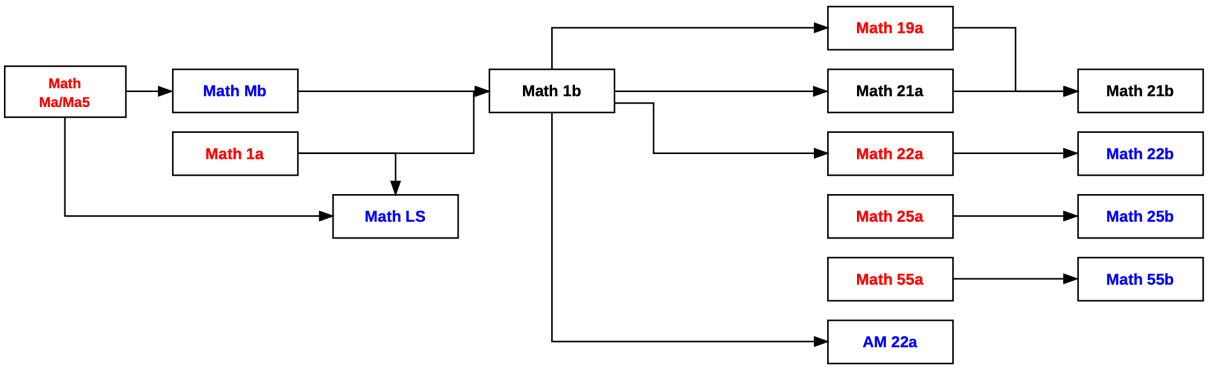
MATH FOR FIRST YEAR STUDENTS

The following chart lists the introductory mathematics courses. Fall courses are red, Spring courses are blue and courses taught in both the fall and spring are in black.



In July, you will receive a math placement recommendation indicating one of the following starting points:

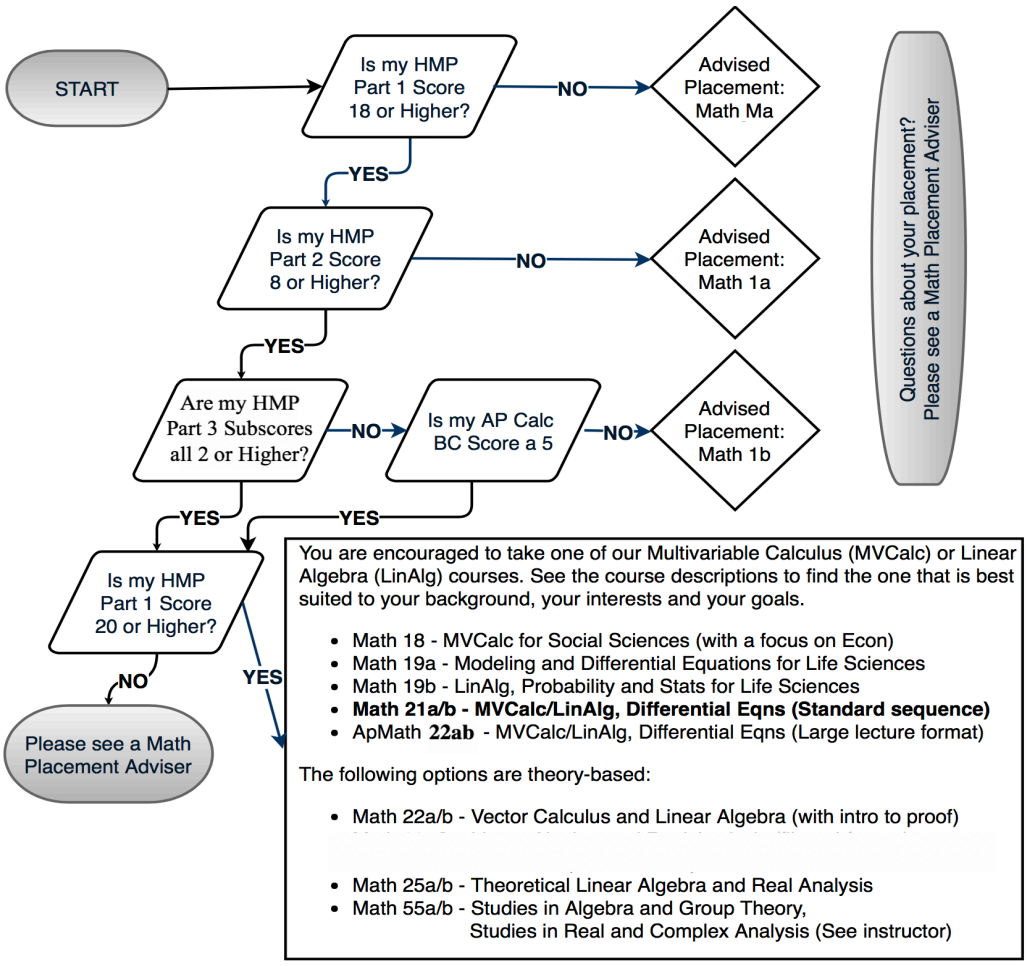
- Math Ma or Math Ma5
- Math 1a
- Math 1b
- The group of courses in the "Math 19a–55 and AM 22a" column

More detail about each of these courses and about the placement process appears below.

