FLORIDA ATLANTIC UNIVERSITY™

Graduate Programs—NEW COURSE PROPOSAL

UGPC APPROVAL _____
SCNS SUBMITTAL _____
CONFIRMED _____
BANNER POSTED _____
CATALOG POSTED _____
WEB POSTED _____

DEPARTMENT NAME: BIOLOGICAL SCIENCES

COLLEGE OF: Science

RECOMMENDED COURSE IDENTIFICATION:

PREFIX ___PCB____ **COURSE NUMBER** __6456____ **LAB CODE** (L or C) _____

COMPLETE COURSE TITLE **EXPERIMENTAL DESIGN AND BIOMETRY**

EFFECTIVE DATE (first term course will be offered): ____**FALL, 2010**____

INSTRUCTIONAL METHOD (V, BB, IC, EC, ETC.):

CREDITS: 4	**LAB/DISCUSSION:**	**TEXTBOOK INFORMATION:** HANDOUT
LECTURE:	**FIELD WORK:**	

GRADING: REGULAR ___x___ **PASS/FAIL** _____ **SATISFACTORY/UNSATISFACTORY** _____

COURSE DESCRIPTION, NO MORE THAN 3 LINES: THIS COURSE COVERS EXPERIMENTAL DESIGN AND STATISTICAL ANALYSIS IN THE BIOLOGY AND ECOLOGY. STUDENTS LEARN PROBABILITY THEORY BASICS, UNIVARIATE AND MULTIVARIATE ANALYSES, PROPER EXPERIMENTAL DESIGN (REPLICATION, BLOCKING, ETC) AND HOW TO USE THE SAS SOFTWARE APPLICATION.

PREREQUISITES:	**COREQUISITES:**	**OTHER REGISTRATION CONTROLS (MAJOR, COLLEGE, LEVEL):**
PERMISSION FROM INSTRUCTOR O *Check box to enforce**	O *Check box to enforce**	O *Check box to enforce**

MINIMUM QUALIFICATIONS NEEDED TO TEACH THIS COURSE:

PHD IN MOLECULAR BIOLOGY

Other departments, colleges that might be affected by the new course must be consulted. List entities that have been consulted and attach written comments from each.

Department of Mathematics –see below

C. Edward Proffitt, cproffit@fau.edu, 772 297-1011 (at Harbor Branch) _____
Faculty Contact, Email, Complete Phone Number

SIGNATURES

Approved by:	***Date:***
Department Chair: 	_____*03.25.2010*____
College Curriculum Chair: _____	_____
College Dean: _____	_____
UGPC Chair: _____	_____
Dean, Graduate Studies _____	_____

SUPPORTING MATERIALS

Syllabus—must include course objectives.

Written Consent—required from all departments affected.

Go to: *http://graduate.fau.edu/gpc/* to download this form

* "Enforce" prerequisites or other registration controls adds these restrictions to the course schedule; students whose academic careers do not show these prerequisites or other details will not be able to register. When box is not checked, restrictions show in catalog description only.

Email this form and syllabus to ejohn@fau.edu and eqirjo@fau.edu one week ***before*** the University Graduate Programs Committee meeting so that materials may be viewed on the UGPC website by committee members prior to the meeting.

Here is a simple template you may use to help you set up a syllabus.

1. *To insert text, position the cursor in the box and type in the text you want.*
2. *All items are required except schedule and instruction method which are recommended*

Course name: Experimental Design and Biometry

Course number:

Section number:

Pre-requisites: None

Co-requisites: None, other than graduate standing

Required text: Zar, J.H. (Edition 4). Biostatistical analysis. Prentice Hall, N.J.

Supplementary texts: (placed on reserve)

Scheiner, S.M. and J. Gurevitch. 1993. **Design and analysis of ecological experiments**. Chapman & Hall, NY, NY. (NOTE: Newer edition available).

Underwood, A.J. 1997. **Experiments in Ecology: Their logical design and interpretation using analysis of variance**. Cambridge University Press, Cambridge, U.K.

Gotelli, N.J. and A.M. Ellison. 2004. **A primer of ecological statistics**. Sinauer Associates. Sunderland, MA.

Sokal, R. and F. J. Rohlf. (latest edition available). **Biometry**. W.H. Freeman and Co., San Francisco, CA. (NOTE: Newer edition available).

