



Michigan's Introductory Statistics Pathway

In early 2016, recognizing that successful implementation of the mathematics recommendation in the Michigan Transfer Agreement (MTA) would be critical to improving statewide transfer and credential completion, the Michigan Community College Association (MCCA) and the Michigan Association of State Universities (MASU) established The Right Math at the Right Time (RM@RT) initiative to strengthen the implementation of three primary mathematics pathways (quantitative reasoning, introductory statistics and preparation for calculus) across Michigan's two- and four-year public postsecondary institutions. In undertaking this work, Michigan joins a national network of colleges, supported by the Charles A. Dana Center at the University of Texas at Austin, who are building and strengthening mathematics pathways to promote student success and completion.

The Michigan RM@RT Steering Committee members represent community colleges and universities, the Michigan Department of Education and state mathematics associations. The 2016 report, [The Right Math at the Right Time: Addressing Mathematics Challenges Facing Michigan Colleges and Universities](#), outlines a structure to help Michigan colleges and universities review and revise mathematics curricula to meet the needs of students and employers, design new, high-quality mathematics learning experiences, align learning outcomes for developmental and gateway mathematics courses and enable students who transfer to apply their math credits to their program of study.

Recent research in the field of mathematics suggests that, rather than requiring all students to complete courses intended to prepare them for advanced mathematics (including calculus) institutions of higher education should offer multiple mathematics pathways with relevant and challenging math content aligned to specific programs of study. Rather than asking students to memorize a set of skills that they are unable to apply in non-routine settings and whose importance to their future careers is not appreciated, recommendations from the Association of American Colleges and Universities (AAC&U), the Mathematical Association of America (MAA) and other entities stress the importance of conceptual understanding, problem-solving and communication across all math pathways. According to the 2016 [Guidelines for Assessment and Instruction in Statistics Education \(GAISE\)](#), Introductory Statistics should develop students' ability to apply statistical thinking to collect and analyze data to answer questions and solve unfamiliar problems.

. In 2017, the RM@RT Steering Committee established a working group of mathematics faculty from two- and four-year institutions to recommend a set of learning outcomes for entry-level, college-level courses in Introductory Statistics. Colleges and universities are currently reviewing the recommendations with the intent to *adopt* the learning outcomes in their own courses, *accept* courses with those learning outcomes in transfer and *apply* the courses to the appropriate programs of study.

Introductory Statistics Recommendations for Essential Outcomes

1. Demonstrate understanding of the basic principles of data collection, observational study, and experimental design. This may include (but is not limited to) topics such as randomness, sampling error, sampling techniques, bias, blinding, and types of data.
2. Construct and interpret graphical and tabular displays of univariate data. These displays may include (but are not limited to): frequency distributions, pie charts, boxplots, stem plots, histograms.
3. Summarize distributions of univariate data using measures of central tendency, measures of dispersion, and measures of location.
4. Compare multiple data sets with graphical displays and numerical measures.
5. Perform basic probability computations. These may include (but are not limited to): the addition rule, the multiplication rule for independent events, and the complement rule.
6. Solve problems by applying appropriate probability distributions, which may include (but are not limited to) discrete, binomial, and normal probability distributions.
7. Use the Central Limit Theorem to model sampling distributions and compute probabilities based on sampling distributions.
8. Analyze bivariate quantitative data. This includes (but is not limited to), generating and interpreting r - and, r^2 -values, scatterplots, and the least-squares regression lines for bivariate data.
9. Construct and interpret confidence intervals of proportion or mean for one population.
10. Construct and interpret confidence intervals for the difference of proportions or means for two populations.
11. Perform hypothesis tests for the means and proportions for one population. This includes interpreting p-value, type I and type II errors, and statistical and practical significance.
12. Perform hypothesis tests for the difference of proportions or means for two populations. This includes interpreting p-value, type I and type II errors, and statistical and practical significance.
13. Interpret and apply output from a statistical software package and/or a graphing utility.
14. Interpret and apply appropriate statistical techniques and concepts to real-life data and situations in order to make decisions and/or draw conclusions.

