%	See D2L for details
Discussion Boards (8 x 1.4% each)	11%	See D2L for details
Final Portfolio (Team component)[1]	15%	**Dec. 9 at 11:59 pm**
Final Portfolio (Individual component)	10%	**Dec. 9 at 11:59 pm**
Reading Reflections (7 x 1% each)	7%	See D2L for details
Peer Evaluation	2%	See D2L for details

Each piece of work (reports, assignments, quizzes, midterm exam(s) or final examination) submitted by the student will be assigned a grade. The student's grade for each component listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade.

The conversion between a percentage grade and letter grade is as follows.

	A+	A	A-	B+	B	B-	C+	C	C-	D+	D
Minimum % Required	95 %	90 %	85 %	80%	75%	70 %	65 %	60%	55%	53 %	50 %

[1]At the end of the term, each student will evaluate the contributions of the other members of his/her team (peer evaluation). All team members will get a “peer score” based on the final peer evaluation. The peer score for a student is the average rating of the student, divided by the overall average rating for all members of the team. This provides a way to evaluate the relative contributions of each team member to the team’s work. Each student’s total teamwork mark will be multiplied by his/her peer score to determine his/her final mark for the teamwork component of the course (15% of final grade).

4. **Missed Components Of Term Work:**

The university has suspended the requirement for students to provide evidence for absences. Please do not attend medical clinics for medical notes or Commissioners for Oaths for statutory declarations.

In the event that a student legitimately fails to submit any online assessment on time (e.g. due to illness etc...), please contact the course coordinator, or the course instructor if this course does not have a coordinator to arrange for a re-adjustment of a submission date. Absences not reported within 48 hours will not be accommodated. If an excused absence is approved, then the percentage weight of the legitimately missed assignment could also be pro-rated among the components of the course.

If a student chooses to submit their lab assignment *1 day late*, they will be eligible for *80% of the total marks on the assignment*. If they choose to submit their assignment *2 days late*, they will be eligible for *50% of the total marks on the assignment*. If they choose to submit your assignment *more than 3 days late*, they will receive feedback on their assignment but will be eligible for *0 points*.

Due to their nature, Discussion Boards & Quizzes cannot be written late and missed submissions will receive a grade of zero.

5. **Scheduled Out-of-Class Activities:**

There are no scheduled out of class activities for this course.

6. **Course Materials:**

Required Textbook(s):

Michael Whitlock and Dolph Schluter, *The Analysis of Biological Data, 3rd ed.*: Macmillan Learning.

Some teamwork resources are provided by ITP Metrics, a University of Calgary-based system of secure web-based tools for forming teams and doing peer evaluations. These tools are free to all students and are not dependent on prior access.

In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam/Camera (built-in or external);

- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Stable internet connection.

For more information please refer to the UofC ELearning online website.

7. **Examination Policy:**

The quizzes are closed book. You will be able to use a non-programmable calculator for quizzes. You may not access your lecture notes or any other resources during exams. No other aids are allowed on tests or examinations, including accessing internet resources such as search engines (Google, etc.), other websites, shared documents (Google docs etc.) or chat servers (Discord, WhatsApp, etc.), etc., and you are specifically prohibited from working with or contacting any other individuals while you complete the exam. Violation of these rules is considered academic misconduct with penalties as described in the University Calendar section K.

Students should also read the Calendar, Section G, on Examinations.

8. **Approved Mandatory And Optional Course Supplemental Fees:**

There are no mandatory or optional course supplemental fees for this course.

9. **Writing Across The Curriculum Statement:**

For all components of the course, in any written work, the quality of the student's writing (language, spelling, grammar, presentation etc.) can be a factor in the evaluation of the work. See also Section E.2 of the University Calendar.

In this course, the quality of the student's writing in laboratory assignments will be a factor in the evaluation of those assignments.

10. **Human & Living Organism Studies Statements:**

Students will not participate as subjects or researchers in human studies.

See also Section E.5 of the University Calendar.

