Alignment of Mathematics Requirements at Central Texas Area Colleges and Universities

THE New Mathways PROJECT

February 2016

The New Mathways Project and Multiple Math Pathways

In 2012, the Charles A. Dana Center at The University of Texas at Austin, in collaboration with the Texas Association of Community Colleges, developed the New Mathways Project (NMP) to increase student success in developmental mathematics and entry-level college mathematics, and to support student completion of degrees, licenses, or certificates with labor market value.

The NMP promotes student learning through accelerated developmental coursework and relevant and rigorous college-level mathematics that emphasize the skills needed for academic and professional success. Specifically, the NMP supports multiple math pathways through Elementary Statistical Methods (Math 1342), Contemporary Mathematics (Math 1332), and a STEM-prep pathway that includes College Algebra (Math 1314) for students who will take calculus. Implementation and scale of multiple math pathways depend upon ensuring that associated courses will transfer and count toward degree programs at colleges and universities.

Central Texas Regional Math Pathways Alignment

This brief analyzes the alignment of mathematics requirements at community colleges and universities in central Texas. We collected data from 2015–2016 course catalogs on core curriculum requirements and entry-level mathematics course requirements by programs of study, including *algebraically-intensive courses*, College Algebra (Math 1314) and Mathematics for Business and Social Science (Math 1324), and *non-algebraically-intensive courses*, Contemporary Mathematics (Math 1332) and Elementary Statistical Methods (Math 1342).

We focus on illustrative programs within six meta-majors: (1) liberal arts and fine arts, (2) social science and social services, (3) business and accounting, (4) education and teaching, (5) nursing and health professions, and (6) STEM programs. Institutions examined are listed below.

Four-Year Institutions	Two-Year Institutions
Texas A&M University–Central Texas Texas A&M University–San Antonio Texas State University The University of Texas at Austin The University of Texas at San Antonio	The Alamo Colleges Austin Community College Central Texas College Hill College McLennan Community College Navarro College Temple College

Summary of Findings

While we observe a general trend towards alignment of math course requirements between two-year and four-year institutions, more work needs to be done to harmonize math requirements in the region and to ensure efficient transfer pathways for students.

- ***All colleges and universities utilize multiple math pathways in their core curriculum.*** All 12 institutions in central Texas offer and accept for transfer elementary statistics as part of their core curriculum. Eleven institutions offer contemporary mathematics and 11 include college algebra.
- ***Math requirements are often aligned to meta-majors.*** Elementary statistics and contemporary math are allowed for most liberal arts, fine arts, social science, public service, and health programs. Algebraically-intensive courses are typically recommended for STEM, business, and education programs.
- ***Variations in math course requirements for some programs and traditional advising practices stifle seamless transfer and applicability.*** Specific areas of concern are as follows:

  - *Liberal arts, fine arts, and social science:* One university requires college algebra for a majority of their degree programs in liberal arts, fine arts, and social sciences, while other institutions in the region recommend or allow contemporary math or statistics for these programs.

  - *Nursing:* Most programs require or recommend statistics, although there is variation by institution and type of program.

  - *Business:* One university has a unique set of algebraically-intensive courses for business degrees that do not align with Math 1324 or Math 1325.

  - *Advising:* Course catalogs generally do not guide students towards preferred math courses; instead, course catalogs list all possible math course options. This lack of guidance places a burden on students and advisors to seek information about which math courses will satisfy degree requirements at transfer institutions.

Core Curriculum Findings

Core curriculum requirements at central Texas institutions allow for multiple math pathways (see Table 1). All community colleges and four-year universities require three hours of mathematics. Common core curriculum math courses include:

- **Elementary Statistics** – All community colleges and universities offer Math 1342 as part of their core curriculum. Texas A&M University–San Antonio does not list a statistics course in the core curriculum section of its course catalog; however, direct communication with the university revealed that it accepts Math 1342 for transfer credit. In addition, The University of Texas at Austin includes a statistics course equivalent to Math 1342 in its core, but most degree programs that need statistics do

not apply this course to degree requirements.

