LSC Use Only Proposal No:	*UWUCC Use Only* Proposal No: 13-107b
LSC Action-Date: App-1/30/14	UWUCC Action-Date: App-2/4/14 Senate Action Date: App-2/25/14

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) Russell Stocker	Email Address rstocker@iup.edu
Proposing Department/Unit Mathematics	Phone 357-3798

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

1. Course Proposals (check all that apply)

_____ New Course _____ Course Prefix Change _____ Course Deletion

__x__ Course Revision _____ Course Number and/or Title Change _____ Catalog Description Change

Current course prefix, number and full title: MATH 216 Probability and Statistics for the Natural Sciences

Proposed course prefix, number and full title, if changing:

Received
NOV 12 2013
Liberal Studies

2. Liberal Studies Course Designations, as appropriate

_____ This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

_____ Learning Skills _____ Knowledge Area _____ Global and Multicultural Awareness _____ Writing Intensive (include W cover sheet)

__X__ Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

_____ Global Citizenship _____ Information Literacy _____ Oral Communication

__X__ Quantitative Reasoning _____ Scientific Literacy _____ Technological Literacy

3. Other Designations, as appropriate

_____ Honors College Course _____ Other: (e.g. Women's Studies, Pan African)

4. Program Proposals

_____ Catalog Description Change _____ Program Revision _____ Program Title Change _____ New Track

_____ New Degree Program _____ New Minor Program _____ Liberal Studies Requirement Changes _____ Other

Current program name:

Proposed program name, if changing:

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)	Russell J. Stocker IV	4/29/13
Department Chairperson(s)		4/29/13
College Curriculum Committee Chair	Frank Koontz	10/18/13
College Dean		10/21/13
Director of Liberal Studies (as needed)		1/30/14
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail S Sechrist	2/4/14

Part II.

1. New Syllabus of Record

I. CATALOG DESCRIPTION

MATH 216 Probability and Statistics for Natural Sciences — 3 class hours, 0 lab hours, 3 credits **(3c-0l-3cr)**

Prerequisites: MATH 121 or 125

Frequency distributions; graphical representations of data; measures of central tendency and variation; correlation and regression; probability; probability distributions; sampling distributions. Inferential statistics including confidence intervals and parametric and nonparametric tests of hypotheses. Emphasis will be on applications in the natural sciences using graphing calculators and statistical software.

II. COURSE OUTCOMES

Objective 1:
Solve problems and make interpretations using the basic concepts of probability.
Expected Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Assignments will require students to have a level of knowledge of probability that will enable them to understand the nature of random phenomena. Assignments will also require students to interpret and use the concepts of probability in drawing inferences about random events from the natural, social, and or technical world.

Objective 2:
Estimate population parameters using confidence intervals.
Expected Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Assignments will require students to have a level of knowledge of confidence intervals that will enable them to estimate unknown characteristics of a population. Assignments will also require students to construct and interpret confidence intervals to draw inference to unknown characteristics of populations found in the natural, social, and or technical world.

Objective 3:
Evaluate statements about a population using tests of significance.
Expected Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Assignments will require students to have a level of knowledge of tests of significance that will enable them to evaluate statements about unknown characteristics of a population. Assignments will also require students to perform and interpret tests of significance to answer research questions about phenomena in the natural, social, and or technical world.

Objective 4:
Examine social, political and economic justice using statistics.
Expected Learning Outcomes 3:
Responsible learners
Rationale:
Assignments in this course will require students to use statistical concepts to explore social issues more deeply. These assignments are designed to help students to apply statistical skills to real world social justice issues.

III. COURSE OUTLINE/ TIME SCHEDULE

1. Describing Data with Graphs	(3 hours)
2. Describing Data with Numerical Measures	(3 hours)
3. Describing Bivariate Data	(2 hours)
4. Probability	(5 hours)
5. Discrete Distributions	(3 hours)
6. The Normal Distribution	(3 hour)
7. Sampling Distributions	(3 hours)
8. Large Sample Estimation	(2 hours)
9. Large Sample Tests of Hypothesis	(6 hours)
10. Inference for Small Samples	(6 hours)
11. Analysis of Categorical Data	(3 hours)

This syllabus leaves 3 hours for tests. The final exam or culminating activity is an additional 2 academic hours.

