LSC Use Only Proposal No: LSC Action-Date:	*UWUCC Use Only* Proposal No: 14-760 UWUCC Action-Date: AP 10/22/14 Senate Action Date: App 11/4/14

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)

- [x] New Course
- [ ] Course Prefix Change
- [ ] Course Deletion
- [ ] Course Revision
- [ ] Course Number and/or Title Change
- [ ] Catalog Description Change

Current course prefix, number and full title: MATH 412 (Multivariate Data Analysis)

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

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 Across the Curriculum (W Course)
- [ ] Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)
  - [ ] Global Citizenship
  - [ ] Information Literacy
  - [ ] Oral Communication
  - [ ] 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	8/25/2014
Department Chairperson(s)		8/25/14
College Curriculum Committee Chair		9/16/14
College Dean		9/22/14
Director of Liberal Studies (as needed)		
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail S Sechrist	10/23/14

Received
OCT 23 2014
Liberal Studies

Received
SEP 23 2014
Liberal Studies

I. Catalog Description

MATH 412 Multivariate Data Analysis **(3c-0l-3cr)**
Prerequisites: MATH 214, 216, or 217, or permission of the instructor.

An applied statistics course that focuses on multivariate statistical methods. Research procedures on the relationship among variables, significance of group differences, prediction of group membership, and structure exploration are introduced. Factorial analysis of variance, analysis of covariance, multivariate analysis of variance and covariance, path analysis, factor analysis, and discriminant analysis are introduced and used to analyze data. Emphasizes the applied aspects of these statistical methods and uses computer software for data analysis.

II. Course Outcomes

Students completing this course will be able to

1. Apply the methods of factorial analysis of variance, analysis of covariance to complex data.
2. Apply multivariate analysis of variance and covariance procedures to analyze complex data.
3. Apply the path analysis method to establish causal relationships.
4. Apply factor analysis to explore the underlying structure of a set of variables.
5. Apply discriminate analysis to classify observations.
6. Identify appropriate statistical procedures for different research questions and interpret the results.

III. Detailed Course Outline

A. Data Screening Methods (3 hours)
   1. Methods for examining and imputing missing data.
   2. Testing for outliers, normality, linearity, and homoscedasticity in univariate data.
   3. Testing for outliers, normality, linearity, and homoscedasticity in multivariate data.

B. Factorial Analysis of Variance and Analysis of Covariance (8 hours)
   1. Testing for main effects and interaction effects in factorial analysis of variance.
   2. Testing for main effects and interaction effects in analysis of covariance.
   3. Testing the independence and homogeneity assumptions.
   4. Testing the linear relationship between the dependent variable and the covariates.
   5. Interpretation of results.

Exam 1 (1 hour)

C. Multivariate Analysis of Variance and Covariance (8 hours)

1. Testing for the equality of population mean vectors.
2. Testing for the equality of the adjusted population mean vectors.
3. Assessing the assumptions of the multivariate analysis of variance and covariance methods.
4. Interpretation of results.

D. Path Analysis (6 hours)

1. Reviewing simple and multiple linear regression methods.
2. Constructing the path diagram and structural equations.
3. Estimating structural coefficients.
4. Assessing the model fit and interpretation of results.

Exam 2 (1 hour)

E. Factor Analysis (7 hours)

1. Maximum likelihood, unweighted least squares, and generalized least squares approaches to factor extraction.
2. Concepts and applications of factor loading, communalities, and scree plot.
3. Applying orthogonal and oblique rotation techniques.
4. Testing the multivariate normality and linearity assumptions.
5. Assessing the model fit and interpretation of results.

F. Discriminant Analysis (7 hours)

1. Discriminant function, standardized and unstandardized coefficients, discriminant score, and canonical correlation.
2. Testing the significance of discriminant functions.
3. Standard, hierarchical, and stepwise discriminant analysis.
4. Assessing the adequacy of classification, split-in-half and jackknife procedures.
5. Testing the normality, homoscedasticity, and linearity assumptions.
6. Interpretation of results.

Exam 3 (1 hour)

Final Exam (2 hours)

IV. Evaluation Methods

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

54%: Three in-class exams.
16%: Homework. Homework will be regularly assigned and graded.
20%: Final Exam. A cumulative final exam will be given during exam week.
10%: Project. A project that requires using software to analyze multivariate data will be assigned.

V. Example Grading Scale:

The following is an example grading scale that could be used in the course:

A: $\geq$ 90% B: 80-89% C: 70-79% D: 60-69% F: $<$ 60%

VI. Undergraduate Course Attendance Policy Attendance will conform to that outlined in the Undergraduate catalog.

VII. Required Textbooks(s), Supplemental Books and Readings

Lattin, J., Carroll, D. and Green P. (2002), *Analyzing Multivariate Data*, Duxbury, 1st ed.

IX. Bibliography

Everitt, B. and Dunn, G. (2010), *Applied Multivariate Data Analysis*, 2nd ed., John Wiley & Sons.

Gnanadesikan, R. (2011), *Methods for Statistical Data Analysis of Multivariate Observations*, 2nd ed., John Willey & Sons.

Hair, J., Black, W., Babin, B. and Anderson, R. (2009), *Multivariate Data Analysis*, 7th ed., Prentice Hall.

Lattin, J., Carroll, D. and Green P. (2002), *Analyzing Multivariate Data*, 1st ed., Duxbury.

Lunneborg, C. and Abbott, R. (1983), *Elementary Multivariate Analysis for the Behavioral Sciences - Applications of Basic Structure*, 1st ed., Elsevier Science Publishing Co.

Course Analysis Questionnaire

A Details of the Course

A1 This course will be the second course of a new required core course sequence in the Applied Statistics minor. This course is designed for both majors and non-majors who are part of the Applied Statistics minor. No other courses in the department cover similar material.

A2 This course will require a change in the Applied Statistics minor. A comprehensive proposal for the revision of the Applied Statistics minor program will be submitted.

A3 This course has not been offered at IUP on a trial basis.

A4 This course will not be a dual-level course.

A5 This course is not to be taken for variable credit.

A6 Similar courses are offered at the following institutions.

Amherst College: Multivariate Data Analysis (MATH 330)

Johns Hopkins: Multivariate Statistics and Stochastic Analysis (625.463)

University of Nevada, Reno: Multivariate Data Analysis (STAT 755)

A7 No professional society, accrediting authority, law or other external agency recommends or requires the content or skills of this proposed course.

B Interdisciplinary Implications

B1 This course will be taught by one instructor from the Mathematics Department.

B2 The content of this course does not overlap with any other at the University.

B3 This course will not be cross-listed with other departments.

C Implementation

C1 A new faculty member is not required to teach this course. The department currently offers MATH 418 every spring semester. The new proposed course will take the place of MATH 418 in our course rotation and we will offer MATH 418 occasionally as an elective.

C2 Other resources:

(a) Space: The current space allocations in the department are adequate to offer this course.

(b) Equipment: The department has a computer laboratory in Stright 202 that is needed for demonstrating statistical software.

(c) Laboratory Supplies with other Consumable Goods: No laboratory supplies are needed for this course.

(d) Library Materials: Current library materials are adequate for this course.

(e) Travel Supplies: Travel supplies are not needed for this course.

C3 None of the resources for this course are funded by a grant.

C4 We plan to offer this course every academic year.

C5 We plan to offer one section of this course during a semester.

C6 Stright 220 has 30 computers available. Therefore we plan to accommodate 30 students in a section of this course.

C7 No professional societies recommend enrollment limits or parameters for a course of this nature.

C8 This course is not a distance learning course.

D Miscellaneous

No additional information is necessary.