Course and instructional objectives: This course is intended to provide graduate students with the knowledge and tools necessary to conduct and analyze biological and ecological studies. The format will include lecture, class discussions (led by class members) of papers from the biological and ecological scientific literature focusing on analyzing experimental design and statistical analyses, and hands-on analysis of example biology/ecology datasets using SAS. The fundamentals of probability as it applies to biological sampling, experimental design, and statistical analysis will be covered. Data types and distributions, error types, power of the test, proper replication vs pseudo-replication, will be prime foci of the early weeks. Analysis topics include typical uses in biology and ecology of ANOVA (various types), MANOVA, regression, correlation, goodness of fit, mantel tests, failure-time analysis, and path analysis/structural equation modeling. A prior course in statistics is encouraged, but not absolutely required.

Schedule including topics covered: Example from Fall 2009

Week of	Topics
Aug. 31	Introduction to experimental design, hypothesis testing, & probability. Experimental design pitfalls & solutions. Type I & II errors. Power. Data types and distributions. Data reduction and descriptive statistics**.** Introduction to SAS. Papers (handed out early by email) to discuss are Hurlburt (1984), Heffner et al. (1996) (Ed Proffitt will lead this discussion).
Sept. 7	Introduction to ANOVA: Assumptions, utility, response variables, independent variables, Sum of square types. Testing for violation of assumptions. Data transformations. Residuals. Simple one-way ANOVA. Multiple comparisons of means: a priori and a posteriori tests – when and why? SAS PROC ANOVA , GLM, & MIXED: examples and problems. Class paper discussion (led by class member). Two "point-counter-point" Papers on the pseudoreplication debate: Oksanen (2001), and Hurlbert (2004).
Sept. 14	ANOVA con't. Block, two-way, and nested designs. Non-parametric alternatives (e.g., Kruskal-Wallis test).SAS: examples and problems. Paper discussions (led by class members). Papers: Day and Quinn (1989) and Stuart-Oaten et al. (1986). **Student Projects: Turn in dataset and brief description of the project to Ed by email NO LATER than TODAY. Ed will provide "go-ahead" approval within a day or two.**
Sept. 21	ANOVA con't. Split-plot, and repeated-measures designs. Non-parametric alternatives (e.g., Kruskal-Wallis test).SAS: examples and problems. Two class paper discussions (led by class members). Papers: Carpenter (1989), Gurevitch and Chester (1986).
Sept. 28	ANCOVA: ANOVA with covariate. MANOVA: Multiple response variables. SAS: examples and problems. Two class paper discussions (led by class members). Paper: and Underwood (1994) and Fry (1992).
Oct. 5	Introduction to correlation and regression. Assumptions, uses, types of. SAS: examples and problems. Two class paper discussions (led by class members). Schluter (1994), two letters to editor [Murtaugh / Bernardo et al and Schluter's reply].
Oct. 12	Continue regression. Uses and misuses. Examples from the biological literature. Logistic regression for dichotomous

	variables. SAS: examples and problems Two class paper discussions (led by class members). Papers: Ainley et al. (2003) and Dea'th and Fabricius (2000).
Oct. 19	Goodness of fit. Chi-square distribution and tests. Log-linear modeling. SAS: examples and problems. Two class paper discussions (led by class members). MacKenzie et al. (2005) and Sandin and Pacala (2005).
Oct. 26	**In class test.** (Ed off giving seminar at U Va)
Nov. 2	Multivariate analyses: Regression, Ordination, etc. SAS: examples and problems. Two class paper discussions (led by class members). Trexler and Travis (1993) and Grossman et al. (2006).
Nov. 9	Dr. Erik Noonburg – Introduction to Modeling
Nov. 16	Dr. Erik Noonburg – Introduction to Modeling. Also, **receive take-home final** sometime today by email from Ed
Nov. 23	Thanksgiving holiday
Nov. 30	Overview of some advanced topics: Mantel tests in field experiments, failure-time analysis, AIC & model selection and other topics suggested by class members as particularly important to their research. **Oral presentations (provide Ed with powerpoint files the DAY BEFORE class) of Student Projects (10 min. each).**
Dec. 2	Overview of some advanced topics: topics con't from last meeting, meta-analysis, & other topics suggested by class members as particularly important to their research. Class paper discussion (led by class member). Paper: Gotelli and McCabe (2002). **Last day to turn in take home final (no later than noon!!)**

Method of instruction: Lecture via Distance Learning. SAS use in departmental computer lab.