IV. EVALUATION METHODS

60% Three Tests (20% for each test) – Test will be given during the regular semester.
20% Final Examination. The final examination will be comprehensive.
20% Homework, Quizzes, and Projects. These will cover textbook assignments and applications.

V. EXAMPLE GRADING SCALE

90% - 100%	A
80% - 89%	B

70%-79%	C
60% - 69%	D
Below 60%	F

VI. UNDERGRADUATE COURSE ATTENDANCE POLICY

Although there is no formal attendance policy for this class, student learning is enhanced by regular attendance and participation in class discussions. The University expects all students to attend class.

[Note: It is recommended that an attendance policy be developed by individual faculty and included in student syllabi. (See undergraduate catalog for Undergraduate Course Attendance Policy.)]

VII. REQUIRED TEXTBOOKS, SUPPLEMENTAL BOOKS AND READINGS

Kokoska, S (2010). *Introductory Statistics: A Problem-Solving Approach.* W. H. Freeman.

SUPPLEMENTAL READING

Schneps L. and Colmez C. (2013). *Math on Trial: How Numbers Get Used and Abused in the Courtroom.* Basic Books.

VIII. SPECIAL RESOURCES REQUIREMENTS

Calculator with statistical capabilities such as the TI-83/84.

IX. BIBLIOGRAPHY

Buntinas, M., and Funk, G. M. (2004), Statistics for the Sciences. Pacific Grove, CA: Duxbury Press.

Chance, B. L., and Rossman, A. J. (2005), Investigating Statistical Concepts, Applications, and Methods. Pacific Grove, CA: Duxbury Press.

Larose, D.T. (2014). *Discovering the Fundamentals of Statistics (2nd ed.)* .New York, NY: W.H. Freeman.

Moore, D. L., and McCabe, G. P. (2005) Introduction to the Practice of Statistics (5th ed.), New York: W. H. Freeman.

Peck, R. (2013). *Statistics Learning From Data (1st ed.).* Brooks/Cole: Cengage Learning.

2. SUMMARY OF PROPOSED REVISIONS

1. Objectives: The course objectives were aligned with the Expected Undergraduate Student Learning Outcomes as part of Liberal Studies Elective Revisions.
2. An additional objective has been included that addresses responsible learners.
3. An additional supplementary reading was assigned that addresses responsible learners.
4. The required textbook has been changed.

3. JUSTIFICATION

This course is a currently approved Liberal Studies elective and is being revised to meet the new curriculum criteria for quantitative reasoning. Below we give a justification on why this course meets the guidelines for quantitative reasoning.

Students in this course are engaged in the interpretation, analysis, and use of numerical and graphical data. This includes the use of descriptive statistics, histograms, boxplots, frequency and relative frequency tables to summarize data sets. These are also used in the modeling of populations and in statistical inference procedures applied to the social and natural sciences.

Students in this course learn to apply quantitative techniques to problems within the natural science disciplines. These include the following:

- The use of probability to make statements about the social and natural sciences. Examples include the use of probability distributions to model the number of bugs in a software program and to model the lifespan of organisms.
- The use of confidence intervals and hypothesis testing to make statements about population proportions found in the social and natural sciences. Examples include statements regarding the proportion of ticks that carry Lyme disease and statements comparing the proportion of males to those of females that contain a certain genetic component.
- The use of confidence intervals and hypothesis testing to make statements about population means in the social and natural sciences. Examples include statements regarding the true mean number of deer per year in Indiana County and statements comparing a control and treatment group in a clinical drug study.

Students in this course develop deductive and non-deductive reasoning. They use descriptive statistics and graphical summaries to describe samples and or populations. Probability is naturally deductive in that it uses a basic set of axioms and deduces from them more general theories. The addition rule, complement rule, and multiplication rule are all derived in the course using this set of axioms. Lastly, students use statistical inferential procedures that use induction to make general statements about a population based on a sample of data. This includes using both confidence intervals and hypothesis testing.

Part II.

