ARIZONA STATE UNIVERSITY EAST/TEMPE CAMPUS

GENERAL STUDIES PROGRAM COURSE PROPOSAL COVER FORM

Courses submitted to the GSC between 2/1 and 4/30 if approved, will be effective the following Spring.

Courses submitted between 5/1 and 1/31 if approved, will be effective the following Fall.

(SUBMISSION VIA ADOBE.PDF FILES IS PREFERRED)

DATE 10/05/08

1. ACADEMIC UNIT: School of Human Evolution and Social Change

2. COURSE PROPOSED: AML (prefix) 100 (number) Intro to Applied Math for the Life and Soc. Scie (title) 3 (semester hours)

3. CONTACT PERSON: Name: Alissa Ruth Phone: 5-4628

   Mail Code: 2402 E-Mail: alissa.ruth@asu.edu

4. ELIGIBILITY: New courses must be approved by the Tempe Campus Curriculum Subcommittee and must have a regular course number. For the rules governing approval of omnibus courses, contact the General Studies Program Office at 965–0739.

5. AREA(S) PROPOSED COURSE WILL SERVE. A single course may be proposed for more than one core or awareness area. A course may satisfy a core area requirement and more than one awareness area requirements concurrently, but may not satisfy requirements in two core areas simultaneously, even if approved for those areas. With departmental consent, an approved General Studies course may be counted toward both the General Studies requirement and the major program of study.

Core Areas	Awareness Areas
Literacy and Critical Inquiry–L ☐	Global Awareness–G ☐
Mathematical Studies–MA ☒ CS ☒	Historical Awareness–H ☐
Humanities and Fine Arts–HU ☐	Cultural Diversity in the United States–C ☐
Social and Behavioral Sciences–SB ☐	(Note: **one course per form**)
Natural Sciences–SQ ☐ SG ☐	

6. DOCUMENTATION REQUIRED.
   (1) Course Description
   (2) Course Syllabus
   (3) Criteria Checklist for the area
   (4) Table of Contents from the textbook used, if available

7. ***In the space provided below (or on a separate sheet), please also provide a description of how the course meets the specific criteria in the area for which the course is being proposed.***

CROSS-LISTED COURSES: ☒ No ☐ Yes; Please identify courses: ____________

Is this a multisection course?: ☒ No ☐ Yes; Is it governed by a common syllabus? ________

Sander van der Leeuw
Chair/Director (Print or Type)

[signature]
Chair/Director (Signature)

Date: 10/6/08.

Proposer: Please complete the following section and attach appropriate documentation.

ASU--[MA] CRITERIA

A MATHEMATICS [MA] COURSE MUST SATISFY ALL OF THE FOLLOWING CRITERIA:

YES	NO		Identify Documentation Submitted
☒	☐	**1.** Mathematics course with a minimum prerequisite of College Algebra or a course already approved as satisfying the MA requirement.	See next page
☒	☐	**2.** Applies mathematical skills in the solution of real life problems.	See next page
☒	☐	**3.** The focus of the mathematics being taught is distinct from a traditional Algebra II course taught in High School.	See next page
		4. Introduces or makes significant use of all of the following mathematical skills and concepts:	
☒	☐	**a.** Manipulation of mathematical expressions.	See next page
☒	☐	**b.** Functions and their various forms of expression (algebraic, graphic, and numeric).	See next page
☒	☐	**c.** Problem solving using mathematics.	See next page
☒	☐	**d.** Quantitative literacy.	See next page
		5. Acceptable courses include (check applicable course):	
☐	☐	**a.** College Mathematics	
☐	☐	**b.** Precalculus	
☒	☐	**c.** Any mathematics course with College Algebra as a prerequisite	See item 1
☐	☐	**d.** Any mathematics course with any of its prerequisite courses satisfying the MA criteria.	

Course Prefix	Number	Title	Designation
AML	100	Introduction to Applied Mathematics for the Life and Social Sciences	MA

Explain in detail which student activities correspond to the specific designation criteria. Please use the following organizer to explain how the criteria are being met.

