LSC Use Only Proposal No:	UWUCC Use Only Proposal No: 12-262.
LSC Action-Date: APP-2/7/13	UWUCC Action-Date: APP-5/7/13 Senate Action Date: APP-9/10/13

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) Francisco Alarcon	Email Address falarcon@iup.edu
Proposing Department/Unit Mathematics	Phone 724-357-2608

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

Current course prefix, number and full title: MATH 115 Applied Mathematics for Business

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)

- [x] 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)		4/20/12
Department Chairperson(s)	Edel Reilly	4/20/12
College Curriculum Committee Chair		4/20/12
College Dean		4/20/12
Director of Liberal Studies (as needed)		5/2/13
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail Sechrist	5/7/13

Received
MAY 3 2013
Liberal Studies

Received
APR 22 2012
Liberal Studies

Part II. Description of Curriculum Change

1. New Syllabus of Record

I. Catalog Description

MATH 115 Applied Mathematics for Business

3c-0l-3cr

Prerequisite: MATH 105 or MATH 110 or appropriate placement test score or permission of the Mathematics Department Chairperson.

Note: Students may not take MATH 115 after successfully completing a calculus course without the written approval of the Mathematics Department Chairperson.

Offers a review of elementary functions including logarithmic and exponential functions. Business majors are introduced to the central ideas of the calculus (limit, derivative, and integral). Applications to business and economics are emphasized.

II. Course Outcomes and Assessment (Expected Undergraduate Student Learning Outcomes – EUSLO)

The student will:

Objective 1:
Identify and utilize patterns in the study of mathematics.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Given a set of data, students will be expected to model phenomena using the various functional representations. Solving problems such as these will enable students to see the relationship among the representations and assign mathematical meaning to information related to a variety of real-world business-related situations.

Objective 2:
Apply functions to solve problems in business and economics.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Students will be expected to recognize and identify the input and output variables of a function and interpret how they relate to one another. Emphasis is given to the practicality of starting with one type of data and being able to find the corresponding result from the function. Students are also expected to understand, find, and interpret the domain and range of functions. This can all be accomplished in the context of business applications such as cost, revenue, or profit.

Objective 3:
Interpret functions expressed analytically and graphically.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Students will review the types of functions to be used throughout the course (in the context of Objectives 4, 5, and 6 below). These include linear functions, quadratic functions, polynomial functions, rational functions, radical functions, exponential functions, and logarithmic functions. Students will be expected to identify and reproduce the analytic function format and the graphical features of each. Content should complement and reinforce that from Objective 2. Applications such as compound interest or growth/decay models are used to reinforce the various function categories.

Objective 4:
Relate the limit process to functions in business and economics.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Assignments will require students to make observations about and calculate limits using data tables, graphs, and limit laws. Limits will also be used to make conclusions about the accuracy of mathematical models (usually with business applications) and assist in refining them. Technology can be used to verify observations and exhibit the correspondence between geometric and analytic information.

Objective 5:
Calculate the derivative of a function and interpret its meaning.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Students will be exploring the various interpretations of the derivative, measuring how one quantity changes in response to a change in another quantity. Through this exploration, the relationship between slopes of lines, rates of change, and limits is reinforced. In addition, assignments will be designed so that students will learn the various differentiation formulas and identify the types of functions to which they apply. Also, the concept of the derivative will be used to solve geometric problems, such as curve sketching. Applied problems will be converted into mathematical models and solved using differential calculus. This includes the concept of optimization, in which the student is required to express a written problem mathematically. To do so, the student must have a thorough understanding of the problem, define the function that models the phenomena, and apply the methods of differential calculus to find extreme values. This technique is shown to have applications in business such as production costs, profits, inventory size and/or other areas at the instructor's discretion.

Objective 6:
Calculate the integral of a function and interpret its meaning.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners

Rationale:
The connection between differential and integral calculus is established. Assignments will require the application of the Fundamental Theorem of Calculus to evaluate definite integrals and represent antiderivatives. Students will also be expected to use antidifferentiation formulas to express indefinite integrals, and apply the substitution method when appropriate. Integrals will also be used in a variety of applications to model mathematical and economic situations. In particular, applications include calculating the average value of a function, calculating accumulated changes (in cost, profit, etc.), consumer/producer surplus, or accumulated future value.

