

CURRICULUM PROPOSAL COVER SHEET  
University-Wide Undergraduate Curriculum Committee

LSC Use Only  
Number LS 58  
Action A  
Date 2-2-89

UWUCC Use Only  
Number \_\_\_\_\_  
Action \_\_\_\_\_  
Date \_\_\_\_\_

I. TITLE/AUTHOR OF CHANGE

COURSE/PROGRAM TITLE MATH 216 PROB & STAT FOR BIOLOGY  
DEPARTMENT MATHEMATICS  
CONTACT PERSON DR. JOHN BROUGHTON

II. THIS COURSE IS BEING PROPOSED FOR:

- Course Approval Only  
 Course Approval and Liberal Studies Approval  
 Liberal Studies Approval only (course previously has been approved by the University Senate)

III. APPROVALS

Deborah Shaler  
Department Curriculum Committee

Stanley Wilson  
College Curriculum Committee

Richard D. Carter  
Director of Liberal Studies  
(where applicable)

John Broughton  
Department Chairperson

Gene Ho Katz  
College Dean\*

\_\_\_\_\_  
Provost  
(where applicable)

\*College Dean must consult with Provost before approving curriculum changes. Approval by College Dean indicates that the proposed change is consistent with long range planning documents, that all requests for resources made as part of the proposal can be met, and that the proposal has the support of the university administration.

IV. TIMETABLE

Date Submitted  
to LSC \_\_\_\_\_  
to UWUCC \_\_\_\_\_

Semester/Year to be  
implemented \_\_\_\_\_

Date to be published  
in Catalog \_\_\_\_\_

COURSE NUMBER: MA 216  
COURSE TITLE: Probability and Statistics for Biology  
CREDITS: 4 Semester Hours  
PREREQUISITES: MA 121 Calculus I for Natural, Social Science & Business

CATALOG DESCRIPTION:

Frequency distributions, measures of central tendency and variation, probability, probability distributions, sampling distributions. Hypothesis testing for means, variances, proportions. Estimation of means, variances, proportions. Correlation and prediction, regression, analysis of variance, and nonparametric statistics. Emphasis will be placed on biological applications. Four hours lecture per week.

COURSE OUTLINE:

- I. Introduction
  - A. Illustrative Statistical Problems
  - B. The Population and the Sample
  - C. The Essential Elements of a Statistical Problem
  - D. The Role of Statistics and the Statistician
  
- II. Describing Distributions of Measurement
  - A. Graphical Methods
  - B. Numerical Methods
  - C. Measures of Central Tendency
  - D. Measures of Dispersion
  
- III. Probability
  - A. The Sample Space
  - B. The Probability of an Event
  - C. Counting Techniques-Permutations and Combinations
  - D. Probabilities of Compound Events
  
- IV. Probability Distributions
  - A. Random Variables
  - B. Probability Distributions of Discrete Random Variables
  - C. The Mean and Variance for Probability Distributions of Discrete Random Variables
  - D. The Binomial Distribution
  - E. The Poisson Distribution
  - F. Probability Distributions of Continuous Random Variables
  - G. The Normal Distribution
  - H. The Normal Approximation to the Binomial Distribution

V. Sampling Distribution

- A. Simple Random Sampling
- B. Distribution of Sampling Means
- C. The Central Limit Theorem
- D. Applications of the Central Limit Theorem

VI. Large-Sample Statistical Inference

- A. Types of Estimators
- B. Point Estimation of a Population Mean
- C. Interval Estimation of a Population Mean
- D. Estimating the Difference Between Two Means
- E. Estimating the Parameter of a Binomial Population
- F. Estimating the Difference Between Two Binomial Parameters
- G. Choosing the Sample Size in Finding an Estimate
- H. Nature of Hypothesis Testing
- I. Large-Sample Hypothesis Testing