STUDIES IN THE BIOLOGICAL SCIENCES INVOLVE THE USE OF LIVING AND DEAD ORGANISMS. Students taking laboratory and field-based courses in these disciplines can expect involvement with and experimentation on such materials. Students perform dissections on dead or preserved organisms in some courses. In particular courses, students experiment on living organisms, their tissues, cells, or molecules. Sometimes field work requires students to collect a variety of living materials by many methods, including humane trapping.

All work on humans and other animals conforms to the Helsinki Declaration and to the regulations of the Canadian Council on Animal Care. The Department strives for the highest ethical standards consistent with stewardship of the environment for organisms whose use is not governed by statutory authority. Individuals contemplating taking courses or majoring in one of the fields of study offered by the Department of Biological Sciences should ensure that they have fully considered these issues before enrolling. Students are advised to discuss any concern they might have with the Undergraduate Program Director of the Department.

Students are expected to be familiar with Section SC.4.1 of the University Calendar.

11. **Reappraisal Of Grades:**

A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See Section I.3 of the University Calendar.

   a. **Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **ten business days** of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall submit the Reappraisal of Graded Term work form to the department in which the course is offered within 2 business days of receiving the decision from the instructor. The Department will arrange for a reappraisal of the work within the next ten business days. The reappraisal will only be considered if the student provides a detailed rationale that outlines where and for what reason an error is suspected. See sections I.1 and I.2 of the University Calendar

   b. **Final Exam:** The student shall submit the request to Enrolment Services. See Section I.3 of the University Calendar.

12. **Other Important Information For Students:**

a. **Mental Health** The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (Room 370, MacEwan Student Centre, Mental Health Services Website) and the Campus Mental Health Strategy website (Mental Health).

b. **SU Wellness Center:** For more information, see www.ucalgary.ca/wellnesscentre or call 403-210-9355.

c. **Sexual Violence:** The Sexual Violence Support Advocate, Carla Bertsch, can provide confidential support and information regarding sexual violence to all members of the university community. Carla can be reached by email (svsa@ucalgary.ca) or phone at 403-220-2208. The complete University of Calgary policy on sexual violence can be viewed at (https://www.ucalgary.ca/policies/files/policies/sexual-violence-policy.pdf)

d. **Misconduct:** Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under Section K. Student Misconduct to inform yourself of definitions, processes and penalties. Examples of academic misconduct may include: submitting or presenting work as if it were the student's own work when it is not; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; collaborating in whole or in part without prior agreement of the instructor; borrowing experimental values from others without the instructor's approval; falsification/ fabrication of experimental values in a report. **These are only examples**.

e. **Academic Accommodation Policy:** Students needing an accommodation because of a disability or medical condition should contact Student Accessibility Services in accordance with the procedure for accommodations for students with disabilities available at procedure-for-accommodations-for-students-with-disabilities.pdf.

   Students needing an accommodation in relation to their coursework or to fulfill requirements for a graduate degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to the Associate Head, Undergraduate of the Department of Biological Sciences, Heather Addy by email addy@ucalgary.ca or phone 403 220-6979. Religious accommodation requests relating to class, test or exam scheduling or absences must be submitted no later than **14 days** prior to the date in question. See Section E.4 of the University Calendar.

f. **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). Students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information, see Legal Services website.

g. **Student Union Information:** VP Academic, Phone: 403-220-3911 Email: suvpaca@ucalgary.ca. SU Faculty Rep., Phone: 403-220-3913 Email: sciencerep@su.ucalgary.ca. Student Ombudsman, Email: ombuds@ucalgary.ca.

h. **Surveys:** At the University of Calgary, feedback through the Universal Student Ratings of Instruction (USRI) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference - please participate in these surveys.

i. **Copyright of Course Materials:** All course materials (including those posted on the course D2L site, a course website, or used in any teaching activity such as (but not limited to) examinations, quizzes, assignments, laboratory manuals, lecture slides or lecture materials and other course notes) are protected by law. These materials are for the sole use of students registered in this course and must not be redistributed. Sharing these materials with anyone else would be a breach of the terms and conditions governing student access to D2L, as well as a violation of the copyright in these materials, and may be pursued as a case of student academic or non-academic misconduct, in addition to any other remedies available at law.