Criteria (from checksheet)	How course meets spirit (contextualize specific examples in next column)	Please provide detailed evidence of how course meets criteria (i.e., where in syllabus)
Mathematics course with a minimum prerequisite of College Algebra or a course already approved as satisfying the MA requirement.	College Algebra is required	Students are expected to have completed MAT 117 or MAT 113 with a grade of A, B or C. (see page 1)
Applies mathematical skills in the solution of real life problems	This is an applied mathematics course for the life and social sciences and focuses on developing mathematical skills that can be applied to real life problems.	Every week we discuss a mathematical method with a set of real life problems. The topics of each week relate to actual problems like climate change, health, ecology, sports, and economic development. (see the description of topics in the schedule: page 3 and 4).
The focus of the mathematics being taught is distinct from a traditional Algebra II course taught in High School	This is a new course which focuses on applications of a set of different mathematical methods to the social and life sciences. Such a course is not available in High School programs.	Besides building on content of algebra II like defining equations and functions, this course teach the students to apply this to actual problems and data. Furthermore, we introduce them to other mathematical methods like difference equations, probability, matrices and simulation (see page 3 and 4).
Manipulation of mathematical expressions.	The students are expected to define simple linear and quadratic models for examples of real problems (with actual data). They are expected to adjust existing models to applications.	Each week students will get homework on a series of problems in which they have to define, adjust and solve equations. As discussed on page 2 of the syllabus the homework consists of a selection of problems from Harshbarger and Reynolds (2007) and problems defined by the instructor. An typical example (H&R, page 486) on probability: 34. Politics. A group of 100 people contains 60 Democrats and 35 Republicans. If there are 60 women and if 40 of the Democrats are women, what is the probability that a person selected at random is a Democrat or a woman? And for linear equations (H&R, page 69): 44. Seawater pressure. In seawater, the

		pressure p is related to the depth p according to $33\ p - 18\ d = 495$ Where d is in feet and p is in pounds per square inch. (a) solve this equation of p in terms of d (b) The Titanic was discovered at a depth of 12,460 ft. Find the pressure at this depth
Functions and their various forms of expression (algebraic, graphic, and numeric).	Students are expected to write mathematical expressions in algebraic functions, implement this in an excel spreadsheet and graph the results of the expression.	On page 2 of the syllabus we say "The homework assignments will consist of algebraic, computational and graphic ways to solve mathematical problems.". This means that some simple problems are solved analytically. They use Excel and Netlogo to explore more complicated models, and use Excel to implement dynamic models by using difference equations. Examples of typical homework assignment to be implemented in Excel: Page 382 (H&R) 68. Deforestation. One of the major causes of rain forest deforestation is agricultural and residential development. The number of hectares destroyed in a particular year t can be modeled by $Y = -3.91435 + 2.62196 \ln t$ Where $t = 0$ in 1950 (a) Graph this function (b) Use the model to predict the number of hectares that will be destroyed in the year 2010 because of agricultural and residential development.
Problem solving using mathematics.	Real-life problems are the starting point for showing the potential of different mathematical method.	See schedule on page 3 and 4 of Syllabus. The basic philosophy of this class is to start with actual problems and then translate this to mathematical models. We cover a large set of model in brief. The students learn some basics of these methods, but mainly see which methods are useful for which kind of problems. An typical assignment will be a model of 2 difference equations which represents atmospheric CO_2 concentration as a function of CO_2 emissions, and a function of temperature change as a function of CO_2 concentration. The students are asked to implement the model in Excel and then calculate how much they have to reduce emissions by 2050 to keep temperature rise below a certain level.

Quantitative literacy	Students use Excel spreadsheets and simulation platform to perform a number of weekly assignments.	As mentioned on page 2 (homework) and in various weeks in the schedule (week 5 and 6) we use Excel to implement difference equations. Netlogo is used in week 7, 8 and 12 to simulate more complex example models. Students are not expected to program in Netlogo , but to explore interactively the dynamics of the model

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R.J. Harshbarger and J.J. Reynolds (2007) *Mathematical Applications for the Management, Life, and Social sciences*, eight edition, Houghton Mifflin Company, Boston New York.

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Proposer: Please complete the following section and attach appropriate documentation.