VII. Inference from Small Samples

- A. Student's  $t$  Distribution
- B. Small-Sample Inferences Concerning a Population Mean
- C. Small-Sample Inferences Concerning the Difference Between Two Means
- D. A Paired-Difference Test
- E. Inferences Concerning a Population Variance
- F. Inferences Concerning Comparing Two Population Variances

VIII. Linear Regression and Correlation

- A. A Simple Linear Probabilistic Model
- B. The Method of Least Squares
- C. A Regression Equation
- D. Inferences Concerning the Slope of the Line
- E. Predicting a Value of  $y$  for a Given Value of  $x$
- F. A Coefficient of Correlation
- G. A Multivariable Predictor

IX. Analysis of Enumerative Data

- A. The Chi-Square Test
- B. Comparing Specified Cell Probabilities
- C. Contingency Tables
- D. Tests of Goodness of Fit
- E. Tests of Independence
- F. Tests of Homogeneity

X. Analysis of Variance

- A. A Comparison of More Than Two Means
- B. The Completely Randomized Design
- C. The Randomized Block Design
- D. The Factorial Experiment

XI. Nonparametric Statistics

- A. The Sign Test
- B. The Mann-Whitney U Test
- C. The Runs Test
- D. Rank Correlation Coefficient
- E. Analysis of Variance by Ranks
- F. Comparing Statistical Tests

### PART III (MA 216)

A. There will be a common syllabi of topics that should be covered by each of the individual instructors teaching this course. Such common syllabi should include but not be limited to topics which introduce the student to deductive reasoning, develop in the student problem solving skills, and enable the student not only to understand the underlying principles of formulae but also to have the ability to use and interpret numerical data.

B. Whenever appropriate, information will be introduced into the classroom discussion which will reflect the contributions made to mathematics by women and by racial minorities.

C. The Statistics Curriculum Committee of the Mathematics Department will provide a minimum reading list for this course. Instructors will be encouraged to supplement this reading list with appropriate magazine/journal/etc. articles pertinent to the mathematics material discussed in this course. Additionally, instructors could require the students to report in writing on articles they have discovered through their reading which pertain to mathematics and/or applications of mathematics.

D. The thrust of MA 216 is to introduce the study of probability theory and statistics to mainly natural science majors. An additional goal is to develop in the student an awareness of and an appreciation for the power and usefulness of mathematics and its important role in a technological society. In particular, it should prepare the student for the further study of other mathematics courses and/or natural science courses. A partial list of topics that would be appropriate for this course would include descriptive statistics; probability; discrete and continuous probability distributions; statistical inference; sampling theory; large-sample statistical inference; small-sample statistical inference; linear regression and correlation; analysis of enumerative data; analysis of variance; and nonparametric statistics. The emphasis in this course will be applications of the topics studied. These topics would provide the course with a suitable mathematical strata that would improve the mathematical maturity of students to the point where they would be prepared to enroll in other mathematics or natural science courses which require MA 216 as a prerequisite. Additionally, this course would enable the student to develop confidence in handling numerical problems, would present the student with an opportunity to develop an appreciation for mathematics, and would allow the introduction to students of hand held calculators and possibly computers.

E. #2.- The very nature of mathematical study requires that problems be clearly analyzed and defined, that solutions be generated for such problems, and that an interpretation be assigned to each possible solution in order that a correct choice may be made.

#4.- Mathematics is exactly the art of creative thinking. One moves from the collection of data to the definition of the problem to the abstract generalization in which a solution or solutions are constructed to the interpretation of the solution or solutions

to the application of the solution(s). This process requires one to recognize creativity and to engage in creative thinking.

#5.- One is constantly exposed to information which needs the principles of mathematics for proper interpretation. Skills mastered in this course can last one a life time.