- **Contemporary Mathematics** – All community colleges and universities, except Hill College, offer Math 1332 in their core curriculum.
- **Calculus-prep sequence** – All community colleges and 4 out of 5 universities in the region offer Math 1314. The University of Texas at Austin has eliminated Math 1314 from its core requirements because college algebra is considered a prerequisite for calculus rather than a terminal course. Texas A&M University–San Antonio does not offer pre-Calculus (Math 2312) and Central Texas College does not offer Calculus I (Math 2413) in the core.
- **Business Mathematics** – All community colleges, except for Central Texas College, offer Math for Business and Social Science (Math 1324) in their core curriculum. Of the four-year universities, only Texas A&M University–San Antonio and Texas State University offer Math 1324 in their core.
- **Fundamentals of Mathematics** – The University of Texas at Austin and Texas A&M University–San Antonio are the only four-year institutions that include Math 1350 in their core curriculum. No community colleges include Math 1350.
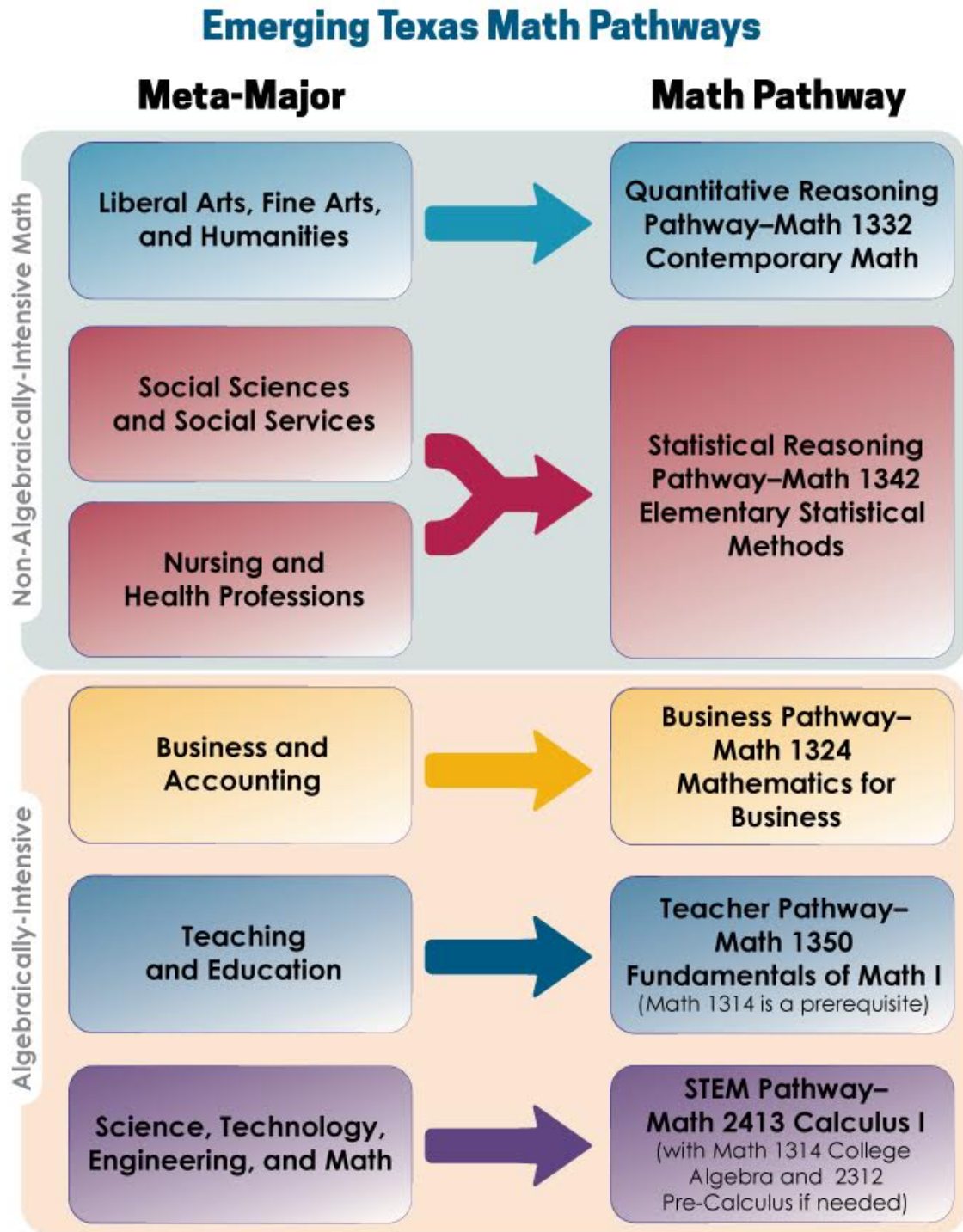
Table 1: 2015-2016 Core Math Curriculum at Central Texas Institutions*

