MAT 120 College Algebra

Department of Mathematics
Southern Connecticut State University

I. Catalog Description

Algebraic problem solving and quantitative reasoning skills needed for business and social science majors; equations and inequalities in one variable; linear, quadratic, exponential, and logarithmic functions; systems of linear equations in two variables.

II. Purpose

The purpose of this course is to provide students with the algebraic problem solving skills needed for business and social sciences major. It also will provide students with the quantitative reasoning skills needed to satisfy the mathematics general education requirement for the University Liberal Education Program.

III. Credit

(A) MAT 120 carries three semester-hours of university credit.

(B) MAT 120 does not currently (2011) satisfy the University Requirement in mathematics.

(C) MAT 120 (or MAT 122) is a prerequisite for MAT 139

(D) Students may earn at most 4 credits toward graduation from MAT 120 and MAT 122.

IV. Prerequisites

The student must satisfy one of the following two prerequisites:

(A) passed MAT 112 with a grade of C- or better;

(B) establish a placement level appropriate for the course.

V. Format

MAT 120 meets for 3 contact hours per week throughout a standard academic semester and is conducted primarily in a lecture and discussion format.

VI. Liberal Education Program

This course satisfies the University's Liberal Education Program (LEP) requirement in Quantitative Reasoning (QR). It addresses the key elements of the QR requirement as indicated in Section VIII: Course Objectives. Further, as a Tier 1 LEP course, it will do the following:

(A) Address at least one *Area of Knowledge and Experience* through the choice of data sets or word problems that are applied to one of the sciences, *Natural World I: Physical Realm* or *Natural World II: Life and the Environment*. Examples of data could also be chosen to introduce other *Areas of Knowledge* such as *American Experience* (for example, data measuring population changes in America) or *Global Awareness* (for example, data measuring poverty levels in different countries).

(B) Incorporate at least one *Discussion of Values*. For example, *Environmental Awareness* could be discussed through modeling data that comes from an environmental issues such as global warming trends. *Rational Thought* can be emphasized by asking students to interpret and make predictions from a given mathematical model. For example, students might be asked to interpret the meaning of slope in context or they might be asked about the limitations of the model. *Civic Engagement* is another area that could be discussed by choosing to model data that directly affects students' local communities.

(C) Address at least one *Embedded Competency* in a significant manner. Instructors may choose to address this requirement by incorporating one of the following requirements into their course: *Oral Communication* by requiring students to present the results of their work through oral presentations, *Interpersonal Effectiveness* by requiring students to work in group settings, *Information Literacy* by requiring students to locate and evaluate their own information and/or data for a project, or *Creative Thinking* by requiring students to create a model for a set of data or scenario in which they have not already been told what type of model is most appropriate.

(D) Present the Quantitative Reasoning aspects of College Algebra in context. The key elements QR1–Quantitative Situations, QR2–Quantitative Data, QR3–Methods, QR4–Reliability of Data and Solutions, and QR5–Mathematical Process are addressed in the course objectives listed below.

VII. Quantitative Reasoning Key Elements

(A) **QR1**: Quantitative Situations - Identifying the essential quantitative elements in both routine and novel situations and understanding the relationships between those quantitative elements, and producing mathematical models appropriate for the intended analysis (e.g., writing equation(s) to represent the situation).

(B) **QR2**: Quantitative Data - Representing quantitative information in both technical and common language by using symbolic, graphical, and tabular formats, and drawing correct inferences from quantitative information through the interpretations of such representations.

(C) **QR3**: Methods - Acquiring the tools and methods necessary to resolve both routine and novel quantitative questions, including a correct sequencing of procedures, and using them appropriately, given the nature and constraints of a situation. In addition to using knowledge previously acquired in intermediate algebra, students will demonstrate proficiency with information presented in numerical or statistical form and mathematical concepts of growth and decay with their applications (e.g., linear, quadratic, exponential, etc.).

(D) **QR4**: Reliability of Data and Solutions - Correctly evaluating the level of accuracy stated or implied for given data, and assessing the correctness and accuracy of an analysis, including the assessment of the method and model used and the reasonableness of the solution.

(E) **QR5**: Mathematical Process - Using discovery (e.g., exploration and pattern-recognition), conjecture, and testing to develop mathematical formulas, theorems, and then giving persuasive mathematical arguments to establish their validity.

VIII. Course Objectives

In addition to satisfying LEP Tier 1 requirements, MAT 120 has specific course objectives. By the end of the course, a successful student should be able to do the following:

(A) Sketch the basic shape and behavior of the basic graphs of linear, exponential, logarithmic, absolute value, quadratic, and power functions without using a graphing calculator. Sketch basic transformations of these graphs without a calculator.

(B) Sketch polynomial and rational functions using a technology. Identify and algebraically find important characteristics of these graphs such as intercepts, vertical asymptotes, and horizontal asymptotes.

(C) Discuss and use the range of function topics: the definition of function, function notation, domain and range, zeros, local extremes and end behavior, periodicity, algebraic combinations of functions, composition of functions, and inverse functions for all of the basic elementary functions and for the general families of functions studied in the course.