ASU--[CS] CRITERIA

A COMPUTER/STATISTICS/QUANTITATIVE APPLICATIONS [CS] COURSE MUST SATISFY ONE OF THE FOLLOWING CRITERIA: 1, 2, OR 3

YES	NO		Identify Documentation Submitted
		1. Computer applications*: courses must satisfy both **a** and **b**:	
☐	☐	**a.** Course involves the use of computer programming languages or software programs for quantitative analysis, modeling, simulation, animation, or statistics.	
		b. Course requires students to analyze and implement procedures that are applicable to at least one of the following problem domains **(check those applicable)**:	
☐	☐	**i.** Spreadsheet analysis, systems analysis and design, and decision support systems.	
☐	☐	**ii.** Graphic/artistic design using computers.	
☐	☐	**iii.** Music design using computer software.	
☐	☐	**iv.** Modeling, making extensive use of computer simulation.	
☐	☐	**v.** Statistics studies stressing the use of computer software.	

*The **computer applications** requirement **cannot** be satisfied by a course, the content of which is restricted primarily to word processing or report preparation skills; learning a computer language or a computer software package; or the study of the social impact of computers. Courses that emphasize the use of a computer software package or the learning of a computer programming language are acceptable, provided that students are required to understand, at an appropriate level, **the theoretical principles embodied in the operation of the software and are required to construct, test, and implement procedures that use the software to accomplish tasks in the applicable problem domains.**

YES	NO		Identify Documentation Submitted
		2. Statistical applications: courses must satisfy both **a** and **b**.	
☐	☐	**a.** Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Precalculus, or a course already approved as satisfying the MA requirement.	
		b. The course must be focused principally on developing knowledge in statistical inference and include coverage of all of the following:	

ASU--[CS] CRITERIA			
YES	**NO**		**Identify Documentation Submitted**
☐	☐	**i.** Design of a statistical study.	
☐	☐	**ii.** Summarization and interpretation of data.	
☐	☐	**iii.** Methods of sampling.	
☐	☐	**iv.** Standard probability models.	
☐	☐	**v.** Statistical estimation	
☐	☐	**vi.** Hypothesis testing.	
☐	☐	**vii.** Regression or correlation analysis.	
		3. Quantitative applications: courses must satisfy both **a** and **b**.	
☒	☐	**a.** Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Precalculus, or a course already approved as satisfying the MA requirement.	See page 5
		b. The course must be focused principally on the use of mathematical models in quantitative analysis and design making. Examples of such models are:	
☐	☒	**i.** Linear programming.	
☐	☒	**ii.** Goal programming.	
☐	☒	**iii.** Integer programming.	

ASU--[CS] CRITERIA			
YES	NO		Identify Documentation Submitted
☐	☒	iv. Inventory models.	
☐	☒	v. Decision theory.	
☒	☐	vi. Simulation and Monte Carlo methods.	See page 5
☐	☐	vii. Other (explanation must be attached)	

Course Prefix	Number	Title	Designation
AML	100	Applied Mathematics for the Life and Social Sciences	**Quantitative Applications**

Explain in detail which student activities correspond to the specific designation criteria. Please use the following organizer to explain how the criteria are being met.

Criteria (from checksheet)	How course meets spirit (contextualize specific examples in next column)	Please provide detailed evidence of how course meets criteria (i.e., where in syllabus)
3a. Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Precalculus, or a course already approved as satisfying the MA requirement.	College Algebra is required	Students are expected to have completed MAT 117 or MAT 113 with a grade of A, B or C. (see page 1)
3b. The course must be focused principally on the use of mathematical models in quantitative analysis and design making. Examples of such models are: *Simulation and Monte Carlo methods.*	Simulation of mathematical models using simulation package Netlogo and spreadsheet Excel. An important goal of the course is to let students define mathematical models and implement them in a spreadsheet or use simulation to explore the consequences of different assumptions in the models.	Page 2. Weekly homework assignments include the use of simulation tool Net Logo and implementing mathematical models (such as difference equations) in Excel, and simulate the outcome of mathematical models for different parameter values. Almost every week assignments include quantitative applications, including testing models on empirical data. The quantitative methods are applied to various problem domains in the life and social sciences.

AML 100: Introduction to Applied Mathematics for the Life and Social Sciences

Spring 2009

Instructor:
Marco A. Janssen, Ph.D., School of Human Evolution and Social Change (SHESC), Matthews Hall 108A, Marco.Janssen@asu.edu; Phone; 480 965 1369; Office hours by appointment

Teaching Assistant
Dori Luli, contact information and office hours will be provided later

Prerequisites: Students are expected to have completed MAT 117 or MAT 113 with a grade of A, B or C.

Textbook: R.J. Harshbarger and J.J. Reynolds (2007) *Mathematical Applications for the Management, Life, and Social sciences*, eight edition, Houghton Mifflin Company, Boston New York.