Introductory Statistics Recommendations for Optional Outcomes

1. Perform intermediate probability computations. These may include (but are not limited to): the multiplication rule for dependent events, conditional probability, and Bayes Theorem.
2. Analyze bivariate qualitative data presented in two-way tables and interpret relationships between categorical variables. This may include (but is not limited to) computing probabilities, identifying lurking variables, explaining Simpson's Paradox, and conducting appropriate chi-square tests.
3. Perform more advanced hypothesis tests such as the goodness-of-fit test, independence test, and ANOVA.

Introductory Statistics Recommended Skill Level

The [MTA Handbook](#) allows for courses that are equivalent to Introductory Statistics to satisfy the MTA math requirement if the course is organized or taught in the Math or Statistics Department or is cross-listed as a math or statistics course.

To be successful in an introductory statistics course, students will be expected to apply basic algebra skills similar to those taught in [high school algebra I in the Michigan Merit Curriculum](#) or in beginning algebra.

The proposed outcomes follow the recommendations by the American Statistical Association known as [the Guidelines for Assessment and Instruction in Statistical Education \(GAISE\)](#) which are strongly recommended when teaching or developing an introductory statistics course.

Read more in the [White Paper on RM@RT Strategy I](#).

MICHIGAN'S MATHEMATICS PATHWAYS: INTRODUCTORY STATISTICS

Introductory Statistics Course Transfer Patterns

Once colleges and universities adopt the learning outcomes, they are encouraged to accept courses from other institutions and post equivalencies to the [Michigan Transfer Network](#) (MTN). The RM@RT Steering Committee will periodically review these equivalencies to monitor progress toward accepting courses for transfer. This chart indicates current equivalencies listed in the MTN as of March 2018. Green boxes indicate direct equivalencies between courses identified as Introductory Statistics by both entities, yellow indicate that the university offers general or departmental credit only, and orange identifies where the university offers credit for a different course than the identified Introductory Statistics course. Blank boxes indicate that no information was available about the course in the MTN.