4. Old syllabus

1. New Syllabus of Record

I. Catalog Description

MATH 216 Probability and Statistics for Natural Sciences

3 class hours
0 lab hours
3 credit hours
3c-01-3sh

Prerequisites: MATH 121 or 125

Frequency distributions; graphical representations of data; measures of central tendency and variation; correlation and regression; probability; probability distributions; sampling distributions. Inferential statistics including confidence intervals and parametric and nonparametric tests of hypotheses. Emphasis will be on applications in the natural sciences using graphing calculators and statistical software.

II. Course Outcomes

Upon successful completion of this course, students will be able to:

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

III. Course Outline

12. Describing Data with Graphs (3 hours)

- 12.1 Variables and Data
- 12.2 Types of Variables
- 12.3 Graphs for Categorical Data
- 12.4 Graphs for Quantitative Data
- 12.5 Interpreting Graphs with a Critical Eye

13. Describing Data with Numerical Measures (3 hours)

- 13.1 Measures of Center
- 13.2 Measures of Variability
- 13.3 Practical Significance of the Standard Deviation
- 13.4 Measures of Relative Standing

13.5 Boxplots

14. Describing Bivariate Data (2 hours)

14.1 Graphs for Qualitative Variable
14.2 Scatterplots
14.3 Numerical Measures for Quantitative Bivariate Data

15. Probability (5 hours)

15.1 Events and the Sample Space
15.2 Calculating Probabilities using Simple Events
15.3 Event Composition and Event Relations
15.4 Conditional Probability and Independence
15.5 Bayes'Rule (optional)

16. Discrete Distributions (3 hours)

16.1 Discrete Random Variables and their Distributions
16.2 The Mean and Standard Deviation for a Discrete Random Variable
16.3 The Binomial Distribution
16.4 The Poisson Distribution

17. The Normal Distribution (3 hour)
17.1 Probability Distributions for Continuous Random Variables
17.2 The Normal Probability Distribution
17.3 The Normal Approximation to the Binomial Distribution

18. Sampling Distribution (3 hours)
18.1 Sampling Plans and Experimental Designs
18.2 Statistics and Sampling Distributions
18.3 The Central Limit Theorem
18.4 The Sampling Distribution of the Sample Mean
18.5 The Sampling Distribution of the Sample Proportion

19. Large Sample Estimation (2 hours)
19.1 Point Estimation
19.2 Interval Estimation for Means and Proportions

20. Large Sample Tests of Hypothesis (6 hours)
20.1 The Statistical Test of Hypothesis
20.2 Test for a Population Mean
20.3 Test for Two Population Means
20.4 Test for a Population Proportion
20.5 Test for Two Population Proportions

21. Inference for Small Samples (6 hours)
21.1 Student's t Distribution
21.2 Small Sample Inference for a Population Mean
21.3 Small Sample Inference for Two Population Means

21.4 Paired Difference Test
21.5 Inference for a Population Variance
21.6 Comparing Two Population Variances
21.7 Wilcoxon Signed Rank Test

22. Analysis of Categorical Data (3 hours)
22.1 Pearson's Chi-Square Statistic
22.2 Goodness-of-Fit
22.3 Contingency Tables

This syllabus leaves 3 hours for tests.

IV. Evaluation Methods

The final grade for the course will be determined by elements such as tests, quizzes, projects, and homework assignments. A substantial proportion of the course grade should be determined by tests.

V. Example Grading Scale

90% - 100%	A
80% - 89%	B
70%-79%	C
60% - 69%	D
Below 60%	F

VI. Undergraduate Course Attendance Policy

Although there is no formal attendance policy for this class, student learning is enhanced by regular attendance and participation in class discussions. The University expects all students to attend class.

[Note: It is recommended that an attendance policy be developed by individual faculty and included in student syllabi. (See undergraduate catalog for Undergraduate Course Attendance Policy.)]

VII. Required Textbooks, Supplemental Books and Readings

Mendenhall, W., Beaver, R. J., and Beaver, B. M. (2006), *Introduction to Probability and Statistics* (12th ed.), New York: Thomson Brooks/Cole.

Moore, D. S., and McCabe, G. P. (2006), *Introduction to the Practice of Statistics* (5th ed.), New York: W. H. Freeman.