Course Description
During the history of civilizations, mathematics has been developed to solve practical problems. Nowadays a lot of puzzles in the life and social sciences can be addressed by the use of mathematics. In this course you will learn what mathematical tools are applied in the life and social sciences, what the basic principles are of these mathematical methods, and how you can apply them to basic problems.

A model is a simplified representation of reality, and mathematical models are used to find solutions for practical problems. Students will learn the basic steps in developing a model and to test this on actual data.

We will provide a broad overview of different methods applied mathematicians use to develop models and how they apply them to practical problems. For each method basic principles are provided and you will learn the first steps to represent these methods in equations, graphs and solve the equations by computer software.

Goals of the Course:
.. to learn how mathematics can be used in the life and social sciences
.. to learn which mathematical methods are used for which type of problem
.. to learn to apply mathematical methods to practical problems
.. to learn to develop a model of a practical problem
.. to learn to implement simple models in spreadsheets
.. to learn to test a model on actual data

Prerequisites
Students are expected to have completed MAT 117 or MAT 113 with a grade of A, B or C.

Blackboard website
The teaching assistant and/or instructor will post the following course materials on the course website:

Course syllabus
Power point presentation
Homework assignments
Homework solutions
Exam scores
Grades

Software
For a number of homework assignments we will use software:
- Microsoft Excel (or related spreadsheet program)
- Netlogo (a simulation package which you can download for free from http://ccl.northwestern.edu/netlogo/).

Homework will be assigned every week and "graded" throughout the course. The homework consists of a selection of problems from Harshbarger and Reynolds (2007) and problems defined by the instructor. The homework assignments will consist of algebraic, computational and graphic ways to solve mathematical problems.

Students are encouraged to work together on homework, but each individual student is required to write up and turn in his own work. All homework assignments will be posted on Blackboard and problem solutions will be given in on Blackboard and discussed in class. Of course you can always see me about homework problems or solutions. For final grading, the lowest homework score will be dropped.

Exams: There will be two exams given during the course. These exams will involve a mix of mechanical skills and conceptual reasoning. The best possible preparation for the exams is regular attendance and completion of assigned homework. Exams will be taken in class on the dates indicated on the schedule (to be defined later). Makeup exams are given at my discretion and only in the case of verified medical or other emergencies, which must be documented. I must be notified before the test is given. E-mail me at marco.janssen@asu.edu, or call me (480-965-1369) and leave a message regarding the exam conflict. It is best to discuss conflicts as soon as possible.

Schedule
Topics for each week

1. Overview of course
What can you expect in this course? Syllabus, overview, competencies, why mathematics is important, homework, exams and expectations.

2. The history of mathematics
In this week we will discuss important discoveries in the history of mathematics and we will show that important mathematical innovations are the result of solving concrete problems. We will discuss examples from Mesopotamia, Ancient Greek, Egypt and China as well as more recent examples like the work of Isaac Newton who showed that the motions of objects on Earth and of celestial bodies can be explained be the same mathematical model.

3. Models
What is a mathematical model? What is a system? What are variables and parameters? How do we represent phenomena in life and social sciences in a mathematical way? We discuss a number of examples of models in different application areas of the life and social sciences.

4. Statistical Models
How does one start finding relationships between different variables? What are tools mathematicians use to develop models? How do we estimate a linear relation between different variables? What is the difference between a statistical and a causal relationship?

5. Dynamic models: Capturing change
Systems are change over time. How do we formulate change of a system? We introduce difference equation to define how state variables change over time. We illustrate this with a number of examples like population dynamics, the build up of CO_2 in the atmosphere and the changes on bank accounts. Furthermore we will use Excel spreadsheets to calculate the difference equations.

6. Feedback
Everything seems to depend on everything else like a big bowl of spaghetti. How do we model the consequences of a change in one part of the system to another part? We introduce systems of two difference equations by a number of examples such as the interaction between predators and prey, and the interaction of climate change and forest growth. We will also use Excel spreadsheets to calculate through the examples.

7. The Butterfly Effect
Systems that change over time can lead to very strange effect when there are nonlinear interactions. Some systems are very sensitive to small changes like a butterfly in Brazil may cause a tornado in the Midwest of the USA by the flap of her wings. We will use simulation models to explore a number of examples.

