March 2, 2015

Memo to: University Provost Council and Community College Council of Instructional Administrators

From: JBAC (Joint Boards Articulation Commission

Regarding: Associate of Arts/Oregon Transfer Math Requirement

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JBAC recommends a revision in the Foundational Requirements of the AAOT:

Mathematics: One course in college-level mathematics **designated by the college as meeting statewide criteria for mathematics**

- Through its Math Pathways work, JBAC has found that Intermediate Algebra (Math 95) best serves a particular niche of students—those preparing for College Algebra and a calculus-focused college mathematics track.

- Extensive work has been done across many community colleges to develop an alternative pathway into college mathematics that is based on quantitative literacy and statistics. Several colleges are currently offering a newly-developed Quantitative Literacy course.

- Math 105 has been found to meet university math requirements for all public universities in Oregon. Many students earning Bachelor of Arts degrees at Oregon universities take only Math 105 to meet their university math requirements.

- Math faculty from all Oregon community colleges and 4 of the 7 universities (EOU, OSU, PSU, UO) participated in an alignment meeting in Fall 2014 to develop agreed-upon statewide outcomes, topics, and prerequisite skills for Math in Society (Math 105). An alignment meeting was held in Winter 2015 to develop similar consistency for Math 98, which may serve as a prerequisite for MTH 105.

- Upon review of these courses, and in light of disciplinary discussions during the JBAC Math Pathways convening of faculty in mathematics and biology, chemistry, economics, physics, psychology, and sociology, JBAC finds that Math 105 counts toward the AAOT, as it meets the statewide outcomes and criteria.

- The AAOT's restriction on Intermediate Algebra for college-level mathematics courses was established prior to the development of the statewide outcomes and criteria for transferable general education college mathematics courses.

- Upon deliberation, JBAC recommends to Provost Council and CIA that the prerequisite language in the AAOT for mathematics be removed and replaced with specific reference to the outcomes and criteria for transferable General Education Mathematics courses in Oregon.

Additional background information to be included with this memo.

Proposed Change in AAOT mathematics prerequisite

Associate of Arts-Oregon Transfer: http://handbook.ccwdwebforms.net/handbook/programs-degrees-and-certificates/definitions/associate-degrees/associate-of-arts-oregon-transfer-(aa-ot)

Foundational requirements

- *Writing*: Students taking writing classes of three credits each must take WR 121, 122, and either WR 123 or 227. Students taking writing classes of 4 credits each must take WR 121 and either WR 122 or 227. A student must have eight credits of Writing.
    - Information Literacy will be included in the Writing Requirement.
- *Oral Communication:* One course in the fundamentals of speech or communication designated by the college as meeting the statewide criteria for speech communication.
- ***Mathematics:*** **One course in college-level mathematics, ~~for which Intermediate Algebra is a prerequisite~~ designated by the college as meeting statewide criteria for mathematics.**
- *Health/Wellness/Fitness:* One or more courses totaling at least three credits.

Background:

Outcomes and Criteria for Transferable General Education Courses in Oregon excerpt: http://handbook.ccwdwebforms.net/handbook/appendices/appendix-k

Mathematics

OUTCOMES

As a result of taking General Education Mathematics courses, a student should be able to:

• Use appropriate mathematics to solve problems; and

• Recognize which mathematical concepts are applicable to a scenario, apply appropriate mathematics and technology in its analysis, and then accurately interpret, validate, and communicate the results.

CRITERIA

A collegiate level Mathematics course should require students to:

1) Use the tools of arithmetic and algebra to work with more complex mathematical concepts.

2) Design and follow a multi-step mathematical process through to a logical conclusion and judge the reasonableness of the results.

3) Create mathematical models, analyze these models, and, when appropriate, find and interpret solutions.

4) Compare a variety of mathematical tools, including technology, to determine an effective method of analysis.

5) Analyze and communicate both problems and solutions in ways that are useful to themselves and to others.

6) Use mathematical terminology, notation and symbolic processes appropriately and correctly.

7) Make mathematical connections to, and solve problems from, other disciplines.

The Outcomes and Criteria statements in Mathematics were developed from 2007-2009 by:

Mariah Beck	Math	Umpqua Community College
Janet Brougher	Math	Rogue Community College
Ben Cornelius	Math	Oregon Institute of Technology
Tom Dick	Math	Oregon State University
Phyllis Leonard	Math	Chemeketa Community College
Neal Ninteman	Math	George Fox University
Jeanette Palmiter	Math	Portland State University
Julie Rowland	Math	Concordia University
Hal Sadofsky	Math	University of Oregon
Linda Samek	Math & Education	Corban College
Michael Ward	Math	Western Oregon University
Renae Weber	Math	Treasure Valley Community College
Jim Whittaker	Math	Blue Mountain Community College

Mth 105 --- Math in Society

Course Description:
Math in Society is a rigorous mathematics course designed for students in Liberal Arts and Humanities majors. The course provides a solid foundation in quantitative reasoning, symbolic reasoning, and problem solving techniques needed to be a productive, contributing citizen in the 21st century.