ADDENDUM TO THE SYLLABI FOR THE COURSES MA 214, MA 216, and MA 217

Course Objectives for the Statistics Courses MA 214, MA 216, and MA 217:

I. General Objectives:

- A. Students will develop an appreciation for the nature, the breadth, and the power of mathematics and for its role in a technological society.
- B. Students will develop an understanding for the application of mathematics to the development of statistics.
- C. Students will develop computational skills using the techniques studied in class.
- D. Students will learn to communicate in the language of statistics. This learning will involve reading, writing, listening, and speaking.
- E. Students will study the development of a body of principles and methods concerned with extracting useful information from numerical data.
- F. Students will study the two basic areas of statistics: descriptive statistics and inferential statistics.

II. Some Specific Course Objectives:

- A. Students will be able to represent data in frequency distributions and other graphical representations.
- B. Students will understand and be able to compute data parameters such as mean, median, mode, variance, and standard deviation.
- C. Students will study data represented in both ungrouped and grouped form and will understand the relationship between the two categories.
- D. Students will study the basic principles of probability including probability trees and Bayes' Theorem.
- E. Students will use the principles of probability to study random variables and their probability distributions.
- F. Students will study specific probability distributions such as binomial, poisson, and normal.
- G. Students will apply the principles of probability to develop the theory of sampling.
- H. Students will study the sampling distribution of  $\bar{x}$  sampling distribution random variables.
- I. Students will apply the principles of probability to develop the method of confidence interval estimation.
- J. Students will apply the principles of sampling distributions to the construction of hypothesis tests for certain random variables.
- K. Students will use the results of their study of hypothesis testing to study analysis of variance and chi-square tests.
- L. Students will use the principles of statistics to study linear correlation and non-parametric statistics.

# LIBERAL STUDIES COURSE APPROVAL FORM

**About this form:** Use this form only if you wish to have a course included for Liberal Studies credit. The form is intended to assist you in developing your course to meet the university's Criteria for Liberal Studies, and to arrange your proposal in a standard order for consideration by the LSC and the UWUCC. If you have questions, contact the Liberal Studies Office, 353 Sutton Hall; telephone, 357-5715.

**Do not** use this form for technical, professional, or pre-professional courses or for remedial courses, none of which is eligible for Liberal Studies. **Do not** use this form for sections of the synthesis course or for writing-intensive sections; different forms will be available for those.

## PART I. BASIC INFORMATION

**A. For which category(ies) are you proposing the course? Check all that apply.**

### LEARNING SKILLS

- First English Composition Course
- Second English Composition Course
- Mathematics

### KNOWLEDGE AREAS

- Humanities: History
- Humanities: Philosophy/Religious Studies
- Humanities: Literature
- Fine Arts
- Natural Sciences: Laboratory Course
- Natural Sciences: Non-laboratory Course
- Social Sciences
- Health and Wellness
- Non-Western Cultures
- Liberal Studies Elective

**B. Are you requesting regular or provisional approval for this course?**

- Regular       Provisional (limitations apply, see instructions)

*new course*

**C. During the transition from General Education to Liberal Studies, should this course be listed as an approved substitute for a current General Education course, thus allowing it to meet any remaining General Education needs?  yes  no**

**If so, which General Education course(s)?** MA 101 MA 110



**PART II. WHICH LIBERAL STUDIES GOALS WILL YOUR COURSE MEET? Check all that apply and attach an explanation.**

All Liberal Studies courses must contribute to at least one of these goals; most will meet more than one. As you check them off, please indicate whether you consider them to be primary or secondary goals of the course. [For example, a history course might assume "historical consciousness" and "acquiring a body of knowledge" as its primary goals, but it might also enhance inquiry skills or literacy or library skills.] Keep in mind that no single course is expected to shoulder all by itself the responsibility for meeting these goals; our work is supported and enhanced by that of our colleagues teaching other courses.

