BIOLOGY 4605/7220   **Quantitative Methods in Biology**   **FALL 2009**

Lectures:	Mon Wed Fri 12 PM	SN 2036
Labs:	Tue 3-5 or 7-9 PM	SN3116 or CP 2003

Instructor:	David Schneider	Office (4 Clark Pl) Tel 737-8841
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Demonstrators:	TBA	

Course Summary. The goal of this course is for you to learn how to apply quantitative methods to the solution of problems in biology. You won't learn all the answers to specific questions but you should develop the skill to find the solution yourself! Skill and confidence come with practice, so assignments and quizzes will be short and frequent rather than lengthy and infrequent. Lecture material will emphasize principles of good quantitative analysis, illustrated by complete examples. Laboratories will cover the computational aspects of problem solving.

Goals
1. Principles of good analysis.
2. Skill in application.
3. Capacity for self-instruction.
4. Confer with statistician.
5. Develop critical capacity.
6. Evaluate quantitative presentations.

Evaluation	4605	7220
Problem sets	15 %	10 %
Lab assignments	15 %	10 %
Quizzes	20 %	15 %
First exam	15 %	10 %
Second exam	15 %	10 %
Final exam	20 %	15 %
Written report	--	30 %

Exams and quizzes are open book, emphasizing ability to use tools, rather than to memorize formulas. Weekly quizzes are based on all material covered since the previous quiz.
Material from both labs and lectures are fair game.

Graduate students registered for Biology 7220 will be required to prepare a written report on the analysis of a set of data of interest to the student. The topic will be decided during a conference early during the semester, then discussed during tutorial sessions. This report will constitute 30% of the final mark
Course material is on the Web at   www.osc.mun.ca/schneider/b4605
                              or   www.mun.ca/biology/schneider/b4605
    Required material from web: Lecture Notes in Quantitative Biology
                                       Laboratories in Quantitative Biology
    Additional material from web: Review Questions in Quantitative Biology

A hand-held calculator is required for quizzes, all exams, and Lab 2.
The calculator does not require statistical functions.

Policy on late work (labs and problem sets). Work received late stresses the grad students who do the marking because they have to return to a previous marking scheme. Work handed in late takes a day to reach grad students at Logy Bay. The penalty for late work will be 5% off per day late.

Labs 1 is a group project that requires attendance for successful completion.
Labs 2, 3, and 9 are group projects for which attendance is recommended.

About labs. Group participation is encouraged in all labs. Lab groups are also encouraged to work together in preparing lab report and assignments.   However, each person is responsible for turning in their own written report.

Personal Computer lab.	Location	Time	Terminals
	CP2003	Tue 3-5, 7-10 PM	40
	CP2004	Open access	70
	CS1009	If not locked up	32

You can use CP2004 anytime. You can use CP2003 and CS1009 if they are not in use.
Minitab, SPSS, and Excel are available in CP2003, CP2004, and CS1009.

About statistical packages. Labs 3, 5, and 6 can be completed in a spreadsheet, using functions and data analysis tools. The GLM labs (5, 6, 7, 8, 9) can be completed in any statistical package with a general linear model routine. Lab 10 can be completed in any package with a logistic regression routine, or with a generalized linear model routine.

Minitab. Available in CP2003, CP2004, and CS1009.
          A student version of Minitab can be downloaded from the web for free for a limited time.
SPSS. Pulldown menu version in CP2003, CP2004, and CS1009.
SAS. In October 2004 MUN C&C ceased licensing a UNIX version of SAS.
          MUN has arranged windows versions to be licensed to individual computers.
SPlus. A student copy of SPlus can be downloaded from the web, for a one year period.
R   Freeware version of SPlus.

Please do not print the sometimes verbose files produced by statistical packages. Instead, cut and paste the appropriate sections of output into your lab report or assignment. Note that you will have to use a <u>non-scalable</u> font (`such as courier`) to print or display numerical output (ANOVA tables, *etc.*) without distortion.

Assignments
<u>A1.   Units</u>
   In the library, find a journal reporting research results in biology. Open the journal to an article, and list the first defined physical or biological quantity you encounter (if you must move to the next article, then so be it). State the Journal name, volume, and page number. For this quantity, provide complete details for each of the 5 components of the quantity: name, symbol, typical value, units, and procedural statement.

For each of the **next 3** quantities in the journal, complete the following checklist:

    Journal name, volume, and page number _____

    name of quantity in words.   Present ? _____

    symbol   Present in article ? _____

    number of values   N = _____ or cannot be determined _____

    procedural statement   Present ? _____

          Reproducible by another investigator ? _____

    type of measurement scale (nominal, ordinal, interval, ratio)   _____

          if ratio scale: units   = _____

                                                                        (4 due in all)

Assignments

A2. Data Equations. In the published literature find a graph where a regression equation has been displayed. Write the equation, write the name of each symbol, and give its units.   Immediately below the equation display a data equation for each of 3 different values of the explanatory (X) variable. If you don't find an example in the first journal you choose, try a journal in physiology, biochemistry, or medecine.

A3. Hypothesis testing.   Find, in the published literature, two mean values with associated standard deviations and sample size.
1. Report the 6 values with full citation of source of the published data.
2. Compute the t-statistic using the appropriate formula from Ch7.3. State which formula you used and why. Use the generic recipe for decision making with statistics (Ch7.3, Table 7.1a) to declare a decision about the two means.
3. Use the generic recipe for hypothesis testing to declare a decision about whether the two variances differ significantly (see Ch7.3 for example)..