Course Outcomes: Skills and abilities that result from the course.

- ✓ [MR] Mathematical Reasoning: Students will read a complex problem requiring quantitative and/or symbolic analysis, use flexibility in selecting a solution strategy, and impose an appropriate mathematical structure or mathematical procedure in solving the problem.
- ✓ [MH] Mathematical Habits of Thought: Students will determine the reasonableness and implications of mathematical solutions, and will recognize the limitations of the methods used in context.
- ✓ [MDM] Mathematical Decision-Making: Students will apply mathematical processes and solutions in making personal and societal choices.
- ✓ [MC] Mathematical Communication: Student will use appropriate representations to effectively communicate, orally and in writing, quantitative results and mathematical processes.
- ✓ [MS] Mathematical Symbols, Techniques & Computation: Students will demonstrate proficiency in the skills supporting mathematical understanding.

Major Course Topics:
These are the three major topics along with the required supporting topics for each. The major topics are listed in the order in which they should be taught. Reasoning logically and problem solving are skills that should permeate throughout the entire course.

1. Logical Reasoning and Problem Solving --- (10 – 20% of course)
    - ✓ Describing and Critiquing Arguments
    - ✓ Understanding the Language of Logic
    - ✓ Recognizing Common Logical Fallacies
    - ✓ Learning Strategies of Problem Solving (non-algebraic, showing another way)
2. Probability and Statistics --- (30% of course)
    - ✓ Counting --- Multiplication Property
    - ✓ Measures of Central Tendencies and Spread
    - ✓ Calculating and Interpreting Basic Probabilities
    - ✓ Interpreting Graphical Displays/Histograms
    - ✓ Margin of Error/Polls
    - ✓ Expected Value
    - ✓ Interpreting Distributions
    - ✓ Misuse of Data

3. Financial Literacy --- (20% of course)
    - ✓ Percent Sales and Income Tax
    - ✓ Simple and Compound Interest
    - ✓ Annuities
    - ✓ Loans and Credit Cards

4. Additional Math Topics --- (30% of course)

Additional topics that might be addressed include, but are not limited to:

- ✓ Graph Theory
- ✓ Gamming
- ✓ Game Theory
- ✓ Modeling Growth
- ✓ Apportionments
- ✓ Fractals
- ✓ Applied Trigonometry
- ✓ Golden Mean
- ✓ Math in Art
- ✓ Math in Music
- ✓ Sequence and Series
- ✓ Voting Theory
- ✓ Fermi Approximations
- ✓ Infinities
- ✓ Symmetry/Tessellations
- ✓ Cryptography
- ✓ Binary Operations
- ✓ Historical Numbers
- ✓ Proportional Reasoning
- ✓ Scheduling
- ✓ Logistic Models

While the major topics overlap in many ways with content addressed in courses in statistics and business mathematics, the focus in Mth 105 is on the "big ideas" in these areas. That is, the aspects of logic, statistics, and finance which are essential knowledge for an educated citizenry. The course should not have extensive emphasis on procedures and details. The intent is to define a rigorous liberal arts quantitative course that provides an important piece of a well-rounded general education, namely, building a student's ability to reason quantitatively. The list of major topics is meant to address this aim through a consistent focus while still leaving time, about 30% of the course, for additional math topics that can be relevant to a wide range of liberal arts and humanities areas. An instructor could choose to apply the time allotted for the Additional Math Topics area to delve deeper into one, or all of the Major Course Topics.

Prerequisite Skills for Mth 105, Math in Society

In order for students to be successful in a rigorous college, transfer-level quantitative reasoning course it is essential that they have a firm foundation in basic number sense, the ability to reason algebraically, and the ability to read and interpret graphs. The following list of skills is intended to help frame our concept of a transfer-level quantitative reasoning course and to provide students and instructors with an understanding of the expectations we have for students who enroll in such a course. This list represents skills students should have entering this Mth 105 course, not a list of skills corresponding to a specific math course. It is important to realize that students are not expected necessarily to achieve a high level of proficiency in all of these skills prior to entering Mth 105 as many of these skills will continue to be developed in this college, transfer-level course.

