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Number: _____
Submission Date: _____
Action-Date: _____

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MAY - 4 2000
LIBERAL STUDIES

UWUCC USE Only
Number: 00-27
Submission Date: _____
Action-Date: UWUCC App 10/17/00
Senate App 11/7/00

CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

I. CONTACT

Contact Person Gerald Buriok Phone 357 2608

Department Mathematics

II. PROPOSAL TYPE (Check All Appropriate Lines)

Rev.

RECEIVED
OCT - 3 2000
LIBERAL STUDIES

X **COURSE** Prob & Stats Nat Sci
Suggested 20 character title

____ New Course* _____
Course Number and Full Title

X Course Revision MA 216 Probability and Statistics for Natural Sciences
Course Number and Full Title

____ Liberal Studies Approval+ for new or existing course _____
Course Number and Full Title

____ Course Deletion _____
Course Number and Full Title

____ Number and/or Title Change _____
Old Number and/or Full Old Title

_____
New Number and/or Full New Title

X Course or Catalog Description Change MA216 Probability and Statistics for Natural Sciences
Course Number and Full Title

_____ **PROGRAM:** _____ Major _____ Minor _____ Track

____ New Program* _____
Program Name

____ Program Revision* _____
Program Name

____ Program Deletion* _____
Program Name

____ Title Change _____
Old Program Name

_____
New Program Name

III. Approvals (signatures and date)

Mary V. Shaver 3/3/00
Department Curriculum Committee

Gerald Buriok 3/3/00
Department Chair

05/01/00
College Curriculum Committee

John D. Ed 5/2/00
College Dean

+Director of Liberal Studies (where applicable)

*Provost (where applicable)

Part II. Description of Curriculum Change.

1. New syllabus of record: attached.

2. Summary of the proposed revisions: The current catalog description of MA216 lists only MA121 as a prerequisite. The proposed revision would change the prerequisite to MA121 or MA123.

2. Justification/rationale for the revision: MA216 Probably and Statistics for Natural Sciences was originally developed as a course for students whose major was science related. In 1994, the Mathematics Department revised requirements for Applied Mathematics and Mathematics majors to include MA216. In 1998, the Mathematics Department revised the requirements for Secondary Mathematics majors to include MA216. Thus the clientele for MA216 includes the students for whom it was originally intended, along with students majoring in programs in the Mathematics Department.

MA216 was originally approved with a prerequisite of MA121 Calculus I for Business, Natural and Social Sciences. MA121 is a course in calculus for non-mathematics majors, and it was understood that students taking the more rigorous first course in calculus, MA123 Calculus I for Physics, Chemistry, Mathematics, also knew the prerequisite material and were qualified to take the course. However, with the coming of registration on BANNER, the computer will not permit students to register for a course unless they satisfy the exact list of prerequisites in the catalog. This means that approximately thirty students who have completed MA123 will be barred from registering for MA216, when in fact they are fully qualified to take the course.

The coming of BANNER is forcing the Mathematics Department to correct a deficiency in the catalog description of MA216, and properly so. This change will have no effect on the course.

4. Old syllabus of record.

5. The Liberal Studies Committee will be informed of the proposed change.

Part III. Letters of Support.

Syllabus of Record

I. Catalog Description

MA 216 Probability and Statistics for Natural Sciences

4 semester hours
4 lecture hours
0 lab hours
(4c-0l-4sh)

Prerequisites: MATH 121 or MATH 123

Frequency distributions, measures of central tendency and variation, probability, probability distributions, sampling distributions. Hypothesis testing for means, variances, proportions. Correlation and prediction, regression, analysis of variance, and nonparametric statistics. Emphasis on applications.

II. Course Objectives

1. Students will know the basics concepts of probability and how to apply them.
2. Students will know how to determine probabilities associated with random variables.
3. Students will know how to create and interpret the basic graphical representations of data.
4. Students will know how to use confidence intervals and tests of hypothesis for making decisions about populations based on sample data.