OVERVIEW OF THE COURSE:

In this course you will learn:

1. many of the most important statistical tests used by biologists,
2. how to design an experiment,
3. how to apply the process of statistical inference to make statistical conclusions regarding experimental/observational data,
4. how to identify and justify the appropriate statistical test to apply given a biological research question or scenario,
5. how to perform and interpret statistical analyses on real data sets using the statistical computer program, R.

By necessity, this course involves a fair bit of math and computer programming. However, this is not a math or programming class—these are both tools to help us quantify the statistical significance of patterns and trends. I hope to convince you that statistics is not only useful, but really interesting as well. If you find the prospect of learning about statistics daunting, relax. I wouldn't try to teach you anything you couldn't handle. That doesn't mean the course will be easy (if it was easy, you'd be bored), but it does mean that you'll have a lot of opportunity to ask questions and get practice. I am going to do everything I can to help you understand this material, so that at the end, like many years' worth of students before you, you are glad you took the class and go away having learned a lot.

To make our time together as effective as possible, it is important that the lecture learning environment is one of mutual respect. I will do whatever I can to create and maintain that environment; my expectations of student conduct are outlined below:

1. Please let me know right away if you are dealing with a problem or situation that is preventing you from performing at the level you want to be at in this class.
2. Please treat your classmates, peer mentors and me with respect. There may be times when you are frustrated with something that is going on in the course and find it difficult to be patient. However, to maintain a respectful and constructive environment in this class, I ask that you are respectful of others in your words and actions.

What you can expect from me:

1. I will treat all students with respect and do my best to make my expectations about how to succeed in this class clear.
2. I will do my best to help your learning by designing clear assignments and assessments that provide you with timely feedback.
3. I will be available outside of class time through office hours, appointments or email should you want to review concepts that are not clear, discuss study strategies, learn more about any topic or discuss concerns about any aspect of the course. Please note that I will aim to reply to emails within 24h, except on weekends and holidays.

Academic Integrity:

Each student in this course is expected to abide by the University of Calgary Code of Academic Conduct. You are encouraged to study together and to discuss information and concepts covered in class and assigned readings with other students, but all individual work that you submit in this course for academic credit must be your own work. In the case of team assignments, all members of the team are responsible for the honesty and integrity of the document.

Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. All work submitted for this class (whether as a draft or for final grading) is held to the strictest standards for intellectual honesty. A single offence may lead to a grade of zero for the assignment involved, disciplinary probation, suspension or expulsion. The Faculty of Science follows a zero-tolerance policy regarding dishonesty. In addition to reading the sections of the University Calendar under "Student Misconduct", I will assume that you have read and understood the information posted on the Dept. of Biological Sciences' webpage dealing with academic honesty: https://bio.ucalgary.ca/undergraduate/current_students/academic_honesty. In particular, be sure that you understand what constitutes plagiarism—test yourself by taking the on-line quiz.

TEAM BASED LEARNING:

In this class, we will be using a Team Based Learning (TBL) approach. In this process, you will spend many classes working in teams applying what you've learned from the textbook and from lectures. Teams in TBL are different than the kind of group work you may have done in other classes: the instructor forms the teams (as described below) which work together throughout the term to complete course assignments; team members also evaluate each other's contributions to the group throughout the term. Here are the basics:

1. We will be forming teams in the first week of class. Research shows that *diverse* teams function the best and

produce the best outcomes. So it's my job to make the teams as diverse as possible. To help with this I will be using ITP Metrics to divide you into teams of 6 students based on previous courses you've taken, your major/year, work experience, and other factors that will help us form successful teams. These may feel like big teams at first, but research shows that teams of 4-7 individuals work best. As the term progresses, I am sure you will appreciate having the diversity of ideas and perspectives that come with a team of this size. Additionally, I will be putting measures in place (Peer Evaluation) to ensure there is individual accountability to the team.

2. The final aspect of each module will be the*Team Application Activities* in the course Discussion Board. These application activities are the most critical part of the course because they will involve real problems and applications of the material that I expect you to be able to do by the end of the module/course. During these activities, you will work with your teammates to bring all you've learned in the module together to solve a problem. My goal for you in this course is that you should be able ***to do something*** with the material you learn.

