



Dana Center
Mathematics
PATHWAYS



The University of Texas at Austin
Charles A. Dana Center

Program-of-study brief number 6

Mathematics for business:

Recommendations from professional organizations and requirements from the higher education sector

The state of business education and careers in the United States

During the 2011–2012 academic year, 20.5 percent of all bachelor's degrees conferred by postsecondary institutions were granted to business majors, making business the most frequent program of study among undergraduate students (National Center for Education Statistics, 2013, table 322.10). This trend continues into post-baccalaureate education—the Master of Business Administration program is the second most popular graduate degree program in the country (Khurana, 2007).

We provide these briefs to inform institutional discussions about the modernization of mathematics course requirements.

Each brief examines what constitutes relevant math for various majors (thus far, nursing, communications, criminal justice, social work, elementary teacher education, and business) by examining professional organization recommendations and institutional requirements.

The Bureau of Labor Statistics projects that occupations related to business, finance, and management will maintain pace with the average increase in positions in all industries (Bureau of Labor Statistics, 2015). Specifically, occupations in business and finance are expected to increase 8 percent between 2014 and 2024 while occupations in management are expected to increase by 6 percent (Bureau of Labor Statistics, 2015).

The mathematics course requirements for business degrees vary greatly across programs. The dissimilarity in mathematics requirements emerges from two factors. First, there is a wide range of quantitative skills needed for success in different business specializations. Majors offered within schools of business, for example, might range from accounting, finance, or marketing, to healthcare management, human resources, information systems, and supply chain management. As a result of such diverse specializations within business programs of study, recommendations for mathematics course requirements and student learning outcomes differ widely. Consequently, it is common for business programs to require students to take multiple, distinct mathematics courses for each specialization.

Second, different mathematics prerequisites are used to prepare students for upper-division business statistics courses. More than 93% of business programs require students to take one or more business statistics courses, most of which have a mathematics prerequisite to provide students with necessary quantitative foundation for success in statistics (Green et al., 2007; Herrington & Arnold, 2013). Some studies have shown that requiring additional semester hours of more advanced mathematics is associated with better performance in business statistics, yet institutions and states maintain varied mathematics course requirements (Green et al., 2007; Herrington & Arnold, 2013).

Given the distinct needs of major specializations and the varied use of mathematics prerequisites, it is not always clear what skills and content constitute relevant math for a variety of business majors. This brief provides an examination of recommended mathematics content by professional organizations, trends in business education, and standards of accreditation for business schools throughout the United States.

The recommendations in this brief and the research on which they are based are consistent with the Dana Center Mathematics Pathways model—that institutions of higher education should offer multiple mathematics pathways with relevant and rigorous mathematics content aligned to specific programs of study.



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Recommendations from professional organizations of business and mathematics

Recommendations are derived from reports by accrediting organizations, professional associations of business, business education journals, and professional mathematics associations to identify the mathematics courses, skills, or quantitative learning outcomes for business majors. Because specific mathematics course requirements vary from state to state and institution to institution, the recommendations focus on the quantitative content and skills identified in these professional reports.

- *The Curriculum Foundations Project: Voices of the Partner Disciplines* (Ganter & Barker, 2004), a publication by the Mathematical Association of America (MAA), provides a summary of recommendations from a national group of business faculty leaders and contains the most extensive recommendations regarding mathematics in business programs. The report endorses introducing integrative and realistic problem solving (using real—or realistic—data sets when possible), instruction on mathematical modeling, solutions that integrate the use of business technology (e.g., Excel/spreadsheets), increased “attention to numerical methods and less to techniques of symbolic differentiation and integration” in algebra and calculus content, and less emphasis on mathematical proof (Ganter & Barker, 2004, p. 20). The report also supports the need for curriculum to require the implementation of technology to manage and analyze information (Ganter & Barker, 2004).
- The Association to Advance Collegiate Schools of Business’s (AACSB) Standards for Business Accreditation specifies that student learning outcomes for statistical methods should include “data creation, data sharing, data analytics, data mining, data reporting, and storage between and across organizations including related ethical issues” (AACSB, 2013, p. 32).
- The AACSB (2016) and MAA (Ganter & Barker, 2004) both emphasize the importance of increasing communication and connections between industry, research, and teaching in light of the evolving needs of the business sector.
- The Accreditation Council for Business Schools and Programs (2014) encourages the need for increased interdepartmental communication between faculty, as well as between 2-year and 4-year institutions, to increase the efficiency of student transfer and articulation agreements.