| Introductory Statistics University | Central Michigan University | Eastern Michigan University | Ferris State University | Ferris State University | Grand Valley State University | Lake Superior State University | Michigan State University | Michigan Technological University | Northern Michigan University | Oakland University | Saginaw Valley State University | Saginaw Valley State University | University of Michigan-Ann Arbor | University of Michigan-Deaborn | University of Michigan-Flint | Wayne State University | Western Michigan University | |
|---|-----------------------------|-----------------------------|-------------------------|-------------------------|-------------------------------|--------------------------------|---------------------------|-----------------------------------|------------------------------|--------------------|---------------------------------|---------------------------------|----------------------------------|--------------------------------|------------------------------|------------------------|-----------------------------|-----------|
| Course | STA 282QR | STAT 170 | STQM 260 | MATH 251 | STA 215 | MATH 207 | STT 200 | MA 2710 | MA 171 | STA 2220 | MATH 132 | MATH 132A | STAT 250 | STAT 263 | MTH 272 | STA 1020 | STAT 1600 | |
| Alpena Community College | MTH 233 | STA 282QR | STAT 170 | | MATH 251 | STA 215 | MATH 207 | STT 201 | MA 2720 | MA 171 | STA 2220 | | MATH 132A | | GEN CR | SCM 211 | STA 1020 | STAT 3660 |
| Bay College | MATH 210 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | | MA 2710 | MA 171 | STA 2220 | | | | | SOC 215 | STA 1020 | STAT 3660 |
| Delta College | MTH 208W | STA 282QR | STAT 170 | | MATH 251 | | | GEN CR | MA 2720 | MA 171 | STA 2220 | | | | | SOC 215 | STA 1020 | |
| Glen Oaks Community College | MATH 201 | STA 282QR | STAT 170 | | MATH 251 | GEN CR | | | | | | | | STAT 263 | SOC 215 | STA 1020 | STAT 1600 | |
| Gogebic Community College | MTH 211 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | MATH 207 | STT 200 | MA 2710 | MA 171 | STA 2220 | GEN CR | | | MTH 272 | STA 1020 | STAT 2160 | |
| Grand Rapids Community College | MA 215 | STA 282QR | STAT 170 | GEN CR | | STA 215 | PER EVAL | GEN CR | MA 2720 | MA 171 | STA 2220 | | MATH 132A | STAT 263 | SCM 211 | STA 1020 | STAT 3660 | |
| Henry Ford College | MATH 141 | STA 282QR | STAT 170 | | MATH 251 | STA 215 | MATH 207 | | MA 171 | STA 2220 | | MATH 132A | STAT 263 | SOC 215 | STA 1020 | STAT 3660 | | |
| Jackson College | MAT 133 | STA 282QR | STAT 170 | GEN CR | | STA 215 | PER EVAL | GEN CR | MA 2720 | MA 171 | STA 2220 | ECON 235 | | STAT 263 | SOC 215 | STA 1020 | STAT 3660 | |
| Kalamazoo Valley Community College | MATH 220 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | STT 200 | MA 2710 | MA 171 | STA 2220 | | MATH 132A | STAT 263 | SOC 215 | STA 1020 | STAT 3660 | |
| Kellogg Community College | MATH 130 | STA 282QR | STAT 170 | | MATH 251 | STA 215 | PER EVAL | GEN CR | MA 2710 | MA 171 | STA 2220 | | MATH 132A | STAT 263 | SOC 215 | STA 1020 | STAT 3660 | |
| Kirtland Community College | MTH 20600 | STA 282QR | STAT 170 | | GEN CR | STA 215 | PER EVAL | GEN CR | | MA 171 | STA 2220 | | MATH 132A | | SCM 211 | STA 1020 | STAT 3660 | |
| Lake Michigan College | MATH 216 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | | MA 2710 | MA 171 | STA 2220 | | MATH 132A | STAT 263 | SOC 215 | STA 1020 | STAT 3660 | |
| Lansing Community College | STAT 170 | STA 282QR | SOCL 250* | | GEN CR | STA 215 | PER EVAL | GEN CR | MA 2720 | MA 171 | STA 2220 | | MATH 132A | GEN CR | SOC 215 | STA 1020 | STAT 3660 | |
| Macomb Community College | MATH 1340 | STA 282QR | STAT 170 | | | STA 215 | PER EVAL | GEN CR | MA 2720 | | STA 2220 | | MATH 132A | STAT 263 | SCM 211 | STA 1020 | STAT 3660 | |
| Mid Michigan Community College | MAT 212 | STA 282QR | STAT 170 | | MATH 251 | STA 215 | PER EVAL | | MA 2720 | MA 171 | STA 2220 | | MATH 132A | GEN CR | SOC 215 | STA 1020 | STAT 3660 | |
| Monroe County Community College | MATH 162 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | | MA 2720 | MA 171 | STA 2220 | ECON 235 | | GEN CR | SCM 211 | STA 1020 | STAT 3660 | |
| Montcalm Community College | MATH 190 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | | MA 2710 | MA 171 | STA 2220 | | MATH 132A | | SOC 215 | STA 1020 | GEN CR | |
| Mott Community College | MATH 150 | STA 282QR | STAT 170 | | GEN CR | | PER EVAL | STT 200 | MA 2720 | MA 171 | STA 2220 | | MATH 132A | STAT 263 | SCM 211 | STA 1020 | STAT 3660 | |
| Muskegon Community College | MATH 115 | STA 282QR | STAT 170 | | GEN CR | STA 215 | PER EVAL | GEN CR | MA 2720 | MA 171 | STA 2220 | GEN CR | | GEN CR | SCM 211 | STA 1020 | STAT 3660 | |
| North Central Michigan College | STAT 200 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | STT 200 | MA 2710 | MA 171 | STA 2220 | ECON 235 | | GEN CR | SOC 215 | STA 1020 | STAT 3660 | |
| Northwestern Michigan College | MTH 131 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | GEN CR | MA 2720 | MA 171 | STA 2220 | ECON 235 | | GEN CR | MTH 272 | STA 1020 | STAT 3660 | |
| Oakland Community College | MAT 1580 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | | MA 2720 | MA 171 | STA 2220 | | MATH 132A | STAT 263 | SCM 211 | STA 1020 | STAT 3660 | |
| Schoolcraft College | MATH 122 | STA 282QR | STAT 170 | GEN CR | | STA 215 | PER EVAL | GEN CR | MA 2710 | MA 171 | STA 2220 | | MATH 132A | STAT 263 | SOC 215 | STA 1020 | STAT 3660 | |
| Southwestern Michigan College | MATH 150 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | | MA 2720 | MA 171 | STA 2220 | | MATH 132A | | SCM 211 | STA 1020 | STAT 3660 | |
| St. Clair County Community College | MTH 120 | STA 282QR | STAT 170 | | MATH 251 | STA 215 | PER EVAL | GEN CR | MA 2720 | MA 171 | STA 2220 | | MATH 132A | STAT 263 | SCM 211 | STA 1020 | STAT 3660 | |
| Washtenaw Community College | MTH 160 | STA 282QR | STAT 170 | | MATH 251 | STA 215 | PER EVAL | | MA 2720 | MA 171 | STA 2220 | | MATH 132A | STAT 263 | SOC 215 | MAT 2210 | STAT 3660 | |
| Wayne County Community College District | MAT 131 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | GEN CR | MA 2720 | GEN CR | STA 2220 | GEN CR | | GEN CR | SOC 215 | STA 1020 | STAT 3660 | |
| West Shore Community College | MTH 123 | STA 282QR | STAT 170 | STQM 260 | | STA 215 | PER EVAL | GEN CR | MA 2710 | MA 171 | STA 2220 | | MATH 132A | | SCM 211 | STA 1020 | STAT 3660 | |