Rossman, A. J., and Chance, B. (2005), *Investigating Statistical Concepts, Applications, and Methods,* Belmont, CA: Duxbury Press.

VIII. Special Resources Requirements

None

IX. Bibliography

Buntinas, M., and Funk, G. M. (2004), Statistics for the Sciences. Pacific Grove, CA: Duxbury Press. ISBN 0534387748.

Chance, B. L., and Rossman, A. J. (2005), Investigating Statistical Concepts, Applications, and Methods. Pacific Grove, CA: Duxbury Press. ISBN 0495050644.

Moore, D. L., and McCabe, G. P. (2005) Introduction to the Practice of Statistics (5th ed.), New York: W. H. Freeman. ISBN 0716764008.

Answers to Liberal Studies Questions

A. Most faculty who teach this course are members of the Statistics Curriculum Committee, that meets on a regular basis to talk about issues related to this and the other handful of Statistics-based courses in the department. In addition, most textbooks for this course are fairly uniform in the order and content that they present.

B. Whenever appropriate, information will be introduced into the classroom discussion which will reflect the contributions made to the development of the fields of probability and statistics by women and minorities. Examples include an article in the New York Times entitled "David Blackwell, Scholar of Probability, Dies at 91" which describes the contributions of David Blackwell an African American probabilist; and a bibliography of Gertrude Cox, a female statistician who did pioneering work in several areas of statistics including experimental design.

C. The book entitled "Math on Trial: How Numbers Get Used and Abused in the Courtroom" by Schneps and Colmez has been chosen as the supplementary reading. The book is written in a prose style and is not a textbook. It describes 10 different real life court cases in which probability and statistics are misused in the court room. Each case is well-known and the results of each case are controversial. Data collection; the concepts and rules of probability; and estimation procedures are some of the topics from the course that play major roles in the cases discussed in this book.

D. This course is intended for majors in the College of Natural Sciences and Mathematics. This course is more rigorous then MATH 214 or 217 in terms of the presentation of theory and results, but it still tries to focus on overall concepts and applications that are found in the disciplines of the College of Natural Sciences and Mathematics.

Sample Assignment and Rubric

Name: _____

Census Bureau Activity: Best Estimates for Proportions

Directions:

1. Go the website: http://quickfacts.census.gov/qfd/maps/pennsylvania_map.html . At the bottom of the webpage, you will find links to an alphabetized list of 253 cities and towns in Pennsylvania, organized into five columns of 50 of three cities/towns and one column of three cities/towns.

2. Using the random number feature on your calculator, randint(1,253) select a random sample of 12 towns/cities. You may get duplicate id numbers so continue getting random numbers until you have 12 unique ID numbers. Locate the corresponding city/town. ID numbers for the first column are 1-50, for the second column 51-100, etc.

3. Click on the links for your twelve randomly selected towns/cities and record both the 2010 population estimate and the percentage of persons in that city/town who were under 18 years in 2010.

4. Fill in the following summary table with the information from parts 1.-3.

#	Random ID Number	Name of Town/City	2010 Population Estimate	Percentage of people under the age of 18	Number of People Under the Age of 18
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

5. Generate a histogram of the 2010 population estimates and a histogram of the percentage of people under the age of 18. Discuss shapes of the distributions and identify any values that appear to be outliers.

6. Find the mean of the twelve percentages. This is the first estimate of the percentage of people in Pennsylvania who are under the age of 18.

7. Find the sum of the twelve population estimates and the sum of the numbers of people under the age of 18. Use these two statistics to find a second estimate of the percentage of people in Pennsylvania who are under the age of 18.
8. Discuss the differences in the estimates in 6. and 7. Which do you think is the better estimate of the percentage of people in Pennsylvania who are under the age of 18? Why?

Census Bureau Activity: Best Estimates for Proportions
Grading Rubric

Item	Points	Points Earned	Comments
Summary Table	10		
Histogram of the Population Estimates	5		
Histogram of the Percentages of People under the age of 18	5		
Overall Percentages and Discussion	5		
Total	**25**		

Additional Comments:

Please attach this page to your assignment.