Professional associations provide distinct recommendations for specialization-specific content. Some examples include:

- **Accounting:** The National Business Education Association (NBEA, 2007a) states that students should be able to read, interpret, and analyze financial information, apply basic accounting principles, understand how the accounting system provides business information, recognize the various users of accounting information, and understand the dynamic nature of the business environment in which accounting information is used.
- **Finance:** The NBEA's economics and personal finance standards emphasize the importance of students' understanding of scarcity, choice, and opportunity costs; productivity; economic systems, institutions, and incentive; exchange, money, and interdependence; markets, prices, and competition; supply and demand; and the roles of consumers, governments, and citizens. Furthermore, the standards state that "[k]nowing, understanding, and applying these concepts offers the necessary analytical tools for addressing economic issues, both personal and societal. Understanding economic principles and developing sound financial literacy skills provide the basis for responsible citizenship, financial solvency, and career success" (NBEA, 2007b).
- **Supply Chain:** Specifications in the Operations Management Body of Knowledge Framework from the American Production and Inventory Control Society (APICS) articulate the importance of time measurement standards, queuing and regression models, time series, forecasting simulations, and descriptive statistics (APICS, 2011).

The Mathematical Association of America provides detailed proposals regarding how business skills should be integrated within mathematics curriculum (Ganter & Barker, 2004). In addition to echoing the general need for integration of business skills into mathematics courses for business majors, the MAA offers summaries of the skills that business faculty recommend for mathematics course curriculum. The report specifies the mathematics content and skills that business majors should acquire in general education college algebra, calculus, and statistics courses.



Current state of mathematics course requirements for business

Recommendations from professional associations suggest that students in business programs have unique needs for their mathematics preparation. However, the number of credit hours and amount of content of the mathematics courses that are required by business programs vary widely. While virtually all business programs require one or more business statistics courses, there is little consistency in the types of mathematics courses that students are required to complete to prepare for these advanced classes. The MAA notes the general tendency for business students to be directed to general education college algebra and calculus courses, followed by less common courses such as finite math or business mathematics (Ganter & Barker, 2004).

For example, Herrington and Arnold (2013) analyzed the business degree requirements across a sample of almost 1,500 business programs and found diverse mathematics requirements:

- 96% require one or more business statistics courses
- 51% require one or more algebra courses
- 39% require one or more business math courses
- 38% require one or more calculus courses
- 14% require a finite math course

In addition, the authors observed that 83% of business programs require at least one mathematics course (excluding business math and statistics, which are often taught within the business department), with an overall average of only one required math course. Only 27% of programs require more than one mathematics course and 17% require none (Herrington & Arnold, 2013, pp. 206-207).

These findings illustrate that the traditional calculus preparation sequence designed for STEM programs might be inappropriate for business programs given the demand for students to be able to apply their mathematics skills to real-world business applications and to use technology to explore, represent, and solve mathematics problems to the extent recommended by the business community (Ganter & Barker, 2004).

Furthermore, the mathematics requirements for business majors are often different from school to school, especially at the upper-division level. In some cases, the lower-division general education mathematics course requirements for each business specialization remain constant, such as college algebra as a basic prerequisite course for business majors (Ganter & Barker, 2004). In other cases, both upper- and lower-division general education mathematics requirements vary based on the business specialization.