III. Detailed Course Outline

A. Library of Functions (8 hours)
   1. Functions
   2. Linear Functions
   3. Quadratic Functions
   4. Polynomial Functions
   5. Exponential Functions
   6. Logarithmic Functions

B. The Derivative (10 hours)
   1. Rates of Change
   2. The Limit of a Function
   3. The Derivative
   4. Power Rules and Summation Rules
   5. Product and Quotient Rules
   6. Chain Rule: Power Form
   7. Marginal Analysis

C. Graphing and Optimization (7 hours)
   1. Continuity and Graphs
   2. First Derivative and Graphs
   3. Second Derivative and Graphs
   4. Optimization

D. Additional Topics in Differentiation (6 hours)
   1. The Constant *e* and Continuous Compounding
   2. Derivatives of Exponential and Logarithmic Functions
   3. Chain Rule: General Form
   4. Elasticity of Demand

E. The Integral (7 hours)
   1. Antiderivatives and Indefinite Integrals
   2. Introduction to the Definite Integral
   3. The Fundamental Theorem of Calculus
   4. Applications of the Integral to Business and Economics

This syllabus covers 38 hours, leaving 4 hours for testing and/or review.

There are also 2 hours for a final exam or concluding activity.

IV. Evaluation Methods

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

50% Tests. Tests will include problems on basic competency and critical thinking.
20% Final Examination. The final examination will be comprehensive and cover both basic competency and critical thinking.
30% Homework, Quizzes, and Projects. These will cover textbook assignments and applications to business and economics

V. Example Grading Scale

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

VI. Undergraduate Attendance Policy

Although there is no formal attendance policy for this class, student learning is enhanced by regular attendance and participation in class discussions.

[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

Bittinger, M., Ellenbogen, D. and Surgent, S., *Calculus and its Applications,* Tenth Edition, Addison-Wesley, 2012.

Switkes, Jennifer, *A Quotient Rule Integration by Parts Formula,* College Mathematics Journal, Vol 36, No. 1, pp. 58-60, 2005.

Austin, B., Barry, D., and Berman, D., *The Lengthening Shadow: The Story of Related Rates,* Mathematics Magazine, Vol. 73, No. 1, pp. 3-12, 2000.

Cooney, M., *Celebrating Women in Mathematics,* The National Council of Teachers of Mathematics, 1996.

VIII. Special Resource Requirements

Some instructors may require students to purchase a graphing calculator.

IX. Bibliography

Committee on the Mathematical Sciences in the Year 2000. *Everybody Counts: A Report to the Nation on the Future of Mathematics Education*, Washington, DC : National Academy Press, 1989.

Connally, Eric, et al. *Functions Modeling Change: A Preparation for Calculus,* New York: John Wiley & Sons, Inc., 2003.

Haeussler, Ernest, and Richard Paul. *Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences,* Upper Saddle River, NJ: Prentice-Hall, Inc., 1999.

Hughes-Hallet, Deborah, et al. *Applied Calculus*, New York: John Wiley & Sons, Inc., 2011.

Thompson, Richard B., et al. *Mathematics for Business Decisions With Interdisciplinary Multimedia Projects*,Washington, DC. Mathematical Association of America, 2005.

2. Summary of the proposed revisions

1. Objectives – the course objectives were revised from the original syllabus of record and aligned with the Expected Undergraduate Student Learning Outcomes (EUSLO) and Common Learning Objectives found in the criteria for a mathematics course.

2. Common Learning Objectives for a mathematics course are met in the content portion of the course (not necessarily a specific revision but it should be noted that the objectives for the new curriculum have been met). These objectives are:

    - understand deductive reasoning and apply it in the problem-solving process.
    - apply appropriate techniques to solve a variety of problems.
    - interpret, understand, and apply mathematical formulas appropriate to the course.
    - interpret, analyze, and use numerical data and graphs.
    - develop simple mathematical models to solve problems.

3. Updated the required textbook to reflect the textbook currently being used in the course.

4. Objective 7 from the old syllabus of record was removed, as it was determined to be vague and not measurable. The idea behind this objective is already covered by Objectives 1 – 6.

3. Justification/Rationale for the revision

The course is a currently approved Liberal Studies mathematics course and is being revised to meet the new curriculum criteria for this category.

4. Old Syllabus of record

I. Catalog Description

MATH 115 Applied Mathematics for Business 3c-0ℓ-3cr

Prerequisites: MATH 105 or MATH 110 or appropriate placement test score or permission of the Mathematics department chairperson.
Note: A student may not take this course after successfully completing a calculus course without the written approval of the Mathematics Department chairperson.