1. The crucial information

Placement:

- It is crucial to take your Harvard Math Placement (HMP) recommendation seriously because your placement along with your academic interests will allow for an informed choice of a starting math course. Detailed information about math placement can be found at this website. There will also be a '*Making sense of your placement score*' Zoom webinar on August 4 that starts at 12:00 pm ET. This Math Department site will have a link to a recording of the webinar after the event. One goal of the session will be to understand better the placement score and corresponding recommendation. The following chart is helpful.



- The placement test does not distinguish among the courses in the Math 19a, 21, 22, 25, 55 and APMTH 22a column. If you receive this placement, what you take depends on a mix of your concentration interests and personal preferences. Any and all questions about these courses will be answered at a Zoom webinar on August 6th titled *Deciding Among Math 19a, 21, 22, 25, 55 or APMTH 22a.* The Zoom webinar starts at 4pm ET and ends when all of the participants' questions are answered. Here is the Zoom link. (This Math Department site will have a link to a recording of the webinar after the event.)
- If you are interested in enrolling in **Math Ma/Ma5**, **Math 1a**, **Math 1b**, **Math 19a**, **Math 21a**, **Math 21b, or Math 22a** should enroll in Math PL. This is a placeholder course that will block time on your schedule and secure you a spot in an introductory math course. You will take a proctored Math Placement Verification Exam on September 2. The exam will provide an up-to-date snap shot of your skills and preparation for fall courses. The verification exam's results may narrow the possible courses you can enroll in by making sure you are not selecting an overly ambitious course. The results will be emailed on the evening of September 2. More information is available in the Math PL course catalogue entry and the Math PL canvas site.

- After you enroll in Math PL on my.harvard, a form in the Documents section of my.harvard will pop up that will ask you for your time preferences and which course you currently plan on taking (prior to the Placement Verification Exam).
- Math Ma/Ma5, Math 1a, Math 1b, Math 21a, and Math 21b are taught in small sections and all offered at 9:00am , 10:30am, 12:00pm, 1:30pm, and 3:00pm on Monday-Wednesday-Friday (MWF). In addition, you should enroll in the exam section from 6:00pm– 9:00pm, which holds time on your schedule for midterm exams.
- If you have questions about which math course to take after you receive the results of the September 2nd Math Placement Verification Exam, you can sign up for advising on September 3 by using a link in the results email.

Questions about higher-level math courses: Questions about math courses numbered above 55 can be addressed to Professor Laura DeMarco (demarco@math.harvard.edu) or to Senior Lecturer Wes Cain (jcain2@math.harvard.edu).

2. Brief course descriptions

The following briefly describes the courses for first year students. (Some first year courses satisfy Harvard's Quantitative Reasoning with Data (QRD) requirement. The Harvard Course Catalogue listing for the course will say whether it does.)

- Math Ma (or Ma5), Mb: This is a two-semester course which combines pre-calculus with single-variable calculus, including the basics of integration and differentiation. Math Ma/Ma5 run in the fall and Math Mb runs in the spring. A student who completes this sequence continues to Math 1b. Math LS can also be taken after Math Ma instead of Math Mb.
- Math 1a: This is a one-semester course that covers the first half of single-variable calculus and includes differentiation and the basics of integration.
- Math 1b: This is the second half of single-variable calculus. Math 1b covers three main topics: more advanced applications of single-variable integration techniques, Taylor series, and an introduction to ordinary differential equations. All three parts of the curriculum are important for natural and social science concentrations. Courses that list a mathematical prerequisite of Math 1b or beyond may expect mastery of all these topics.
- Math 19a: Math 19a is only given in the fall; it teaches multivariable calculus and differential equations for applications to the life sciences. It satisfies advanced math requirements in several life science concentrations (this means Biological Anthropology, Chemical and Physical Biology,

Human Evolutionary Biology, Molecular and Cellular Biology, Neurobiology, Organismic and Evolutionary Biology, and Social and Cognitive Neuroscience.) Math 19a should not be taken in addition to Math 21a.