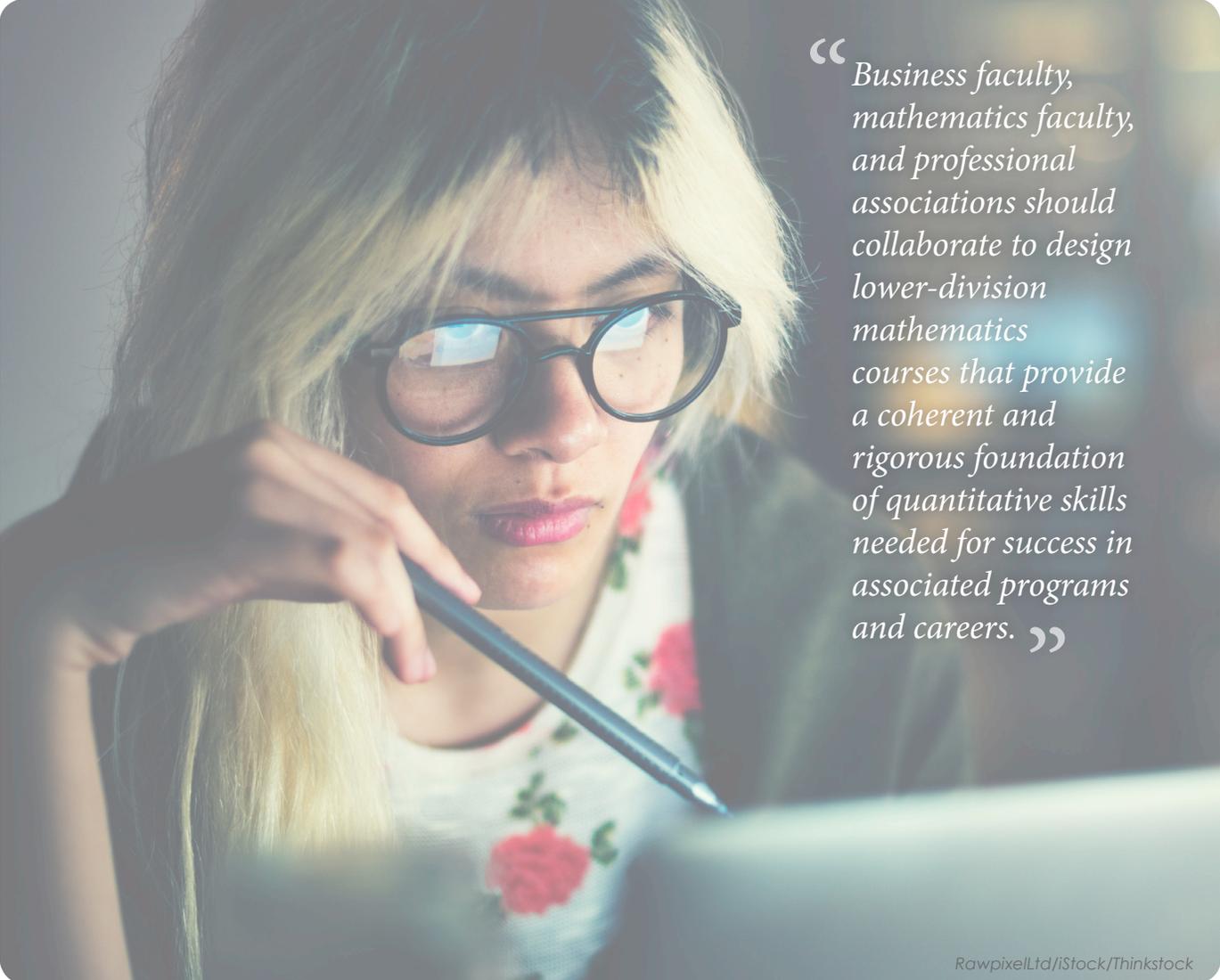
Despite recommendations to develop and utilize courses with specialized content and delivery for business programs, many institutions rely on general education college algebra and calculus courses, especially at 2-year colleges. Consequently, students are not encountering specialization-specific curriculum until their upper-division coursework, despite research indicating that requirements of prerequisite math courses could potentially increase student success in consecutive business math courses (Green et al., 2007).

While virtually all business programs require one or more business statistics courses, there is little consistency in the types of mathematics courses that students are required to complete to prepare for these advanced classes.

Conclusion

While many higher education institutions have done significant work to align mathematics curriculum to the standards of business and accreditation associations, more cross-departmental collaboration is needed to design courses that prepare business students for success in upper-division coursework and in their careers. In addition, further research should be done to better understand the relationship between different lower-division mathematics course prerequisites and student success in upper-division business statistics.