III. Course Outline

1. Describing Data with Graphs (3 Lectures)
   - 1.1 Variables and Data
   - 1.2 Types of Variables
   - 1.3 Graphs for Categorical Data
   - 1.4 Graphs for Quantitative Data
   - 1.5 Interpreting Graphs with a Critical Eye
2. Describing Data with Numerical Measures (3 Lectures)
   - 2.1 Measures of Center
   - 2.2 Measures of Variability
   - 2.3 Practical Significance of the Standard Deviation
   - 2.4 Measures of Relative Standing
   - 2.5 The Boxplot
3. Describing Bivariate Data (2 Lectures)
   - 3.1 Graphs for Qualitative Variable
   - 3.2 Scatterplots
   - 3.3 Numerical Measures for Quantitative Bivariate Data
4. Probability (5 Lectures)
   - 4.1 Events and the Sample Space
   - 4.2 Calculating Probabilities using Simple Events

4.3 Event Composition and Event Relations
4.4 Conditional Probability and Independence
4.5 Bayes' Rule (optional)

5. Discrete Distributions (3 Lectures)
5.1 Discrete Random Variables and their Distributions
5.2 The Mean and Standard Deviation for a Discrete Random Variable
5.3 The Binomial Distribution
5.4 The Poisson Distribution

6. The Normal Distribution (3 Lectures)
6.1 Probability Distributions for Continuous Random Variables
6.2 The Normal Probability Distribution
6.3 The Normal Approximation to the Binomial Distribution

7. Sampling Distributions (3 Lectures)
7.1 Sampling Plans and Experimental Designs
7.2 Statistics and Sampling Distributions
7.3 The Central Limit Theorem
7.4 The Sampling Distribution of the Sample Mean
7.5 The Sampling Distribution of the Sample Proportion

8. Large Sample Estimation (2 Lectures)
8.1 Point Estimation
8.2 Interval Estimation for Means and Proportions

9. Large Sample Tests of Hypothesis (6 Lectures)
9.1 The Statistical Test of Hypothesis
9.2 Test for a Population Mean
9.3 Test for Two Population Means
9.4 Test for a Population Proportion
9.5 Test for Two Population Proportions

10. Inference from Small Samples (5 Lectures)
10.1 Student's t Distribution
10.2 Small sample Inference for a Population Mean
10.3 Small sample Inference for Two Population Means
10.4 Paired Difference Test
10.5 Inference for a Population Variance
10.6 Comparing Two Population Variances

11. Analysis of Variance (4 Lectures)
11.1 What is Analysis of Variance?
11.2 Completely Randomized Design
11.3 Randomized Complete Block Design
11.4 Two-way ANOVA with Interaction

12. Linear Regression and Correlation (4 Lectures)
12.1 The Simple Linear Probabilistic Model
12.2 The Method of Least Squares
12.3 ANOVA for Linear Regression
12.4 Inference Concerning the Slope

12.5 Estimation and Prediction

13. Multiple Regression (3 Lectures)
    - 13.1 The Multiple Regression Model
    - 13.2 Multiple Regression Analysis
    - 13.3 Interpreting Residual Plots
    - 13.4 Stepwise Regression Analysis
    - 13.5 Building a Multiple Regression Model

14. Analysis of Categorical Data (3 Lectures)
    - 14.1 Pearson's Chi-Square Statistic
    - 14.2 Goodness-of-Fit
    - 14.3 Contingency Tables

15. Nonparametric Statistics (4 Lectures)
    - 15.1 Wilcoxon Rank Sum Test
    - 15.2 Wilcoxon Signed-Rank Test
    - 15.3 Kruskal-Wallis Test
    - 15.4 Friedman Test
    - 15.5 Rank Correlation Coefficient

IV. Evaluation Methods

The final grade for the course will be determined as follows:

70% Tests. Three tests, each worth 100 points, and a final exam worth 120 points. Tests will include definitions, problem-solving, derivations, and proofs.

13% Quizzes. Eight quizzes worth 10 points each.

17% Project. Each student will prepare a 3-4 page paper worth 100 points on a statistical analysis of data of interest to them. The instructor's approval must be obtained. The paper will be due at the end of the semester.

A total of 600 points are possible. Grades will be assigned as follows:

A - 540 to 600
B - 480 to 539
C - 420 to 479
D - 360 to 410
F - 359 and below

V. Required textbooks , supplemental books and readings

Textbook: Mendenhall, Beaver, Beaver, *Introduction to Probability and Statistics*, 10th Ed., Duxbury Press, 1999.

Supplemental Materials:

Greenberg, B.S, *Minitab Guide for Moore's* The Basic Practice of Statistics, 2nd Ed., W.H. Freeman, New York, 1999.

VI. Special resource requirements

None

VII. Bibliography

Moore, D.S. and McCabe, G.P., *Introduction to the Practice of Statistics*, 3rd Ed., W.H. Freeman, New York, 1999.