	<b>Primary</b>	<b>Secondary</b>
<b>A. Intellectual Skills and Modes of Thinking:</b>		
1. Inquiry, abstract logical thinking, critical analysis, synthesis, decision making, and other aspects of the critical process.	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2. Literacy--writing, reading, speaking, listening	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3. Understanding numerical data	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4. Historical consciousness	<input type="checkbox"/>	<input type="checkbox"/>
5. Scientific inquiry	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. Values (ethical mode of thinking or application of ethical perception)	<input type="checkbox"/>	<input type="checkbox"/>
7. Aesthetic mode of thinking	<input type="checkbox"/>	<input type="checkbox"/>
<b>B. Acquiring a Body of Knowledge or Understanding Essential to an Educated Person</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>C. Understanding the Physical Nature of Human Beings</b>	<input type="checkbox"/>	<input type="checkbox"/>
<b>D. Certain Collateral Skills:</b>		
1. Use of the library	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2. Use of computing technology	<input checked="" type="checkbox"/>	<input type="checkbox"/>

## ADDENDUM TO LIBERAL STUDIES PROPOSALS: PART II

The Liberal Studies Goals met by the Statistics Courses MA 214  
MA 216, and MA 217:

### A. Intellectual Skills and Modes of Thinking:

1. Inquiry, abstract logical thinking, critical analysis, synthesis, decision making, and other aspects of the critical process is a primary goal of the course. It is apparent that the study of Mathematics requires that the student learn to apply the pattern of using these categories to collect data, clearly state the problem under study, apply the methods known to affect a solution to the problem, and then to analyze and interpret the resulting solution.
2. Literacy-writing, reading, speaking, listening, is a secondary goal of this course. All of these areas can be applied and improved during a course of study in mathematics. Reading skills are absolutely necessary for a clear understanding of the material; the writing of solutions to mathematical problems requires clarity of mind and organization of thought; the requirement of discussing mathematics in the classroom shows the student the importance of clear patterns of thinking and of the expression of those thoughts orally; and listening skills are very important in the understanding of mathematics. These skills can be improved through the writing of tests and of assigned papers, through the oral response to classroom questions, and through the reading of assignments.
3. Understanding numerical data is a primary goal of this course. No data is meaningful without interpretation and the study of mathematics attempts to train the student in the methods and skills needed to interpret data correctly.
4. Historical consciousness is a secondary goal. Students should have some awareness of the historical significance of the role of mathematical statistics in the development of western and other civilizations, and its importance in contemporary technological times.
5. Scientific inquiry is a secondary goal. Students should be made aware of the importance of mathematical logic and its role in statistics and in the application of statistics to evaluate data in all areas of human study.
6. Aesthetic mode of thinking is a secondary goal. Statistics to mathematicians and statisticians is a beautiful art form for communication. An effort should be made to develop in the student a sense of this beauty and an appreciation for its power and utility.

### B. Acquiring a Body of Knowledge or Understanding Essential to an Educated Person:

#### Secondary Goal

Although specific mastery of statistics is not required of all students, it is important that students studying statistics develop a sense of the importance and utility of statistics to society. In

addition, the course of study should develop in the student a feeling of confidence in their own ability to use the statistical skills that have been learned in their particular course.

D. Certain Collateral Skills:

2. Use of computing technology is a secondary goal. Students need to be aware of the technology available in computing as it applies to statistics. Where possible, appropriate software can be discussed even if only briefly.

**PART III. DOES YOUR COURSE MEET THE GENERAL CRITERIA FOR LIBERAL STUDIES?** Please attach answers to these questions.

- A. If this is a multiple-section, multiple-instructor course, there should be a basic equivalency (though not necessarily uniformity) among the sections in such things as objectives, content, assignments, and evaluation. Note: this should not be interpreted to mean that all professors must make the same assignments or teach the same way; departments are encouraged to develop their courses to allow the flexibility which contributes to imaginative, committed teaching and capitalizes on the strengths of individual faculty.

