SOUTHEAST COMMUNITY COLLEGE
DIVISION OF ARTS AND SCIENCES
Mathematics
Revised Date: 01-01-21

I. CATALOG DESCRIPTION

Course Number:	MATH 2070
Course Title	Using Math to Understand Our World
Prerequisite(s):	MATH1150 or by permission
Catalog Description:	Uses a series of projects to study the mathematics underlying several socially-relevant questions (i.e. real-world problems, such as how to use mathematics to understand the spread of a disease) and the construction of models to describe them.
Credit Hours:	3.0
Class Hours:	45
Lab Hours:	0
Total Contact Hours:	45

II. COURSE OBJECTIVES:

This course is comprised of a series of projects that will broadened students' mathematical perspective by exposing them to a variety of interdisciplinary settings to which mathematical concepts can be applied. Additionally, this course will (1) develop mathematical modeling and problem solving skills; (2) improved ability to read technical reports and research articles; and (3) strengthen and refine written mathematical communication skills.

III. STUDENT LEARNING OUTCOMES AND GENERAL EDUCATION LEARNING OUTCOMES:

A. Student Learning Outcome: *Student will be able to:*

1. Analyze data in order to determine whether an appropriate mathematical model is a linear function, a polynomial function, an exponential function or something else.

2. Understand the mathematics behind measuring temperatures and behind the rates at which temperatures heat or cool.

3. Use a spreadsheet to model the spread of an illness; then based on this experience, analyze an original research report submitted to the CDC.

4. Understand concepts of probability and how they can be applied to quality control.

5. Use mathematics to model problems and analyze the results.

B. General Education Learning Outcomes

1. Identify the concepts in real-world phenomena that can be analyzed with mathematics.

2. Reason, justify and communicate about complex ideas (and mathematics) through writing.

3. Reason, justify and communicate about complex ideas (and mathematics) through oral presentation.

IV. CONTENT/TOPICAL OUTLINE (*course outline may provide more detailed information)*

Function Review: Mathematical concepts needed for the various projects are presented in class as needed. It is assumed students are familiar with linear functions, so these are briefly reviewed. Additional concepts needed include exponential functions, logarithms, exponential growth and decay, modeling with linear and exponential functions.

Projects will vary. Some possibilities are as follows:

Project 1: Measuring Temperature & Newton's Law of Cooling

Project 2: Using Body Temperature to Estimate Time Since Death
Description: In these projects students will examine methods for the derivation of number scales for measuring temperature, construct their own thermometer and determine its temperature scale. Students will learn how Isaac Newton first measured very high temperatures and how Newton's Law of Cooling came out of this study. Participants will see Newton's original paper on cooling (in Latin and in English), use his ideas to predict the temperatures of simple cooling objects, and study methods for adapting Newton's Law to more complicated objects. In particular, students will examine how these mathematical ideas are used to estimate time of death of a human body and use standard coroners' algorithms to solve a murder mystery.
Mathematical Tools: exponential functions, logarithms, modeling, graphing, linear functions, proportional reasoning, conversions between scales, basic statistics.

Project 3: Containing Infectious Diseases
Description: Due to concerns about bioterrorism, the U.S. government commissioned the CDC (Center for Disease Control) to come up with recommendations for how to react in the event of a smallpox attack. With the goal of containing the outbreak to prevent an epidemic, the CDC came up with a plan that involves quarantining infected individuals and vaccinating a percentage of healthy individuals. The CDC used mathematics to solve this problem and the goal of this project is to understand it. Students will begin by analyzing the simpler (fictitious) disease, schoolpox, and various strategies for containing schoolpox outbreaks. After the simplified problem is understood, students will read the actual CDC smallpox report. During this project, students will study strategies (based on mathematics) employed to contain cholera outbreaks in the 1800's, strategies which virtually eliminated cholera epidemics and saved literally tens of thousands of lives.
Mathematical Tools: modeling and simulation, iterative processes, basic statistics, interpretation of graphs, linear functions.

Project 4: Testing the Quality of Things that Explode
Description: Near the end of WWII, the British Navy struggled with the fact that the majority of their artillery shells were duds and were useless in battles against German ships. The British Ordnance board blamed shell manufacturers and wanted the manufacturers to develop a strategy for testing the quality of the shells prior to their distribution. Unfortunately, the only method to accurately determine if a particular shell worked was to detonate it, and once used it could not be employed in the war effort. Participants will read a memo written by the head of the British Ordnance board about how shell quality was tested and study the complicated issues involved in testing the quality of consumable products. Participants will formulate their own testing recommendations to shell manufacturers.
Mathematical Tools: probability, determining optimal sample size.

V. INSTRUCTIONAL MATERIALS

A. Required Text(s):
- **1.** No textbook required

B. Other Resources:
- **1.** None.

VI. METHODS OF PRESENTATION/INSTRUCTION

A. Methods of presentation typically include a combination of the following:
The course will be structured around a series of projects. For each project, participants will work in groups to complete a pattern of activities that is similar to the following:
- **1.** Review the mathematical concepts necessary for the given project. Students solve problems which reinforce the content being learned.
- **2.** Read the project statement and review essential background information (using original documentation whenever possible).

3. Identify the mathematical aspects of the problem in order to develop an appropriate mathematical model.
4. Analyze the mathematical model and connect the results to the problem at hand.
5. Groups provide written reports which include mathematical explanations and justifications for solutions and recommendations for the problems.
6. Groups give oral presentations of their solutions to the different projects.
7. Groups offer feedback to one another through peer review.

B. Daily in-class activities may consist of:
1. Interactive lecture: Instructor reviews or presents background material and mathematical concepts needed to model the problem in the project. Students work in groups on tasks designed to solidify understanding of the topics.
2. Introduction to the project – groups collaborate to begin making sense of the problem and develop a model.
3. Groups meet with instructor to assess progress.
4. Groups work in class for those projects which require hands-on engagement.
5. Groups present solutions and offer feedback to one another.

VII. METHODS OF EVALUATION

A. Methods of evaluation typically include a combination of the following:
1. Class participation
2. Quality of written solutions focusing on accuracy, justification, communication
3. Oral presentations and peer review
4. Homework assignments on concepts presented as background for the various projects
5. "Final Project" which involves revising one of the projects completed during the semester and adding some relevant content to the project.

B. SCC GRADING SCALE

A+	95-100	C+	75-79	F	59 or less
A	90-94	C	70-74		
B+	85-89	D+	65-69		
B	80-84	D	60-64		

VIII. SPECIFIC COURSE REQUIREMENTS

None.