MA 216 Syllabus

Mathematics Department
Indiana University of Pennsylvania
Indiana, PA 15705

Course Number: MA 216

Course Title: Probability and Statistics for Natural Sciences

Credits: 4 semester hours

Prerequisites: MA 121, or 123, or 127

Textbook: **Introduction to the Practice of Statistics**
Moore
Freeman

Revised: 9/94

Catalog Description:

Frequency distributions, measures of central tendency and variation, probability, probability distributions, sampling distributions. Hypothesis testing for means, variances, proportions. Correlation, regression, analysis of variance, and nonparametric statistics. Emphasis on applications. The computer is used for data analysis.

Course Outline

I. Looking at Data: Distributions
- A. Displaying Distributions
  1. Measurement
  2. Variation
  3. Stemplots
  4. Histograms
  5. Looking at Data
  6. Time Plots
- B. Describing Distributions
  1. Measuring Center
  2. Resistant Measures of Spread
  3. The Standard Deviation
  4. Changing the Unit of Measurement
- C. The Normal Distributions
  1. Density Curves
  2. Normal Distributions
  3. Normal Distribution Calculations
  4. Assessing Normality

II. Looking at Data: Relationships
- A. Scatterplots
  1. Interpreting Scatterplots
  2. Smoothing Scatterplots
  3. Categorical Explanatory Variables
- B. Least Squares Regression
  1. Fitting a Line to Data

2. Least-Squares Regression
3. Residuals
4. Outliers and Influential Observations

C. Correlation
1. Computing the Correlation
2. Correlation in the Regression Setting
3. Interpreting Correlation and Regression

D. Relations in Categorical Data
1. Analyzing Two-Way Tables
2. Simpson's Paradox

E. The Question of Causation
1. Smoking and Lung Cancer
2. Establishing Causation

III. Producing Data

A. First Steps
1. The Need for Design
2. Sampling
3. Experiments

B. Design of Experiments
1. Comparative Experiments
2. Randomization
3. How to Randomize
4. Cautions about Experimentation
5. Other Experimental Designs

C. Sampling Design
1. Simple Random Samples
2. Other Sampling Designs
3. Cautions about Sample Surveys

D. Toward Statistical Inference
1. Sampling Distributions
2. Bias
3. Variability
4. What about Experiments?
5. Conclusion

IV. Probability: The Study of Randomness

A. Probability Models
1. Sample Spaces
2. Assigning Probabilities
3. Addition and Multiplication Rules

B. Random Variables
1. Discrete Random Variables
2. Continuous Random Variables

C. Means and Variances of Random Variables
1. The Mean of a Random Variable
2. The Law of Large Numbers
3. Rules for Means
4. The Variance of a Random Variable
5. Rules for Variances

D. Probability Laws
1. General Addition Rules
2. Conditional Probabilities and General Multiplication Rules

V. From Probability to Inference

A. Counts and Proportions
1. The Binomial Distributions
2. Binomial Probabilities
3. Binomial Mean and Variance
4. Sample Proportions
5. Normal Approximation for Proportions and Counts

B. Sample Means
1. The Distribution of a Sample Mean

2. The Central Limit Theorem

C. Control Charts
1. Control Charts
2. Out-of-Control Signals

VI. Introduction to Inference
A. Estimating with Confidence
1. Statistical Confidence
2. Confidence Intervals
3. How Confidence Intervals Behave
B. Tests of Significance
1. The Nature of Significance Testing
2. Tests for a Population Mean
3. Tests with Fixed Significance Level
C. Use and Abuse of Tests
1. Using Significance Tests
2. Abuse of Significance Tests
3. Power
4. Inference As Decision

VII. Inference for Distributions
A. Inference for the Mean of a Population
1. The One-Sample t Procedures
2. Matched Pairs t Procedures
3. The Power of the t Test
4. Inference for Nonnormal Populations
B. Comparing Two Means
1. The Two-Sample z Statistic
2. The Two-Sample t Procedures
3. The Pooled Two-Sample t Procedures

VIII. Inference for Count Data
A. Inference for a Single Proportion
1. Confidence Intervals and Significance Tests
2. Choosing A Sample Size

B. Comparing Two Proportions
1. Confidence Intervals
2. Significance Tests
C. Inference for Two-Way Tables
1. Describing Relations in Two-Way Tables
2. The Chi-Square Test
3. Computations
4. Models for Two-Way Tables

IX. Inference for Regression
A. Simple Linear Regression
1. Statistical Model For Linear Regression
2. Estimating the Regression Parameters
3. Confidence Intervals and Significance Tests
4. Confidence Intervals For Mean Response
5. Prediction Intervals
6. Analysis of Variance For Regression
7. Calculations for Regression Inference
8. Inference for Correlation