The Mth 105, Math in Society, description of skills and outcomes presumes that students entering the course should have developed a skill set through a college developmental math sequence or from math courses taken in high school. These skills include the following:
Note: While many of these skills provide foundational support for more than one major course topic area in Mth 105, the coding abbreviations in parentheses, where noted, suggest a primary link between a particular skill and one of the three major course topic areas listed for the course: LR = logical reasoning; FL = financial literacy; and PS= probability and statistics.

Number Sense

- Use standard order of operations to evaluate expressions (including fractions and exponents)
- Calculate with, and convert between, decimals, fractions, and percents (FL)
- Interpret and use scientific notation
- Use various strategies to perform estimations (products, ratios, relative sizes) (FL)
- Use, and convert between, units
- Increase or decrease a given value by a given percentage (FL)
- Calculate the relative change (percent) between two quantities (PS)

Algebraic Reasoning and Modeling

- Use variables to represent quantities (LR)
- Solve linear equations and proportions (FL)
- Create and use linear models in a variety of authentic settings (FL)
- Interpret slope as a rate or ratio as appropriate for the given context (FL)
- Apply exponent rules to simplify basic expressions with exponents. (FL)
- Recognize and describe the relationship between variables expressed in an algebraic equation or graphical representation (intuitive notion of a function)
- Use, and convert between, different representations of relationships (verbal, algebraic, numerical, graphical) (LR)
- Understand order of operations (LR)
- Be able to use Polya's problem solving principles (or at least have modeled and solved some application problems) (LR)

Graphical Sense

- Create and use simple graphs: lines, bar charts, pie charts, and histograms (PS)
- Read and interpret graphs, charts, and tables (PS)

Mth 105 Convening Representatives

Two-Year Institutions	
Blue Mountain	Gary Parker
Central Oregon	Jessica Giglio
Chemeketa	Wayne Barber
Clackamas	Carrie Kyser
Clatsop	TJ Lackner
Columbia Gorge	Lucas Lembrick
Klamath Falls	George Harpham
Lane	Jessica Knoch
Linn-Benton	Nicole Francis
Mt. Hood	Maria Miles
Oregon Coast	Marge Burak
Portland	Virginia Somes
Rogue	Charlotte Hutt
Southwestern	Nikki Armstrong
Tillamook Bay	Geza Laszlo
Treasure Valley	Pat Rhodes
Umpqua	Mariah Beck

Four-Year Institutions	
Eastern Oregon	Bryan Fisher
OIT	Not Participating
Oregon State	Scott Peterson
Portland State	Joe Ediger
Southern Oregon	Not Participating
University of Oregon	David Steinberg
Western Oregon	Not Participating

Special Guests	
CCWD	Lisa Reynolds
HECC	Donna Lewelling
OCCA	Elizabeth Cox-Brand
ODE	Mark Freed

Math 98 Quantitative Literacy (DRAFT)

The following document reflects the collaborative efforts of mathematics faculty members from all 17 two-year institutions in Oregon in developing a course outcome guide for Mth 98, Quantitative Literacy. Representatives from Oregon State University, Oregon Community Colleges Association, Oregon Department of Community Colleges and Workforce Development, the Higher Education Coordinating Commission, and the Oregon Department of Education have also contributed to this effort.

Mth 98, Quantitative Literacy, is a rigorous mathematics course that is designed to be part of an alternate pathway from the traditional algebra track. Rigor implies that students display conceptual understanding and procedural fluency while working on authentic applications. Throughout the course, the Rule of Four is implemented. That is, the information given in any mathematical problem is described in at least one of four ways: verbally, numerically, graphically, or algebraically. Students use this information to engage effectively with contextual, open ended mathematical problems. During their engagement, students must reason and interpret the information, make conjectures about the situation, communicate effectively, and verify their results.

A student for whom this Quantitative Literacy course may be appropriate falls under one or more of the following categories:

- ✓ One whose degree or certificate goal does not require Calculus.
- ✓ One whose path takes her or him to Mth 105, Math in Society.
- ✓ One whose path does not require Mth 112, Trigonometry.
- ✓ One whose goal is not within the STEM, Science, Technology, Engineering, or Mathematics, fields. This student could need some science content in their coursework but would not be considered a science major. Students in Liberal Arts fields fall in this category.
- ✓ One who is in a CTE program, particularly a non-STEM program.
- ✓ One who will not need mastery of algebraic manipulation in her or his career field.

All Mth 98 courses cover the following five major course topics:

1. Applied Number Sense
2. Applied Algebraic Reasoning and Modeling
3. Graphical Sense
4. Measurement
5. Statistical Reasoning

For each major topic, a list of supporting items has been drafted and is being finalized for later inclusion.