**What are the strategies that your department will use to assure that basic equivalency exists?** Examples might be the establishment of departmental guidelines, assignment of responsibility to a coordinating committee, exchange and discussion of individual instructor syllabi, periodic meetings among instructors, etc.

- ✓ B. Liberal Studies courses must include the perspectives and contributions of ethnic and racial minorities and of women wherever appropriate to the subject matter. **If your attached syllabus does not make explicit that the course meets this criterion, please append an explanation of how it will.**

- C. Liberal Studies courses must require the reading and use by students of at least one, but preferably more, substantial works of fiction or nonfiction (as distinguished from textbooks, anthologies, workbooks, or manuals). **Your attached syllabus must make explicit that the course meets this criterion.**

[The only exception is for courses whose primary purpose is the development of higher level quantitative skills; such courses are encouraged to include such reading, but are not expected to do so at the expense of other course objectives. If you are exercising this exception, please justify here.]

- D. If this is an introductory course intended for a general student audience, it should be designed to reflect the reality that it may well be the only formal college instruction these students will have in that discipline, instead of being designed as the first course in a major sequence. That is, it should introduce the discipline to students rather than introduce students into the discipline. **If this is such an introductory course, how is it different from what is provided for beginning majors?**

ADDENDUM TO LIBERAL STUDIES PROPOSALS: PART III

B. Whenever appropriate, information will be introduced into the classroom discussion which will reflect the contributions made to mathematics by women and by minorities. Particular attention will be given to the following areas as they relate to this topic:

1. The classroom discussion will be sensitive to gender balancing with respect to language.
2. Quizzes, tests, examinations, and any other written information distributed to the students will be sensitive to gender balancing, especially in problem construction, and to minorities whenever possible.
3. Specific names and contributions made by women and other members of minority groups will be discussed in the classroom when the discussion of such is germane to the material being studied. It should be noted though that mathematics has been the domain of the male throughout history and only in recent time has there been numbers of women involved. Even today, there are too few women in the field of mathematics.

E. The Liberal Studies Criteria indicate six ways in which all courses should contribute to students' abilities. To which of the six will your course contribute? Check all that apply and attach an explanation.

1. Confront the major ethical issues which pertain to the subject matter; realize that although "suspended judgment" is a necessity of intellectual inquiry, one cannot live forever in suspension; and make ethical choices and take responsibility for them.
2. Define and analyze problems, frame questions, evaluate available solutions, and make choices
3. Communicate knowledge and exchange ideas by various forms of expression, in most cases writing and speaking.
4. Recognize creativity and engage in creative thinking.
5. Continue learning even after the completion of their formal education.
6. Recognize relationships between what is being studied and current issues, thoughts, institutions, and/or events.

**PART IV. DOES YOUR COURSE MEET THE CRITERIA FOR THE CURRICULUM CATEGORY IN WHICH IT IS TO BE LISTED?**

Each curriculum category has its own set of specific criteria in addition to those generally applicable. The LSC provides copies of these criteria arranged in a convenient, check-list format which you can mark off appropriately and include with your proposal. The attached syllabus should indicate how your course meets each criterion you check. If it does not do so explicitly, please attach an explanation.

**CHECK LIST -- MATHEMATICS**  
**(Learning Skills Area)**

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**Mathematics Criteria which the Course must meet:**

- Introduce students to deductive reasoning
- Develop in the student problem solving techniques appropriate for the course.
- Enable the student to understand the underlying principles of formulas.
- Enable the student to use and interpret numerical information.

**Courses appropriate to the Mathematics Learning Skills Area must be either:**

- A. Mathematics courses that develop significant mathematical skills required by a major discipline.
- B. Mathematics courses designed for Liberal Studies.

**Additional criteria which courses in Category B must meet:**

- Develop the student's confidence in handling numerical problems and data.
- Be sensitive to the diverse background characteristics of the student.
- Include elements on the history or appreciation of mathematics.
- Introduce the hand-held calculator or the computer as a tool.