- Math 21a: This course covers multivariable calculus in 2 and 3 dimensions:
  Curves, surfaces, functions, their derivatives, calculus of variations, multi-variable integration, integration on curves and surfaces, multivariable generalizations of the fundamental theorem of calculus. It is a general purpose multi-variable calculus course that is useful in many fields.
- Math 21b: This course is an introduction to linear algebra in dimensions 2, 3 and higher. A good part of the course uses linear algebra to study ordinary and partial differential equations.
- Math 22a,b: This course covers multivariable calculus and linear algebra for students interested in theoretical sciences. It covers several of the same topics as Math 21a,b, but introduces abstraction, spending concerted time on the key theorems of the field. Students are taught techniques of proof and mathematical reasoning, so no previous proof-writing experience is required. Compared to Math 21, the linear algebra and calculus are more interlinked, with linear algebra presented first. This means Math 22a approximately corresponds to Math 21b and Math 22b approximately corresponds to Math 21a with respect to content.
- Math 25 and 55: These are theory courses that should be selected only by those students who have a particular interest in, prior experience with, and enjoyment of abstract mathematics, as well as a solid understanding of single-variable calculus. These courses assume a willingness to think rigorously and abstractly about mathematics, and to work hard. Both courses study multivariable calculus and linear algebra plus many very deep related topics. These courses come with an iron clad guarantee that you will be challenged by the mathematics.
- Choosing Among Math 22, 25, and 55: covers both applications and some theory and assumes no prior proof-writing experience. Math 25 differs from Math 22 in two main ways: (1) Math 25 focuses on theory over applications, and (2) by virtue of this change in emphasis, the workload is significantly greater in Math 25. In particular, Math 25 covers abstract material from the 100-level courses Math 112 and Math 121, and it is normal for incoming students to have some proof-writing experience. Students new to proofs in Math 25 can expect their time investment in the course to increase to accommodate extra review. Note, however, that any course that asks for Math 25 as a prerequisite accepts Math 22 as well. Math 55 differs from Math 25 in that the former assumes an extensive proof-oriented mathematics background from the outset. (Between the prerequisite experience necessary and the course's content coverage, Math 55 covers material in more of the 100-level math classes than Math 25, and acts as an anti-requisite for some of the 100-level courses.)

- Applied Math 22a: Applied Math 22a (Solving and optimizing) covers some of the same material as Math 21a plus some of Math 21b. It is taught from a more applied point of view than Math 21a,b with a specific focus on applications to computer science. This course is taught in a large lecture format in the spring term only. While its colloquial spoken abbreviation is "A.M.," the course catalog code is APMTH.

NOTE: Math 21a,b can be taken in either order, but it is advantageous to take Math 21a first. While Math 21a should not be taken with Math 19a, Math 19a can be taken with Math 21b. Math 22b can be taken after Math 21b and Math 21a can be taken after Math 22a, Math 25a or Math 55a

OTHER COURSES:

- Math 101: Math 101 (fall and spring semesters) is designed to give interested students with Math 1b-preparation a taste of what modern mathematics is all about. This course can be taken concurrently with Math 21a or 21b. It is not to be taken with Math 25 or 55 (without special permission). It can be taken with Math 22 (concurrently or after). Math 101 also gives a good background for writing and following mathematical proofs. This skill will be needed for most 100-level math courses. This skill is also taught in Math 22 and Math 25, and in a few other 100 level courses.
- First-year students taking other 100-level courses: This is OK in principle (but concurrent registration in Math 25 or 55 is recommended). Any first-year student that is considering this must first talk to Professor Laura DeMarco (demarco@math.harvard.edu).
- Courses at MIT: Any first-year student considering a mathematics course at MIT must talk first with Professor DeMarco.
- First-Year Seminars: Most first-year seminars by Mathematics Department faculty members can be used as one of the 8 required Mathematics courses for a concentration in Mathematics. To do this, a student must petition to Professor Taubes after taking the course. First-Year seminars are to be recommended.

4. Course meeting times

Each of the sectioned courses **Math Ma**, **Math 1a**, **Math 1b**, **Math 21a** and **Math 21b** has an introductory meeting on the morning of Friday, September 4:

- Math Ma: 8:20–8:50 in Science Center lecture hall D.
- Math 1a: 7:45–8:15 in Science Center lecture hall D.

- Math 1b: 8:20–8:50 in Science Center lecture hall B.
- Math 21a: 7:45–8:15 in Science Center lecture hall B.
- Math 21b: 8:20–8:50 in Science Center lecture hall A.

(You can attend more than one of these if you are unsure which course to take.) The regular class section meetings start on **Wednesday, September 9** (so no section meetings on either Wednesday September 2 or Friday September 4 or Monday, September 7). Section assignments and meeting room information will be emailed to students before the first section meeting.

Non-sectioned courses 19a, 22a, 25a, 55a and AM 22a begin on **Wednesday September 2** at the times noted in the Course Catalogue. Math courses numbered 101 and above start on either Tuesday, September 1, or Wednesday, September 2; the day/time meeting pattern is noted in the Harvard Course Catalogue.