(D) Algebraically solve linear, quadratic, exponential, logarithmic, and power equations. Algebraically solve higher-order polynomial equations that can be solved using factoring methods. (QR3)

(E) Construct linear or exponential models to fit sets of data. In particular, the review of linear functions can be done through "straight-edge" modeling of a set of data, which then can be used to introduce the topic of linear regression and the correlation coefficient. Similarly, after introducing exponential models, they can be reinforced by looking at exponential regression models of data sets. (QR1, QR2, QR4, QR5)

(F) Construct and use appropriate functions to model applications. In particular, linear functions, the exponential function, and logarithmic functions should be used to model applications. (QR1, QR2, QR4, QR5)

(G) Use a technology in the course. In addition to the ordinary scientific calculator capabilities, students completing MAT 120 should have the technology skills listed below. However, the use of the technology should support, not replace, fundamental skills and knowledge from the course outline, such as items A3, A4, A5, A8, C1, and C2. These topics are marked with an asterisk in the course outline.

1. Recognize and deal with misleading graphs, including graphs with hidden behavior (for example, removable discontinuities and vertical asymptotes of rational functions), and incomplete graphs, by choosing an appropriate viewing window.
2. Solving equations graphically by means of tracing and zooming, and using the special equation solving capabilities of the TI-83/84, including "Zero" and/or "Intersect".

IX. Outline

Items in the outline marked with an asterisk indicate skills that students are expected to be able do without the use of a graphing calculator.

Functions and Their Graphs (30%)

(a) The coordinate planes (including circles and their equations).

(b) The concept of a function (including numerical, symbolic, graphical and modeling representations, domains and ranges, and the vertical line test).

*(c) Graphs of power functions (including positive and negative integer exponents and rational exponents) and the absolute value functions.

*(d) Transformations of graphs of functions (including vertical and horizontal shifts, stretches and shrinks, and reflections).

*(e) Review of the analytical methods for solving linear, quadratic, and polynomial equations (including the solution of quadratic equations by factoring, root extraction, completing the square, and the quadratic formula, including irrational and complex roots).

(f) (Optional) Complex number arithmetic.

(g) Fitting linear functions to data, linear regression models and the correlation coefficient. This topic should be used to briefly review linear functions (including slope, intercepts, and the equations of straight lines).

*(h) Graphs of linear and quadratic functions (including intercepts and vertices of parabolas).

(i) Graphical solution of functional equations.

(j) Arithmetic combinations and composition of functions.

(k) Inverse functions.

(l) Graphs of piecewise defined functions.

Polynomial Functions and Their Zeros (30%)

(a) Review of long division of polynomials.

(b) (Optional) Synthetic division of polynomials.

(c) The remainder and factor theorems.

(d) (Optional) The rational roots theorem.

(e) Analytical and graphical solution of polynomial equations and their interplay.

(f) General characteristics of graphs of polynomial functions (including intercepts, local extremes, the number of local extremes, end behavior, and continuity and the intermediate value property). General characteristics of graphs of power functions and the concept of a complete graph.

(g) Brief introduction to the general characteristics of graphs of rational functions (including vertical asymptotes and removable discontinuities, and end behavior and horizontal asymptotes).

Exponential and Logarithmic Functions (30%)

*(a) The basic exponential functions (including the natural exponential function) and their graphs.

*(b) The basic logarithmic functions and their graphs.

(c) The laws of exponents and the properties of logarithms.

(d) Analytical and graphical solution of exponential and logarithmic equations.

(e) Exponential growth and decay models, i.e. interest, population models, radioactive decay.

(f) Exponential regression models.

Systems of Equations (10%)

(a) Solving systems using substitution.

(b) Solving systems using elimination.

(c) Systems of inequalities.

X. Assessment

Individual instructors may vary assessment modes, but typically grades will be based on a combination of homework assignments, quizzes, and exams.

	QR 1 Quantitative Situations	QR 2 Quantitative Data	QR 3 Methods	QR 4 Reliability of Data and Solutions	QR 5 Mathematical Process
Homework	Individual instructors decide which QR will be assessed appropriately.				
Quizzes	Individual instructors decide which QR will be assessed appropriately.				
Tests	✓	✓	✓	✓	✓
Final Exam	✓	✓	✓	✓	✓

XI. Recommended Text

R,. Harshbarger and L. Yocco, *College Algebra in Context*, Addison Wesley, 2012.

XII. Waiver Policy

This course may be waived. If a student places directly into MAT 139 (and subsequently takes and passes it), OR if a student receives AP credit for MAT 139, then the math department will waive the Quantitative Reasoning requirement for that student.

XIII. Bibliography

(A) M. Sullivan, *College Algebra*.

(B) Larson, Hostetler and Hodgkins, *College Algebra: A Concise Course*

(C) Larson, Hostetler, and Edwards, *College Algebra: A Graphing Approach*.

(D) Rockswold, *Essentials of College Algebra with Modeling & Visualization*.

(E) Stitz and Zeager, *College Algebra*

(Online at `http://www.stitz-zeager.com/Precalculus/Stitz_Zeager_Open_Source_Precalculus.html`)

XIV. Preparation

- Proposed outline prepared by M. El-Nabbout, K. Kruczek, J. Scheuermann, January 2012.
- Approved by the MDCC, 7-0-0, March 13, 2012.
- Approved by the Department of Mathematics 12-0-0, March 30, 2012.
- Revised outline prepared by J. Hong, November 1, 2020.
- Approved by the MDCC, 9–0–0, November 10, 2020.