Assessment procedures including tests, quizzes and projects: Tests (take-home portion includes problems for statistical analysis via SAS and ensuing write-up), paper

discussions (address design and analysis in papers from the primary scientific literature), and a project (in depth data analysis and oral and written presentations).

Grading criteria: A >=90, B 80-89, C 70-79, etc. Students must perform on tests (2 tests, 35% of final grade each), project (20% of final grade), and in class discussions of papers (10% of final grade).

Accommodations for students with disabilities

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodations due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD) located in Boca Raton - SU 133 (561-297-3880), in Davie - MOD I (954-236-1222), in Jupiter - SR 117 (561-799-8585), or at the Treasure Coast - CO 128 (772-873-3305), and follow all OSD procedures.

Honor Code

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty, including cheating and plagiarism, is considered a serious breach of these ethical standards, because it interferes with the University mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the University community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see http://www.fau.edu/regulations/chapter4/4.001_Honor_Code.pdf.

From: Spyros Magliveras
To: Rod Murphey
Cc: Lianfen Qian ; Dragan Radulovic ; Hongwei Long ; Lee Klingler ; Bill Kalies
Sent: Fri Jan 09 11:54:47 2009
Subject: Exper. Design - Biometry

Dear Rod,

In a meeting we had in the Mathematical Sciences Department among colleagues who may have overlap interests with Exper. Design, we have agreed that the graduate course proposed by Dr. Ed. Proffitt, titled "Experimental Design and Biometry" is certainly a course related to the research activities in Biology and give our blessings to its establishment in the Biology Department.

Best wishes,

Spyros Magliveras
Professor and Chair, Mathematical Sciences - FAU
& Director, CCIS

Course name: **Experimental Design and Biometry**

Course number: BSC 6456

Section number:

Pre-requisites: None

Co-requisites: None, other than graduate standing

Required text: **Zar, J.H. (Edition 4). Biostatistical analysis. Prentice Hall, N.J.**

Supplementary texts: (placed on reserve)

Scheiner, S.M. and J. Gurevitch. 1993. **Design and analysis of ecological experiments**. Chapman & Hall, NY, NY.

Underwood, A.J. 1997. **Experiments in Ecology: Their logical design and interpretation using analysis of variance**. Cambridge University Press, Cambridge, U.K.

Gotelli, N.J. and A.M. Ellison. 2004. **A primer of ecological statistics**. Sinauer Associates. Sunderland, MA.

Sokal, R. and F. J. Rohlf. (latest edition available). **Biometry**. W.H. Freeman and Co., San Francisco, CA. (NOTE: Newer edition available).

Course and instructional objectives: This course is intended to provide graduate students with the knowledge and tools necessary to understand the statistical analyses that they read in the biology and ecology literature and to design and analyze biological data. The format will include lecture, class discussions, written evaluations of papers on topics from the biological literature (focusing the study designs and statistical techniques used in those studies). Also, students will learn the fundamentals of using SAS to analyze biology and ecology datasets; and, the proper oral and written presentation of statistical analyses. The basics of probability as it applies to biological sampling, experimental design, and statistical analysis also will be covered. Data types and distributions, error types, power of the test, proper replication vs pseudo-replication, will be prime foci of the early weeks. Analytical topics include typical uses in biology and ecology of ANOVA (various models), MANOVA, regression, correlation, goodness of fit, mantel tests, failure-time analysis, and path analysis/structural equation modeling. Near the end, we will discuss an entirely different approach to statistical analysis: Model Selection and Multi-model Inference. A prior course in statistics is encouraged, but not required.