	2-year Institutions							4-year Institutions				
	The Alamo Colleges	Austin Community College	Central Texas College	Hill College	McLennan College	Navarro College	Temple College	TAMU-Central Texas	TAMU-San Antonio	Texas State University	UT-Austin	UT-San Antonio
Math 1314/1414 - College Algebra	■	■	■	■	■	■	■	■	■	■		■
Math 1316 - Plane Trigonometry		■		■	■	■			■	■		
Math 1324 - Mathematics for Bus. & Soc. Sci.	■	■		■	■	■	■		■	■		
Math 1325/1425 - Calculus for Bus. & Soc. Sci.				■	■				■	■		■
1332 - Contemporary Mathematics I	■	■	■		■	■	■	■	■	■	■	■
1342/1442/2342/2442 - Elementary Statistical Methods	■	■	■	■	■	■	■	■	■	■	■	■
Math 1350 - Fundamentals of Mathematics I									■		■	
Math 1351 - Fundamentals of Mathematics II											■	
Math 2312/2412 - Pre-Calculus Math	■	■	■	■	■	■	■	■		■	■	■
Math 2413 - Calculus I	■	■		■	■	■	■	■	■	■	■	■

* Excludes upper-level core math courses for which Math 2413 or above is a pre-requisite.

Findings for Degree Requirements by Meta-major

A summary of math alignment for programs of study, organized by meta-major, is shown below. Program requirement details can be found in the following section.

Emerging Texas Math Pathways

Meta-Major	Math Pathway

Non-Algebraically-Intensive Math

Liberal Arts, Fine Arts, and Humanities → Quantitative Reasoning Pathway–Math 1332 Contemporary Math

Social Sciences and Social Services → Statistical Reasoning Pathway–Math 1342 Elementary Statistical Methods

Nursing and Health Professions → Statistical Reasoning Pathway–Math 1342 Elementary Statistical Methods

Algebraically-Intensive

Business and Accounting → Business Pathway–Math 1324 Mathematics for Business

Teaching and Education → Teacher Pathway–Math 1350 Fundamentals of Math I (Math 1314 is a prerequisite)

Science, Technology, Engineering, and Math → STEM Pathway–Math 2413 Calculus I (with Math 1314 College Algebra and 2312 Pre-Calculus if needed)

Liberal Arts and Fine Arts

All institutions in central Texas allow—and often recommend—contemporary mathematics or introductory statistics for liberal arts and fine arts majors. For example, students pursuing English, history, and fine arts degrees at any community college or university can satisfy major requirements by taking any math class offered in the core curriculum.

Aligned programs include: anthropology, art, communication, drama, English, general studies, humanities, Mexican American studies, music, and radio-television-film.

However, this trend is not reflected in degree program requirements at Texas State University. Of the 28 majors that fall under this meta-major category, only 10 allow students to choose from either a statistics or quantitative reasoning course to fulfill core math requirements. Four programs require Math 1314: dance, interior design, recreational administration, and music studies. Five programs allow Math 1314 or Math 1332, but exclude Math 1342: art, art history, communication design, photography, and studio art. Nine programs exclude Math 1332: advertising, public relations, electronic media, journalism, history, philosophy, Spanish, German, and French.

Social Sciences and Social Services

Most degree programs in social sciences and social services allow students to complete core requirements with introductory statistics or contemporary mathematics, with a preference for statistics.

Aligned programs include: global affairs/international studies, political science, public administration, and sociology.

Some barriers to efficient transfer exist within specific degree plans. For example, despite research that shows many institutions in the state are following the recommendation of professional organizations to require statistics for criminal justice programs, transfer students in central Texas who pursue a degree in criminal justice must navigate significant variation in math requirements[1]:

- Navarro College requires either Math 1314 or Math 1332, but does not permit Math 1342.
- The A.A.S. degree in criminal justice at the Alamo Colleges requires either Math 1314 or Math 1332, whereas the A.A. degree in criminal justice allows any core math class. Texas State University requires a limited selection of core math classes (Math 1314, 1324, or 1332) and an additional statistics course (may include Math 2342).

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[1] The Charles A. Dana Center (2014). Mathematics for criminal justice: Recommendations from professional organizations and requirements from Texas institutions of higher education. Program of Study Brief, No. 3. Retrieved from: http://www.utdanacenter.org/wp-content/uploads/NMP_brief_math_CRIMINALJUSTICE_2014.pdf

Social work is another degree program with variation in math requirements. Research indicates that institutions across Texas are following the recommendations of professional organizations, which encourage statistics for social work majors.[2] However, exceptions exist for some institutions.

- The A.A.S. degree in social work at Central Texas College requires Math 1314.
- Texas State University requires either Math 1314 or Math 1324 for a B.S.W. degree.