Offers a review of elementary functions including logarithmic and exponential functions. Business majors are introduced to the central ideas of the calculus (limit, derivative, and integral). Applications to business and economics are emphasized.

II. Course Outcomes

Upon completion of this course, students will be able to

1. demonstrate and take advantage of pattern recognition in the study of mathematics.
2. demonstrate the concept of function and its application to business and economics.
3. interpret functions expressed analytically and graphically.
4. demonstrate the limit process and relate it to functions in business and economics.
5. calculate the derivative of a function and interpret its meaning.
6. calculate the integral of a function and interpret its meaning.
7. apply a solid set of skills and a conceptual framework to the future study of business and economics.

III. Detailed Course Outline

A. Library of Functions (8 hours)

1. Functions
2. Linear Functions
3. Quadratic Functions
4. Polynomial Functions
5. Exponential Functions
6. Logarithmic Functions

B. The Derivative (10 hours)
1. Rates of Change
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3. Chain Rule: General Form
4. Elasticity of Demand

E. The Integral (7 hours)
1. Antiderivatives and Indefinite Integrals
2. Introduction to the Definite Integral
3. The Fundamental Theorem of Calculus
4. Applications of the Integral to Business and Economics

Additional class time for three tests and a review for the final. (4 hours)
Final Exam (2 hours)

Total: 42 hours
+ 2 final exam

IV. Evaluation Methods

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

50% Tests. Tests will include problems on basic competency and critical thinking.

20% Final Examination. The final examination will be comprehensive and cover both basic competency and critical thinking.
30% Homework, Quizzes, and Projects. These will cover textbook assignments and applications to business and economics.

V. Example Grading Scale

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

VI. Undergraduate Attendance Policy

Although there is no formal attendance policy for this class, student learning is enhanced by regular attendance and participation in class discussions.

[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 Textbook

Berresford, G. and A. Rockett, *Brief Applied Calculus*, 3rd Edition, Boston: Houghton Mifflin, 2004.

VIII. Special Resource Requirements

Graphing calculator

IX. Bibliography

Committee on the Mathematical Sciences in the Year 2000. Everybody Counts: A Report to the Nation on the Future of Mathematics Education. Washington, DC : National Academy Press, 1989.

Connally, Eric, Deborah Hughes-Hallett, Andrew M. Gleason, et al. Functions Modeling Change: A Preparation for Calculus. New York: John Wiley & Sons, Inc., 2003.

Haeussler, Ernest, and Richard Paul. Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences. Upper Saddle River, NJ: Prentice-Hall, Inc., 1999.

Hughes-Hallet, Deborah, et al. Applied Calculus. New York: John Wiley & Sons, Inc., 1999.

Thompson, Richard B., Christopher G. Lamoureaux, and Pamela C. Slaten. Mathematics for Business Decisions With Interdisciplinary Multimedia Projects. Washington, DC. Mathematical Association of America, 2005.

5. Assignment instructions for one major course assignment and a grading rubric for that assignment

Major assignments for this course consist of chapter tests and final exams. Although the tests and exams cover the same content from the same chapters, instructors for each section determine their test structures and grading criteria on an individual basis.

6. Answers to Liberal Studies Questions

A. This will be a multiple-section course. There will be a common syllabus that should be covered by each of the instructors. The Mathematics Department Service Courses Committee typically meets each year to discuss the textbook for the following year. Throughout the semester instructors typically meet to compare their pace in the course, check what students are finding difficult, and compare tests.

B. Whenever appropriate, information will be introduced into the classroom discussion which will reflect the contributions made to the development of the mathematics involved by women and minorities. These discussions, for instance, can be based on content from the supplemental readings. Also, instructors will be sensitive to gender and ethnic balancing with respect to language in problem construction on homework, quizzes, and tests. The construction of contextual problems will be used to facilitate learning by making the material culturally relevant.

C. In this course we would like to exercise the exception to the use of a work of fiction or non-fiction. The concentration is on developing the foundation of calculus; we will work on quantitative skills.

D. This course is an introductory course, but for a specific audience: business students. It does not differ from what is provided to beginning mathematics majors. This course is not a part of any mathematics degree program. It does not fulfill the liberal studies requirement for mathematics majors.

(50 total points possible)

MATH 115 - Fall 2011 Name:_____

Homework # 8

Due: Friday, October 28, 2011, 4 PM. Attach extra pages as needed. Be sure to show all relevant work.