As Colby et al. (2011) noted, “Most business programs require their students to take a substantial number of courses outside the business disciplines. . . . However, the relation of these studies to students’ major courses in business is rarely well articulated or closely coordinated” (p. 5). While general business and accreditation organizations tend to offer vague mathematics recommendations, business specialization organizations and mathematics professional associations have provided more detailed suggestions. Lack of alignment between each the aforementioned groups may result in many business majors enrolling in generalized, rather than business-specific, entry-level mathematics courses such college algebra and calculus. Business faculty, mathematics faculty, and professional associations should collaborate to design lower-division mathematics courses that provide a coherent and rigorous foundation of quantitative skills needed for success in associated programs and careers.



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References

- Accreditation Council for Business Schools and Programs (ACBSP). (2014). *Standards and criteria for demonstrating excellence: Associate degree schools and programs*. Overland Park, KS: Author.
- APICS Foundation. (2011). *Operations management body of knowledge framework* (3rd ed.). Retrieved from <http://www.apics.org/docs/default-source/industry-content/apics-ombok-framework.pdf?sfvrsn=2>.
- Association to Advance Collegiate Schools of Business (AACSB International). (2013). *Eligibility procedures and accreditation standards for business accreditation*. Tampa, FL: Author. Retrieved from <http://www.aacsb.edu/~media/AACSB/Docs/Accreditation/Standards/2013-bus-standards-update.ashx>.
- Association to Advance Collegiate Schools of Business (AACSB International). (2016). *A collective vision of business education*. Tampa, FL: Author. Retrieved from <http://www.aacsb.edu/~media/ManagementEducation/docs/collective-vision-for-business-education.ash.x>.
- Bureau of Labor Statistics, U.S. Department of Labor. (2016–2017). *Occupational outlook handbook: Business and financial occupations*. Retrieved from <http://www.bls.gov/ooh/business-and-financial/home.htm>.
- Colby, A., Ehrlich, T., Sullivan, W., & Dolle, J. R. (2011). *Rethinking undergraduate business education: Liberal learning for the profession*. Stanford, CA: The Carnegie Foundation for the Advancement of Teaching.
- Ganter, S. L., & Barker, W. (Eds.). (2004). *Curriculum Foundations Project: Voices of the partner disciplines*. Washington DC: The Mathematical Association of America.
- Green, J. J., Stone, C. C., Zegeye, A., & Charles, T. A. (2007). Changes in math prerequisites and student performance in business statistics: Do math prerequisites really matter? *Journal of Economics and Finance Education*, 6(2), p. 27–38.
- Herrington, J. D., & Arnold, D. R. (2013). Undergraduate business education: It's time to think outside the box. *Journal of Education for Business*, 88, 202–209.
- Khurana, R. (2007). *From higher aims to hired hands: The social transformation of American business schools and the unfulfilled promise of management as a profession*. Princeton, NJ: Princeton University Press.
- National Business Education Association. (2007a.) *Business education standards: The national standards for accounting*. Retrieved from <https://www.nbea.org/newsite/curriculum/standards/accounting.html>.
- National Business Education Association. (2007b.) *Business education standards: The national standards for economics and personal finance*. Retrieved from <https://www.nbea.org/newsite/curriculum/standards/economics.html>.
- National Business Education Association. (2013). *Business education standards: The national standards for business education*. Retrieved from <https://www.nbea.org/newsite/curriculum/standards/index.html>.
- National Center for Education Statistics, U.S. Department of Education. (2013). Table 322.10: Bachelor's degrees conferred by postsecondary institutions, by field of study: Selected years, 1970–71 through 2011–12. Retrieved from https://nces.ed.gov/programs/digest/d13/tables/dt13_322.10.asp.



About this resource

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Our briefs provide information on programs for nursing, communications, criminal justice, social work, elementary teacher education, and business.

About the Charles A. Dana Center

The Dana Center develops and scales math and science education innovations to support educators, administrators, and policy makers in creating seamless transitions throughout the K–14 system for all students, especially those who have historically been underserved.

We focus in particular on strategies for improving student engagement, motivation, persistence, and achievement.

The Center was founded in 1991 at The University of Texas at Austin. Our staff members have expertise in leadership, literacy, research, program evaluation, mathematics and science education, policy and systemic reform, and services to high-need populations.

For more information about the Dana Center Mathematics Pathways, see www.dcmathpathways.org.

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