X. Analysis of Variance
A. One-Way Analysis of Variance
1. Comparing Means
2. The ANOVA Model
3. The ANOVA Table and the F Test
4. Multiple Comparisons

Supplemental Materials:

Telecourse Study Guide for Against All Odds and Introduction to the Practice of Stat
Author: Moore
Publisher: Freeman

Minitab Guide: Introduction to the Practice of Statistics
Author: Greenberg
Publisher: Freeman

STAT 101
Author: Addison-Wesley
Publisher: Addison-Wesley

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Maintained by H. Edward Donley <*hedonley@grove.iup.edu*>
Last Modified on Friday, 06-Sep-96 18:20:15 EDT

I have been informed by the chairperson that the Mathematics Department is submitting a proposal to the University-wide Undergraduate Curriculum Committee requesting a change in the prerequisite of MA216 Probability and Statistics for Natural Sciences from "MA121" to "MA121 or MA123." It is my understanding this change is necessitated by the switch to BANNER software for registration and the change will have no impact on the MA216 course in any way.

Gary L Burtenbaugh
Name

2-17-00
Date

Computer Science
Program

Please return to: Gerald Buriok
Mathematics Department
233 Stright Hall
IUP

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N. Bharathan Roy W. Harding Co-coordinators

N. Bharathan and Roy W. Harding

Name

2/24/2000

Date

Biochemistry

Program

Please return to: Gerald Buriok
Mathematics Department
233 Stright Hall
IUP

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Andrew C. Rowe, coordinator

Name

Feb 21, 2000

Date

Natural Sciences, pre-professional

Program

Please return to: Gerald Buriok
Mathematics Department
233 Stright Hall
IUP

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W. Barff Butler
Name

2/22/00
Date

Biology
Program

Please return to: Gerald Buriok
Mathematics Department
233 Stright Hall
IUP

LIBERAL STUDIES COURSE APPROVAL, PARTS 1-3: GENERAL INFORMATION CHECK-LIST

I. Please indicate the LS category(ies) for which you are applying:

LEARNING SKILLS:

____ First Composition Course
____ Second Composition Course
✓ Mathematics

KNOWLEDGE AREAS:

____ Humanities: History
____ Humanities: Philos/Rel Studies
____ Humanities: Literature
____ Natural Sci: Laboratory
✓ Natural Sci: Non-laboratory
____ Fine Arts
____ Social Sciences
____ Non-Western Cultures
____ Health & Wellness
____ Liberal Studies Elective

II. Please use check marks to indicate which LS goals are primary, secondary, incidental, or not applicable. When you meet with the LSC to discuss the course, you may be asked to explain how these will be achieved.

Prim	Sec	Incid	N/A	
✓				**A. Intellectual Skills and Modes of Thinking:**
				1. Inquiry, abstract logical thinking, critical analysis, synthesis, decision making, and other aspects of the critical process.
	✓			2. Literacy--writing, reading, speaking, listening.
✓				3. Understanding numerical data.
		✓		4. Historical consciousness.
✓				5. Scientific Inquiry.
		✓		6. Values (Ethical mode of thinking or application of ethical perception).
			✓	7. Aesthetic mode of thinking.
✓				**B. Acquiring a Body of Knowledge or Understanding Essential to an Educated Person**
				C. Understanding the Physical Nature of Human Beings
	✓			**D. Collateral Skills:**
✓				1. Use of the library.
				2. Use of computing technology.

III. The LS criteria indicate six ways that courses should contribute to students' abilities. Please check all that apply. When you meet with the LSC, you may be asked to explain your check marks.

✓ 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.

IV.

A. There is a common syllabus of topics that are covered by each of the instructors teaching this course. This syllabus includes, but is not limited to, topics which introduce students to deductive reasoning, develop problem solving skills, and enable the student to understand the underlying principles of formulae and use and interpret numerical data. The Mathematics Department has a Statistics Committee which oversees the content and methodology in all statistics classes taught in the department, including MA216.

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

C. The Statistics Committee provides a minimum reading list for MA216. Currently chapters one and two of Statistics, by Freedman, Pisani, and Purves and the article "An Aspirin a Day . . . " by J. Greenhouse and S. Greenhouse, which appears in the journal CHANCE, are required reading.

D. One of the purposes of MA216 is to introduce the study of probability and statistics to students in several majors in the College of Natural Sciences and Mathematics. One goal is to develop student awareness of, and an appreciation for, the power and usefulness of mathematics and its importance in our technological society. Another goal is to prepare students for further study in mathematics and the natural sciences. Appropriate applications are included. It is expected students will develop an increased level of mathematical maturity and confidence in handling numerical problems.