Course Instructor
Marie-Josée Fortin (Phone: 416-946-7886; email: mariejosee.fortin@utoronto.ca)

Location and Time
Tuesday from 9:30 (sharp) to 12:30; ESC 2144

Course Description
Biologists need to use statistical methods to test their hypotheses. Given the increasing complexity of experiments carried out by biologists, they need however to understand the limitations of these statistics and how to select the appropriate statistics for their needs, and how to interpret them properly both statistically and biologically. The goal of this advanced course in statistics is to teach biologists how to choose and use statistics so that they can address relevant biological questions and test them with the appropriate methods. Specifically, an overview of advanced notions about regression analysis and ANOVA will be presented. The course is lecture-based with assignments designed to develop awareness about the misuse of statistics.

Course Objectives
By the end of the course, graduate students should be able to:
- understand the utility and pitfalls of statistics and their appropriate application to biological problems;
- analyse their data with the appropriate statistics and interpret the results adequately;
- read, understand, and critically evaluate papers and their use of statistics.

Topics and Timetable

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<tr>
<th>2024</th>
<th>Topics</th>
<th>Labs</th>
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<tbody>
<tr>
<td>Sept 10-Wk1</td>
<td>Review of the various types of statistical approaches: parametric, non-parametric, Bayesian, randomization tests</td>
<td>Homework DUE on Sept 19: Your questions/objectives and potential data</td>
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<td>Experimental design, Power analysis, Effect size</td>
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<td>Sept 17-Wk2</td>
<td>Chi-Square-test, G-test, Correlation, partial correlation, Linear regression and Residual analysis</td>
<td>Homework DUE</td>
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<td>Sept 24-Wk3</td>
<td>Multiple regression, Model selection criteria, Causality Analysis</td>
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<td>Oct 1-Wk4</td>
<td>Generalized Linear Models (GLM), Generalized Linear Mixed Models (GLMM)</td>
<td>Lab 1: Regression</td>
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<td>Oct 8-Wk5</td>
<td>Non-linear regression, Smoothing, Generalized Additive Models (GAM), Regression Tree Methods; Clustering</td>
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<td>Oct 15-Wk6</td>
<td>ANOVA, Nested ANOVA, Factorial ANOVA/Multiple comparison tests</td>
<td>Lab 2: ANOVA</td>
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<td>Oct 22-Wk7</td>
<td>ANCOVA, Split-plot models/Repeated measures, MANOVA</td>
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<td>Oct 29</td>
<td>Reading week: no class</td>
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<td>Nov 5-Wk8</td>
<td>Meta-analysis/Survival analysis, Multivariate/Ordination methods</td>
<td>Lab 2 DUE</td>
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<td>Nov 19-Wk9</td>
<td>Student presentations (10 minutes MAX)</td>
<td>Term-paper DUE</td>
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Evaluation

1. Lab 1: Regression methods (10%)
   → I do not want a printout of the figures.
   → The marks are for the statistical and biological interpretations of the results obtained.

2. Lab 2: ANOVA (10%)
   → I do not want a printout of the figures
   → The marks are for the statistical and biological interpretations of the results obtained.

3. Term project = Report (60%): Write the “methods section” of your potential data analysis explaining which statistics you should use to answer your hypotheses/objectives: Compare at least two different statistical methods stressing the assumptions of each selected statistical methods as well as their pros and their cons from a statistical/methodological perspective and from an ecological/evolutionary/biological perspective.
   • Maximum 6 pages single-interlined
     o Half-page presenting the objectives of the study
     o Half-page presenting the data
     o Four pages explaining (assumptions; the goals of each method; how the methods address your objectives; comparing the statistical methods-pros and cons)
     o One page for references (of the methods and examples of applications)

4. Term project = Presentation (20%): Each student will present a 10-minute talk summarizing: the objective(s) of their project; the (potential) data; and the selected methods that should be used to assess/test your hypotheses.

Useful References


Academic integrity

Academic integrity is fundamental to learning and scholarship at the University of Toronto. Participating honestly, respectfully, responsibly, and fairly in this academic community ensures that the U of T degree that you earn will be valued as a true indication of your individual academic achievement, and will continue to receive the respect and recognition it deserves.

Familiarize yourself with the University of Toronto’s Code of Behaviour on Academic Matters (http://www.governingcouncil.utoronto.ca/policies/behaveac.htm). It is the rule book for academic behaviour at the U of T, and you are expected to know the rules.