8. Networks
Most of you are part of social networking communities like Myspace and Facebook. In fact, networks are everywhere. How do we represent social and biological networks mathematically? We will discuss how to formulate networks graphically and mathematically. What are different types of networks and how can we analyze the structure of a network? We will discuss examples on how networks are used to study the spread of diseases and the flow of information in the Blogosphere.

9. Flipping coins
What is the chance to win the lottery? Or to get infected by influenza? How do we calculate these probabilities? We introduce the concept of probability and discuss a number of applications in the life and social sciences.

10. The Matrix
From a webpage we can click often to a number of other web pages. The popularity of your webpage is increased if popular web pages link your webpage. How do we calculate the popularity of a webpage? By defining a transition matrix we can calculate which web pages are the most popular. Google ranking of web pages is based on this approach. Transition matrices are used in many other applications such as land use change, disease spreading, baseball and demographics.

11. Games
In order to reduce the impacts of humans on the climate system do you give up your car, your holidays and eating meat? But what if everybody else will join? Humans and animals experience many social dilemmas where there is a conflict between self interest and the benefits for the group. We can formulate these social dilemmas into games. We discuss payoff matrices and applications of games in life and social sciences.

12. Origins
What is the origin of new behaviors in a social system? Can we use models to understand the origins of species? We will explore a number of examples by using simulation models that model adaptation and evolution.

13. Sustainability
How much do we need to change our behavior and technology here and in other places in the world to improve sustainability of our planet? We discuss a variety of ways models are used to calculate possible futures and desirables changes. Furthermore, we present examples of how models are used in actual policy applications.

Examinations

The examinations will cover material as indicated in the schedule. Each exam will of a number of problems which are similar to homework, but they may also represent applications of principles in entirely different circumstances. Memorization of formulas will not be sufficient for obtaining high grades on examinations.

Examinations are governed by the following policies:

1. There will be **no make-up examinations**.
2. **Academic dishonesty** on an examination will result automatically in a failing grade for the course and referral to the Dean for further sanctions. *Cheating in any form will not be tolerated!*
3. The use of **hand calculators** of any kind is permitted. Students may not wear headphones of any kind during the exam. All cell phones and other electronic devices must be put away and may not be used during the examination.
4. Examination paper (including scratch paper) will be provided. Bring only your pencils and calculators.
5. **Partial credit** is given. Arithmetical errors will be treated charitably, but for answers that do not make sense (wrong dimensions, deviation by several orders of magnitude, etc.) no credit will be awarded. Always examine your solutions for reasonableness.
6. In the event of a **fire alarm** occurring during an examination, students will be asked to close their examination booklets, gather their belongings and leave the room as expeditiously as possible, leaving their examination booklets on the tables where they were working. The booklets will be gathered and graded as they are. Unless the alarm proves to represent a *bona fide* emergency, there will be no make-up examination.
7. If a student believes there to have been an **error in grading** his or her examination, the complaint should be put in writing and handed, together with the examination, to the course instructor. The problem will be regraded by the individual who graded it originally. If the student is not satisfied with the grader's response to the complaint, he or she may appeal to the course instructor. In this event, the instructor reserves the prerogative to regrade the entire examination. (Simple errors, such as point addition, can be corrected by the student's recitation section instructor without the need for a written appeal.)

Final Grades

The final course grades will be derived from homework, and examinations with the following weights:

Homework and in-class assignments	50 %
Midterm exam	20 %
Final exam	30 %

Your final grade will be computed to the nearest whole number (For example, 87.4 = 87, not 88) and your final letter grade will be based on the following table:

A+	>95%	B+	79-83%	C+	64-68%	F	<47%
A	88-94%	B	74-78%	C	58-63%		
A-	84-87%	B-	69-73%	D	47-57%		

There will be no further curve applied to the grades unless the overall class average is less than 67 %. The class average will be calculated by including only the grades of the students who have taken both exams; all other scores will be excluded.

Please note that we will make every effort to record your grades accurately. However, there are times when errors are made. To ensure that you get the grade you have earned you need to keep all of your graded work and other such items as proof that an assignment was done or a lecture attended. No scores will be corrected without proof.

Withdrawal

Withdrawal policies are established by the University. The course withdrawal deadline is **Friday April 3** to withdraw in person and Sunday, April 5 to withdraw via the web. If students wish to withdraw entirely from the university they have until May 5.