*EMU Green = accepted as either STAT 170 or SOCL 250

Introductory Statistics in Bachelor's Degree Pathways

A recent Michigan study sponsored by the Charles A. Dana Center at the University of Texas at Austin looked at minimum mathematics requirements in popular bachelor's degree programs at Michigan public universities. The findings suggest that courses with skill levels and content associated with introductory statistics are part of programs in Biology, Nursing and Psychology in four or more universities.

In 2018, MCCA and MASU will begin the process of creating multi-institutional associate to bachelor's degree pathways in the top majors in the state. This research will inform discipline faculty as they select appropriate math pathways for the disciplines and ensure articulated courses for transfer students. Read more about Michigan's Transfer Initiative [here](#).

| University | Biology | Nursing | Psychology |
|--|-------------|------------|------------|
| Central Michigan University -- Mt. Pleasant | CAL | N/A | QR |
| Eastern Michigan University -- Ypsilanti | CAL or STAT | QR | QR |
| Ferris State University -- Big Rapids | CA | QR | QR |
| Grand Valley State University -- Allendale | CAL or STAT | QR | QR or STAT |
| Lake Superior State University -- Sault Ste. Marie | CA | STAT | STAT |
| Michigan State University -- East Lansing | CAL | CA or STAT | CAL |
| Michigan Technological University -- Houghton | CAL | N/A | CA |
| Northern Michigan University -- Marquette | QR | QR | QR |
| Oakland University -- Rochester | CA | QR | QR |
| Saginaw Valley State University -- Saginaw | QR | STAT | QR |
| University of Michigan -- Ann Arbor | CAL or STAT | STAT | STAT |
| University of Michigan -- Dearborn | CA | N/A | CA |
| University of Michigan -- Flint | CA | QR | QR |
| Wayne State University -- Detroit | CA or STAT | CA/STAT/QR | STAT |
| Western Michigan University -- Kalamazoo | CAL | QR | QR |
| CA= College Algebra | | | |
| CAL=Calculus | | | |
| QR=Quantitative Reasoning | | | |
| STAT=Statistics | | | |
| N/A= Program Not Offered | | | |