BIOL 693 Analysis of Microbial Sequence Data  
Spring 2015  
2 credit hours

Instructor: Dr. Mary-Cathrine Leewis  
Office: 242 West Ridge Research Building (WRRB)  
Phone: 474-7955, Email: mcleewis@alaska.edu  
Office hours: Wednesday 3:00 – 4:00, Friday 10:00 – 11:00 or by appointment

Course location: Murie 230  
Course Time: Thursday 9:00a – 11:00a

Prerequisites  
Graduate standing or permission of instructor. Recommended: Introductory Statistics, Environmental Microbiology. This course is open to students that do not have previous experience with programming or R, however basic knowledge is recommended.

Course description  
This course provides a hands-on research experience in the analysis of next-generation microbial community DNA sequence data for graduate students. Students will analyze their own data during the course, or otherwise will be provided with an actual dataset for training purposes.

Course overview  
This course provides a hands-on research experience in the analysis of next-generation microbial community DNA sequence data for graduate students. Students will analyze their own data during the course, or otherwise will be provided with an actual dataset for training purposes. Students will write up a report following the style of a primary scientific research manuscript (Intro, Methods, Results, Discussion, Figures and Tables, References, etc.). The data analyzed and interpreted by the student throughout the course could potentially be included in their dissertation or thesis.

Course goals  
- Develop skills in analysis of complex microbial community data sets  
- Learn and understand the steps involved in processing next-generation sequence analysis  
- Gain an understanding of the statistical techniques used in microbial data analysis  
- Develop skills in computer programming and bioinformatics  
- Develop scientific writing skills by preparing a manuscript in primary research article format

Student learning objectives  
- Become proficient in the use of software such as mothur and R  
- Be able to convert raw sequence data into tables and figures  
- Prepare a manuscript for submission to a scientific journal
Instructional methods
- The course will meet for two hours each week which will include one hour of lecture and one hour of small group discussion.
- Students will be expected to work on homework outside of class hours, however the instructor will be available for office hours or by appointment. Students are encouraged to come to office hours to discuss their assignments.

Course reading materials:
- Scientific journal articles – Most readings will be drawn from the primary scientific literature to be provided as pdfs or citations that students can then obtain electronically through online databases, with others provided through Dropbox.
- Textbooks – There is no required text for this course.

Other course materials
- We will use the following freely available programs for microbial sequence processing and statistical analyses:
  - Mothur (http://www.mothur.org/wiki/Main_Page)
  - R (http://www.r-project.org/)
  - PAST (http://folk.uio.no/ohammer/past/)
  - QIIME (http://qiime.org/)

Assignments: The goals of these exercises are to help develop and enhance understanding of microbial ecological data and develop research, writing and oral presentation skills important to success in a scientific (or any other) career.
- Assignments:
  - Ten assignments of varying format will be given in lecture (10 pts each). Many will be designed to be completed during class either individually or in groups. In-class assignments will sometimes occur without prior notice. Some examples will include attendance of outside lectures and in-class literature discussions.
    - Literature Discussions:
      - Journal articles will be assigned in advance of discussion and made available through Blackboard. On discussion day, I will assign two class members to co-lead discussion.
      - If you will be absent from class on an assigned literature discussion day, let me know (via email) in advance. Within a week of your absence you will need to send MCL (via email) a short description of the assigned reading which should include: the hypotheses addressed and strengths and weaknesses of the study.
  - A paper report following the style of a primary scientific research manuscript (Intro, Methods, Results, Discussion, References, etc.) will be written using the techniques learned throughout the course.
    - Papers should be 5-10 pages, double spaced. Papers should also include detailed descriptions of the statistics used and interpretation of statistics (including tables and figures).
  - Students will give a short (15 min) presentation on their microbial data analysis projects at the end of the course.
- Presentation should include the following sections: hypothesis, objectives, methods (with a focus on statistical analysis), and detailed interpretation of results.

**Course schedule** (tentative, subject to change)

- **Week 1** - January 15: Introductions, course expectations, student hypotheses/objectives.
- **Week 2** - January 22: Overview of methods used in microbial ecology
- **Week 3** - January 29: Introduction to analysis of NGS microbial data sets – choosing amplicons and primers
  - Literature Discussion
- **Week 4** - February 5: Introduction to sequence analysis
- **Week 5** - February 12:
  - MiSeq Lectures – a representative from Illumina will be in Fairbanks giving a variety of lectures regarding UAF’s new MiSeq February 11 - 12. Attendance of one of these lectures is mandatory and a brief (1 paragraph) write up of the lecture should be turned in to MCL by February 20, 2015 (10 pts).
- **Week 6** - February 19: Improving sequence quality and alignment. Chimera detection
- **Week 7** - February 26: Distance calculations, OTU identification, Sequence/OTU classification
  - Literature Discussion
- **Week 8** - March 5: Methods of measuring alpha and beta diversity
- **Week 9** - March 12: Population level analyses
  - Literature Discussion
- **Week 10** - March 19: Spring Break, no classes
- **Week 11** - March 26: Guest Lecture (TBA)
- **Week 12** - April 2: Introduction to statistical methods
  - Literature Discussion
- **Week 13** - April 9: Ordination in microbial ecology
  - Literature Discussion
- **Week 14** - April 16: statistics and ordination in microbial ecology, continued.
- **Week 15** - April 23: Presentations
- **Week 16** - April 30: Presentations

**Deadlines:**
- Paper draft – April 6 (Intro, Methods, Preliminary results)
- Final paper – April 30

**Assessment**

*Note: some point values may vary slightly, such as more or fewer assignment points*

The course will be graded on a letter grade basis (A, B, C, D, F). Grading will be based on data analyses and of the written manuscript.
Grading

<table>
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<tr>
<th>Points</th>
<th>Grading Scale (% of total course points)</th>
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<tbody>
<tr>
<td>100</td>
<td>A  90-100%  B  80-89%  C  70-79%  D  60-69%  F &lt; 60%</td>
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<td>Course Policies:</td>
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<td>• Attendance: It is required that you attend all lectures. Exercises and graded assignments to enhance learning will occasionally be done during lecture periods without advanced warning. Absence will be allowed only when previously arranged or in documented cases of illness or extenuating circumstances at instructor’s discretion.</td>
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<td>• Plagiarism: Plagiarism will result in a failing grade in the course. All written work will be subjected to an electronic plagiarism check. Plagiarism includes copying text directly from other sources. It also includes use of figures from other sources without proper citation. In general, it is best to paraphrase ideas you read elsewhere and then follow that with a citation of the original source. When in doubt, always rephrase and cite! Don’t copy and paste.</td>
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Grading Scale (% of total course points)
Final grades for the course will be based on the following scale. No curve will be used.
A 90-100%  B  80-89%  C  70-79%  D  60-69%  F < 60%

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Students with disabilities
UAF is committed to equal opportunity for all students. Students with even minor disabilities, students who are the first in their families to attempt a four-year college degree, or students whose incomes are low, have opportunities for tutorial and other forms of support from the office of Disability Services or the office of Student Support Services. If you need classroom accommodations or other support, please meet with me during office hours as soon as possible to let me know; and please make an appointment with Mary K. Matthews at the Office of Disability Services at 474-7043 and Student Support Services at 474-2644, to enlist the appropriate support. I will collaborate to provide the appropriate accommodations and supports or services to assist you in meeting the goals of the course.