1. (based on # 30, pg. 274) Riverside Appliances is marketing a new refrigerator. It determines that in order to sell x refrigerators, the price per refrigerator should be $p = 280 - 0.4x$ dollars. They also determine that the total cost of producing x refrigerators is given by $C(x) = 5000 + 0.6x^2$ dollars. We want to know what price they should charge in order to maximize profit.

   (a) Define all your variables. What are we looking for? (Be specific)

(2 pts) x = # of refrigerators sold
p = price, in $'s
$C(x)$ = cost of producing x refrig., in $'s.
We want to find the price that maximizes profit.

   (b) Find the function for total revenue, $R(x)$.

(2 pts) Revenue = price · # of sales.

$$R(x) = x \cdot p = 280x - 0.4x^2.$$

   (c) Find the function for total profit, $P(x)$.

(2 pts) $P = R - C$.

$$P(x) = (280x - 0.4x^2) - (5000 + 0.6x^2) = -x^2 + 280x - 5000$$

   (d) Find how many refrigerators the company should sell in order to maximize profit. Show work. To max P, find C.V.'s:

Note: P is an upside down parabola, so a critical value will be a max.

(2 pts) $P'(x) = -2x + 280$.

(2 pts) $-2x + 280 = 0 \implies -2x = -280 \implies x = 140$.

So, Riverside Appliances should sell 140 refrigerators to maximize profit.

   (e) How do you know the result above gives a maximum (and not a min. or something else)?

(1 pt)

   (f) What will be the company's maximum possible profit?

(2 pts) P is maxed at $x = 140$.

$$P(140) = 14{,}600.$$

The maximum possible profit is $14,600.

   (g) Answer the original question: What price should they charge for each refrigerator to receive the maximum profit?

Profit is maxed at $x = 140$. So, substitute this into p:

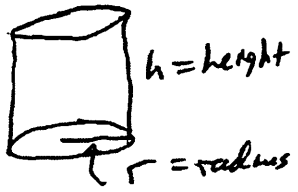
(1 pt) $p = 280 - (0.4)(140) = 224$.

(1 pt) Thus, profit is maximized when the price is $224 for each refrigerator.

3. (#22, pg. 384, Lial, Greenwell, Ritchey) A company wishes to design cylindrical metal containers with a volume of 16 cubic feet. The top and bottom will be made of a sturdy material that cost \$2 per square foot, while the material for the sides costs \$1 per square foot. Find the radius, the height, and the cost of the least expensive container.

(a) Sketch a picture, label it, define variables, and write down all given information.

(2 pts)



V = volume = 16 ft^3 & $V = \pi r^2 h$

C = cost, in dollars, of constructing containers.

(b) What are we supposed to find? What are we trying to minimize? Be specific.

(2 pt) what to find r & h to minimize cost.

(c) Write an *equation* for the quantity you are supposed to minimize.

(2 pt) $\text{Cost} = (\$2)(\pi r^2) + (\$2)(\pi r^2) + (\$1)(2\pi r h) = 4\pi r^2 + 2\pi r h$

(d) Use all the information above to find a *function* for the quantity you are supposed to minimize.

(2 pt) $V = \pi r^2 h \Rightarrow h = \frac{16}{\pi r^2}$. Substitute into Cost:

$$C(r) = 4\pi r^2 + 2\pi r\left(\frac{16}{\pi r^2}\right) = 4\pi r^2 + \frac{32}{r}.$$

(e) What is the domain of your function?

(1 pt) Domain: $(0, \infty)$ (in theory, anyway).

(f) Find the minimum value and any other values you need to know to answer the question.

(2 pt) $C'(r) = 8\pi r - \frac{32}{r^2}$. Set equal to 0:

(2 pt)
$$8\pi r - \frac{32}{r^2} = 0 \Rightarrow 8\pi r = \frac{32}{r^2} \Rightarrow 8\pi r^3 = 32 \Rightarrow r^3 = \frac{4}{\pi},$$
So, $r = \sqrt[3]{\frac{4}{\pi}}$ & $h = \frac{16}{\pi r^2}$ (1 pt) $C\left(\sqrt[3]{\frac{4}{\pi}}\right) \approx 44.29$ (1 pt)

≈ 1.08 ≈ 4.34

(g) Write a summary sentence which includes all of your answers.

The least expensive cylindrical metal container will cost about

(1 pt) \$44.29 & will have a radius of 1.08 feet & a height of 4.34 feet.