Schedule including topics covered: **Example from Fall 2010**

Week of	Topics (* see Homework note below)
Aug. 24 (Tu & Th)	Introduction to experimental design, hypothesis testing, & probability. **Experimental design pitfalls & solutions**. Type I & II errors. Power. Data types and distributions. Data reduction and descriptive statistics**.** Introduction to SAS**..** Introduction to SAS. **Receive scientific papers on pseudoreplication assigned you're your written critique (turn in by Th Sept 16).** Papers to include at a minimum are Hurlburt (1984), Oksanen (2001), Hurlbert (2004), & Heffner et al. (1996). **Receive first statistics SAS homework* assignment (basics of SAS, data distributions, transformations, etc) and turn in by email to ktiling@gmail.com by Tu Aug 31.**
Aug 31	**Introduction to ANOVA**: Assumptions, utility, response variables, independent variables, Sum of square types. Testing for violation of assumptions. Data transformations. Residuals. Simple one-way ANOVA. Multiple comparisons of means: a priori and a posteriori tests – when and why? SAS PROC ANOVA , GLM, & MIXED: examples and problems. **Receive second statistics SAS homework* assignment and turn in by email to ktiling@gmail.com by Tu Sept 7.**
Sept. 7	ANOVA con't. **Block, two-way, and nested designs**. Non-parametric alternatives (e.g., Kruskal-Wallis test).SAS: examples and problems. **Receive third statistics SAS homework* assignment and turn in by email to ktiling@gmail.com by Tu Sept 14.**
Sept. 14	ANOVA con't. **Split-plot, and repeated-measures** designs. Non-parametric alternatives (e.g., Kruskal-Wallis test). **Receive fourth statistics SAS homework* assignment and turn in by email to ktiling@gmail.com by Tu Sept 21.**
Sept. 21	**ANCOVA** (ANOVA with a continuous variable "covariate"). **MANOVA**: Multiple response variables. SAS: examples and problems. **Receive fifth homework assignment and turn in by email to ktiling@gmail.com by Sept 28.**
Sept. 28	**Introduction to correlation and regression.** Assumptions, uses, types of. SAS: examples and problems. **No homework assignment this week.**
Oct. 5	**Multiple regression.** Examples from the biological literature. SAS: examples and problems
Oct. 12	Continue **regression including non-linear** approaches. Introduce multiple regression and model selection. Examples

	from the biological literature. SAS: examples and problems. **Receive sixth homework assignment and turn in by email to ktiling@gmail.com by Oct 19.**
Oct. 14 (Thurs.)	**TEST 1: All material to date (in class test)**
Oct. 19	Continue introduction to **multivariate regression** and other techniques (**PCA, Ordination, MDS**, etc.). **Categorical** and binary data analysis. Logistic regression for dichotomous variables. Goodness of fit. Chi-square distribution and tests. **Logit and Log-linear modeling**. SAS: examples and problems. **Receive seventh homework assignment and turn in by email to ktiling@gmail.com by Oct 26.**
Oct. 26	Introduction to **path analysis** and Structural Equation Modeling. **Receive eighth homework assignment and turn in by email to ktiling@gmail.com by Nov 2.**
Nov. 2	Continue Structural Equation Analysis. Begin failure-time (**survival analysis**) methods. **Receive ninth homework assignment and turn in by email to ktiling@gmail.com by Nov 9.**
Nov. 9	**Intervention Analysis** (ARMA). Overview of some other advanced topics: **Mantel** tests in field experiments, other topics suggested by class members as particularly important to their research. NOTE: Thursday is a holiday (veterans day). **Receive tenth homework assignment and turn in by email to ktiling@gmail.com by Nov 16.**
Nov. 16	Overview of some **advanced topics**: topics con't from last meeting, meta-analysis, & begin **Model Selection & Multi-model Inference**. **Receive take-home final** by Friday of this week by email from Ed. This covers **ALL TOPICS** covered to date in the course, but emphasis is on material since the first test. Format will be SAS problems to work and essay questions.
Nov 23	Turkey Day Holiday (Nov 26-29). Plenty of time to work on that final!
Nov 30	Continue **Model Selection & Multi-model Inference**. Advanced topics suggested by students. **Last day to *turn in* take home final by email (no later than high noon!)**
Dec 7 (finals week)	Last lecture: advanced topics con't. Course wrap-up.

* Homework Note: In each assignment you will have one-to-several problems to work, which will often include setting up and running SAS and interpreting the results.

Method of instruction: Lecture via Distance Learning. SAS use in departmental computer lab.

Assessment procedures including tests, quizzes and projects: Tests (two, 35% of the course grade each), paper discussions and one written critique (addressing design and analysis in papers from the primary scientific literature, cumulatively count 10% of the course grade), and (data analysis of problems done using SAS as homework, all together count 20% of the course grade).

Grading criteria: Tests have in-class (short answer and essay questions) and take home (problems in data analysis using sas). Answers to take home problems and assigned homework problems will be evaluated as to completeness and correctness of the statistical analysis, and quality of write-up of explanation of the results and analyses. Paper discussions will be evaluated by assessing the number and quality of comments made. The written critique is usually a discussion of the arguments for and against the concept of pseudoreplication.

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