While four-year institutions commonly require Math 1342 or additional statistics coursework for social science majors, some two-year institutions do not guide students towards a statistics pathway and instead allow students to choose from a range of core math courses that may default students into college algebra. In these instances, advisors play a crucial role of informing transfer students about the general expectations for statistics in these degree programs and career tracks.

Business and Accounting

Across Texas, most business and accounting degrees require Math 1324 and Math 1325, and some also require a statistics course. The two-year and four-year institutions in central Texas largely share these requirements.

Aligned programs include: business, business administration, computer information systems, finance, general business, human resource management, logistics and supply chain, management, and marketing.

Some exceptions to this trend are seen with A.A.S. degrees in business-related fields. The Alamo Colleges, for example, requires Math 1314 for the following A.A.S. degrees in the business meta-major: banking and financial services, business management, hospitality management, and real estate management.

Central Texas College does not offer Math 1324 or Math 1325 in its core curriculum. Students in A.A.S. degree programs are advised to take Math 1332 or Math 1342. The college only offers one transfer-oriented degree program in this meta-major, an A.S. in business administration, which requires Math 1314.

At The University of Texas at Austin, B.B.A. degrees and the B.A. in economics do not align with the trend towards using Math 1324 and Math 1325. Instead, these programs require a statistics and modeling course and a sequence of calculus courses that are not equivalent to Math 1324 and Math 1325.

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[2] The Charles A. Dana Center (2014). *Mathematics for social work: Recommendations from professional organizations and requirements from Texas institutions of higher education.* Program of Study Brief, No. 4. Retrieved from: http://www.utdanacenter.org/wp-content/uploads/NMP_brief_math_SOCIALWORK_2014.pdf

Education and Teaching

Students pursuing degrees that lead to teacher certification have varied math requirements depending on grade level and content area. According to state policy, all teacher certification candidates in elementary (EC–6), middle (4–8), and all-level (EC–12) special education must take at least College Algebra (Math 1314), Fundamentals of Math I (Math 1350), and Fundamentals of Math II (Math 1351). However, the state does not mandate specific math requirements for teacher certification candidates for grades 7–12 and EC–12 areas other than special education.

Central Texas institutions generally align with these requirements with a few exceptions:

- Navarro College and the Alamo Colleges require Math 1314 for grades 7–12 and EC–12 other than special education, even though algebra may not be required for the certification content area.
- Texas A&M University–Central Texas requires Math 1314 for history and political science majors pursuing secondary teacher certification. These majors allow any core math class for students who are not pursuing teacher certification.
- Texas State University requires Math 1314 for secondary teacher certification in the following majors: agriculture, family and consumer sciences, history, studio art, theatre, political science, and exercise and sports science.

Nursing and Health Professions

Central Texas has a wide range of degree programs for nursing and health professions. Math requirements for each program vary and may hamper efficient student transfer.

No programs in this meta-major in central Texas has a consistent set of math requirements. Many programs direct students towards Math 1314 instead of the state trend towards statistics.

The University of Texas at Austin and Texas A&M University–Central Texas offer bachelor's degrees in nursing, encouraging or requiring students to take statistics. While Texas State University also offers this degree, it requires algebraically-intensive math courses, such as Math 1314 or Math 1324.

Two-year institutions also display significant variation in math requirements:

- The majority of two-year nursing programs in the area offer A.A.S. degrees and do not require college-level math.
- The A.S. programs at the Alamo Colleges and Hill College require Math 1342.
- The A.S. program at Navarro College requires Math 1314 in addition to Math 1342.
- A.A.S. degrees at Hill College require Math 1314.

STEM Programs

Nearly all STEM programs in central Texas institutions require at least Calculus I (Math 2413). Major requirements at community colleges align well with university standards in this meta-major.

Aligned programs include: architecture, astronomy, chemistry, computer science, engineering, mathematics, and physics.

One example of misalignment stands out among central Texas institutions. Every degree program in biology has different math requirements, which presents a potential barrier to transfer students pursuing a bachelor's degree in biology. Some institutions require only pre-calculus while others require calculus. Still others require or allow statistics as an option, often in addition to algebraically-intensive courses.

Conclusion

We find that the central Texas region has made great strides to modernize the undergraduate mathematics curriculum to offer multiple math pathways, which is consistent with national and state trends toward enhancing the relevance of mathematics content for different majors. This analysis reveals that when it comes to transfer and applicability, the devil—of course—is in the details. We find variation in mathematics course requirements by institution and by program. Through the Central Texas Regional Math Pathway Convening, we seek to engage institutional colleagues to help address areas of misalignment that stifle student progress, as well as institutional program, planning, and advising support for transfer students.