A4. Confidence intervals.   For the same data used in A3, compute the confidence limits for each mean. Report all 6 values (means, sd, n), the source of the numbers, and both confidence limits. Use the generic recipe for confidence limits (Ch7.5, Table 7.5a).
      Hint: Use Minitab MTB>Invcdf command to obtain critical t-values.

A5. Correlation. Find, in the published literature, a data set appropriate for correlation. Enter the data into a spreadsheet or statistical package. Compute the mean and variance for each variable. Compute the correlation coefficient. State the source of the data (with full citation), why correlation is appropriate, then display the data (label each column), each mean and variance, and the correlation coefficient. Use the generic recipe for decision making with statistics (Ch 7.2, Table 7.1a) to declare a decision about the correlation coefficient, relative to the null model (show all steps).

Day	Date	On Web	Topic	Location of Lab	Due (A = Assignment)	Marked by
Wed	09-Sep		Intro to Course			
Fri	11-Sep	Ch2.1,2.2	Quantities		Quiz1	
Mon	14-Sep	Ch2.5,2.6	Units Dim		A1 Quantities	
Tues	15-Sep	Lab1	Inferential Cards	SN3116		
Wed	16-Sep	Ch3	Rescaling		Quiz2	
Fri	18-Sep	Ch4	Equations		Lab1	
Mon	21-Sep	Ch5	Data Eq		Quiz3	
Tues	22-Sep	Lab2a	Equations	SN3116		
Wed	23-Sep	Ch6.1	Freq Dist I		A2 Data Equations	
Fri	25-Sep	Ch6.2,6.3	Freq Dist II		Lab2	
Mon	28-Sep	Ch7.1,7.2	Hypoth Test I		Quiz4	
Tues	29-Sep	Lab3	Freq Dist	CP2003		
Wed	30-Sep	Ch7.3,7.4	Hypoth Test II		A3 Hypoth Testing	
Fri	02-Oct	Ch7.5	Conf Limits		Lab3	
Mon	05-Oct	--	Exam I			All
Tue	06-Oct	Lab4	Computing p-values	CP2003		
Wed	07-Oct	Ch8, 9.1	GLM Intro	SN2036	A4 Conf.Limits	
Fri	09-Oct	Ch9.2	Regression		Lab4	
Mon	12-Oct	Holiday				
Tue	13-Oct	Holiday				
Wed	14-Oct	Ch9.5	Power Laws		Quiz5	
Fri	16-Oct	Ch10.1,10.2	t-test			
Mon	19-Oct	Ch10.3, 10.4	1-way ANOVA		Quiz6	
Tue	20-Oct	Lab5	GLM - regression	CP2003		
Wed	21-Oct	Ch11	Rev: 1 Expl Var		Lab5a	
Fri	23-Oct	Ch12	Mult Regr		Lab5b	
Mon	26-Oct	Ch14.1 (14.2?)	ANCOVA		Quiz7	
Tue	27-Oct	Lab6	1-way ANOVA	CP2003		
Wed	28-Oct	Ch13.1,13.2	2-wayANOVA		Lab6a	
Fri	30-Oct	Ch13.3	Paired t-test		Lab6b	
Mon	02-Nov	Ch13.4	Rand. Block		Quiz8	
Tue	03-Nov	Lab7	2 factor ANOVA	CP2003		
Wed	04-Nov	Ch13.6	Nested ANOVA			
Fri	06-Nov	Ch15	GLM Review		Lab7	
Mon	09-Nov	--	Exam II			All
Tue	10-Nov	Lab8	ANCOVA	CP2003		
Wed	11-Nov	Holiday				
Thurs	12-Nov	Lab9a	Problem set-up	SN3116	Tues Schedule	
Fri	13-Nov	Ch20.1	Correlation		Lab8	
Mon	16-Nov	Ch19.1	EDA I		A5 correlation	
Tues	17-Nov	Lab9b	Problem execution	CP2003		
Wed	18-Nov	Ch20.4	EDA II		Quiz9	
Fri	20-Nov	Ch16.1,16.2	Goodness of Fit		Lab9ab	
Mon	23-Nov	Ch18.1	Logistic Regression		Quiz10	
Tue	24-Nov	Lab10	Logistic Regression			
Wed	25-Nov	Ch18.2	Prospective Analysis			
Fri	27-Nov	Ch18.2	Retropsective Analysis		Lab10	
Mon	30-Nov	Ch17.4	Poisson counts		Quiz11	
Tue	01-Dec	-	-			
Wed	02-Dec	Ch22.1	Numerical Methods			
Fri	04-Dec	Ch22.2,22.3	Last Lec, Review			
			Final Exam - B4605 slot			
			Mark Exam			All

Quantitative Background   Fall 2009

Biology 4605/7220   No names! Please!

Which course are you taking ? Circle one.   B4605 B7220

  Grad students: list department or program   _____

  Honors students: list program   _____
and topic _____

Do you own a pocket calculator ?   _____

If so, does it have statistical functions?   _____

How long have you used a computer ?   _____

How do you prepare written reports ?   by hand _____   UNIX system_____
          personal computer_____

Have you ever used Minitab ? _____   SPSS?_____   SAS?_____

List any other statistical packages you have used.   _____   _____

Have you ever used one of the functions in a spreadsheet ? _____

How long has it been since you used logarithms ?   _____

The variable Y has three values, Y = [9 6 3]
                    What is the mean value of Y ? _____

List courses you have taken in mathematics and statistics   _____and over ⇨

List courses where you have collected data _____

List courses where you have analyzed data _____

On the reverse side, list non-classroom experience with quantitative techniques, including any data sets you have collected.