DISCUSSION BOARDS:

I expect that all dialogue in the course Discussion Boards will be conducted in a respectful manner. New Discussion Topics will be released on designated days (see course schedule) at 8:00 and close at 18:00 unless otherwise notified. Grading will be based on the quality of the personal response to the prompt and responding to at least 2 team members.

Ground rules*:

1. Ask questions. If you find something confusing or want to know more, do not hesitate to ask questions. Make sure to post your questions in the appropriate thread.
2. Participate. Contribute to discussions to get as much as possible from the course and to maintain your participation grade.
3. Do not dominate a discussion. If you have something to offer, please share it, but allow everyone to contribute to a discussion.
4. Be intellectually rigorous. Do not post sloppy or illogical thinking. Challenge yourself and one another.
5. Be tactful. Be critical of ideas but remember there are other people involved. Be tactful and kind.
6. Forgive other students' mistakes. Just because you do not agree with a student's post does not mean that they are wrong. Instead, offer a different perspective to encourage further discussion.
7. Read the whole thread before posting. Read all the posts in a thread before responding so you don't repeat what others have already said. Try to contribute clarifying information or a new idea to a discussion.
8. Be concise.
9. Cite your sources. If you use a source, cite it properly.

* Adapted from Wiley 2016

Other grade components in the Course include:

Lab Assignments: Lab assignments will focus primarily on your ability to use R to statistically analyze biological problems. These assignments are to be completed **INDIVIDUALLY**. Academic misconduct on these assignments is taken very seriously. I will provide a detailed guide as to how I would like you to structure your answers for these assignments. These assignments will be submitted via a Dropbox on D2L.

Lab Assignment Wrappers are due at 11:59 pm in the D2L Dropbox the day preceding the next lab assignment submission deadline. The Lab Assignment Wrappers are components of the individual portion of the Final Portfolio.

Tentative BIOL 315 Schedule Fall 2020

Module	Reading	Date		Class	Lab	Lab Assignments
Introduction		**Sept**	9	Introduction to the course, D2L tour, **Practice Quiz**	**No Lab**	**NO ASSIGNMENT**
1: Descriptive Statistics and Estimating with Uncertainty	Ch. 1, 3, 4		11	Module 1: Populations, Variables and Samples		
			14	Module 1: Descriptive Statistics, **Intro DB**	**Lab 1:** Skills 1 - 2	**NO ASSIGNMENT**
			16	Module 1: Sampling distributions & Estimating with uncertainty	**Orientation to the lab and R**	
			18	Module 1: **Quiz**		
2: Hypothesis Testing & Statistical Inference & Experimental Design	Ch. 6 & 14 Interleaves 2, 3, 5, 6		21	Module 2: Hypothesis testing, Inferential statistics, errors of inference	**Lab 2**: Skills 3 - 5	1: Summary Statistics & Visualization in R (5%) **DUE: Oct 2 @ 4:30 pm**
			23	Module 2: Experimental Design	**Descriptive Statistics & Importing data into R**	
			25	Module 2: **Case Study on Experimental Design - DB**		
			28	Module 2: **Team Application Activity - DB**	**Lab 3**: Skills 6 - 10	**NO ASSIGNMENT**
			30	Module 2: **Zoom Modules 1 & 2 Review**	**Data Visualization & Exploratory Data Analysis**	
		Oct	2	Module 2: **Quiz**		
3: Proportions and Frequencies	pp. 179-185, 191-193, 203-222, 233-249		5	Module 3: Binomial & Poisson Distributions	**Lab 4**: Skills 11 - 12	2: Analysis of Frequency data (5%) **DUE: Oct 16 @ 4:30 pm**
			7	Module 3: Goodness of fit (G-test)	**Analysis of Frequency Data**	
			9	Module 3: Contingency analysis (G-test)		
			12	Module 3: **Team Application Activity - DB**	**Portfolio & Assignment catch-up**	**NO ASSIGNMENT**
			14	Module 3: **Zoom Module 3 Review**		
			16	Module 3: **Quiz**		
4: Comparing Numerical Variables	Ch. 10, 11, 327-335		**19**	**No classes -- Thanksgiving**	**No Lab**	**NO ASSIGNMENT**
			21	Module 4: Normal Distribution, Central Limit Theorem		
			23	Module 4: t-distribution, Single sample t-test & Paired t-test		
			26	Module 4: **Team Application Activity - DB**	**Lab 5**: Skill 13-14	3: t-tests (5%) **DUE: Nov 6 @ 4:30 pm**
			28	Module 4: **Zoom Module 4 Review**	**t-tests: single, paired**	
			30	Module 4: **Quiz**		
5: Comparing 2 or more Means	Ch. 15	**Nov**	2	Module 5: GLM & SS	**Portfolio & Assignment catch-up**	**NO ASSIGNMENT**
			4	Module 5: ANOVA & Assumptions		
			6	Module 5: Tukey's test		
			9	**Reading Break**	**No Lab**	**NO ASSIGNMENT**
			11			
			13			
			16	Module 5: **Team Application Activity - DB**	**Lab 6**: Skills 15-17	4: ANOVA, Tukey's HSD & Assumptions (5%) **DUE: Nov 27 @ 4:30 pm**
			18	Module 5: **Zoom Module 5 Review**	**ANOVA, Post-hoc Tukey's test & Assumptions**	
			20	Module 5: **Quiz**		
6: Regression and Correlation	Ch. 16 & 545-565 & Interleaf 4		23	Module 6: Regression	**Lab 7**: Skill 18-21	5: Regression & assumption violations (5%) **DUE: Dec 4 @ 4:30 pm**
			25	Module 6: Correlation	**Linear Regression & Assumption Violations**	
			27	Module 6: **Team Application Activity - DB**		
			30	Module 6: **Quiz**	**Portfolio & Assignment catch-up**	**NO ASSIGNMENT**
7: Dealing with assumption violations: transformations & permutation tests	pp. 371-383 395-399, 643-654	**Dec**	2	Module 7: Transformations		
			4	Module 7: Permutation tests		
			7	Module 7: **Team Application Activity - DB**	**Lab 8: All Skills**	6: Final Portfolio (25%) **DUE: Dec 9 @ 11:59 pm**
			9	Module 7: **Quiz**	**Portfolio Wrap-up**	

Course Outcomes:

- Describe and calculate basic descriptive statistics for measures of central tendency, distribution shape, and

spread

- Describe the process of hypothesis testing and given a statement of a research question, construct an appropriate null and alternative hypothesis to use for hypothesis testing
- List biological variables that follow a binomial and Poisson distribution and use the binomial and Poisson probability equations to determine the probability of certain ‘events’
- Use the Poisson distribution to test a null hypothesis about the spatial distribution of rare, random ‘events’ and describe the properties of the Poisson distribution
- Describe and design experiments according to best practices for experimental design in terms of replication, balanced design, blinding, simultaneous control groups, blocking, random sampling, randomization of treatments
- Explain the approach of ANOVA for detecting differences between means by partitioning the total variation in all observations into the variation between treatments/groups and variation within treatments/groups and using the F test to assess whether the variance among treatment means is larger than would be expected given H0
- Describe the 4 conceptual steps involved in conducting a permutation test and appropriately conduct, interpret and report permutation tests and create a bootstrap SE and CI
- Analyze relationships between two continuously scaled variables using linear regression or correlation depending on whether causality can be assumed
- Use R to conduct and interpret the following statistical tests: Linear Regression, ANOVA, Single sample t-test, Paired sample t-test, Permutation (randomization test) and Bootstrapping, G-test as Goodness of Fit or Contingency Analysis, Detect deviations from normality using visual checks (QQ Plots) and formal tests (Shapiro Wilk), Detect deviations from homoscedasticity using visual checks (QQ plots) and formal tests (Bartlett’s test)

Electronically Approved - Sep 01 2020 15:35

Department Approval

Electronically Approved - Sep 01 2020 17:32

Associate Dean's Approval