Guidelines for Program Review in the Mathematical Sciences

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Introduction

This document describes a framework for undertaking a program review at the postsecondary level. The principles and strategies described here are primarily intended to address the needs of two-year or four-year degree- or credential-granting programs. However, they apply equally well to other postsecondary programs in the mathematical sciences, including remedial programming, general education programs, graduate, and research programs. The key to effective application of these guidelines is understanding the mission and vision of the program; we discuss this in detail later in the document.

We use the terms "department" and "program" flexibly. We intend these words to include any postsecondary academic or other educational undertaking in the mathematical sciences. Similarly, the term "mathematical science" is to be interpreted inclusively to denote not only mathematics programs, but also mathematics education, actuarial science, data science, statistical sciences, and computing science programs. The terms "chair" and "dean," respectively, refer to the person directly responsible for the program, and hence the review, and the institutional administrator asking for the review and receiving the final reports.

We hope these guidelines will provide an adaptable structure for a purposeful and effective review that reflects on where the department has been and where it is now, leading to the creation of actionable plans for future development (Figure 1).

The guidelines themselves are relatively compact, with many details relegated to Appendices. This enables program leaders to quickly read essential material while providing the opportunity for more in-depth reading later. The guidelines include a rich and diverse set of resources that a program chair might draw from.
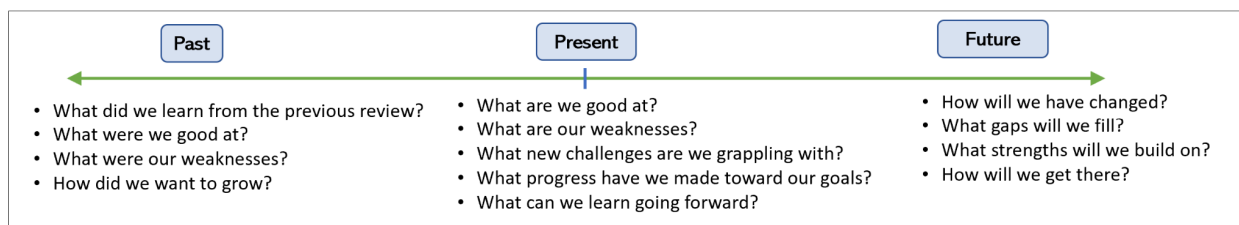
Figure 1. Looking to the past to understand the present and plan for the future. **.**

Why do a program review?

By Federal regulations, regional accreditors require institutions to have a "regular system of program review" to ensure the quality of each institution's academic programs ([8], [9]). Public institutions often are required to meet additional guidelines established by their respective state authorizing agencies.

Higher education institutions have their own motivations for requiring program reviews. While financial concerns, such as resource deployment, are a significant factor, other factors include the ability to identify recruiting, marketing, and branding opportunities. See [3], [4], [5] for examples of institutional guidelines.

Underlying both accreditor and institutional motivations is their fundamental interest in offering quality programs. This is also what motivates the Mathematical Association of America (MAA) to recommend that departments perform periodic reviews of their academic programs as part of an ongoing process of self-evaluation and growth ([1], [7]).

Ultimately, a program review offers an opportunity for the program faculty to articulate shared values and goals and question the status quo. The department can then celebrate and build on its successes, identify activities that are no longer needed, and assess the use of and need for resources. Through this process, faculty can be inspired to explore possible changes and new contributions—such as launching a new curriculum, taking on new roles at the institution in light of changes in the institution's strategic plan, developing a more inclusive culture, identifying areas for faculty development, implementing new pedagogies, or responding to societal changes such as workforce needs.

Organizational Themes

The MAA offers a program review model that encourages programs to advance their work in five key areas: program culture, engaged faculty, purposeful curriculum, evidence-based teaching, and attention to new student success (see Figure 2). Taken together, these key areas provide a context in which inclusive excellence – ensuring all students (undergraduate and graduate) the opportunity to succeed – is the central objective of faculty and of a mathematical sciences program. These areas align with the common institutional program review categories of mission, faculty qualifications, currency of curriculum, teaching practices, and assessment.

First and foremost, to support student success, faculty must establish a **program culture** that is welcoming, inclusive, and committed to equitable opportunities for students, faculty, and staff. This culture shapes who is invited into the community, who feels welcomed, how they are supported and encouraged, and how we recognize each member's successes. We aim for a program culture in which people of all professional, social, and personal identities feel included, respected, and valued.

A program with an **engaged faculty** provides exemplary support for its members to engage in scholarship; service to their department, institution, and professional community; professional development; and most importantly, the teaching and mentoring of all students and of each other. An engaged faculty attracts, retains, and advances its members, fosters community on the local, regional, and national scales, and can be a model for other faculties.

A current, **purposeful curriculum** offers students – in general education, service, and major courses – mathematical content that is relevant to diverse career paths. A purposeful

curriculum utilizes evidence-based pedagogical practices and technological tools to support learning, offers multiple pathways into study of the mathematical sciences, is responsive to the needs of partner disciplines, and provides opportunities to study in emerging disciplines such as data science.

Evidence-based teaching practices enable effective delivery of a curriculum. These practices function on both the micro-level (e.g., using a group problem solving approach for a particular lesson) and the macro-level (e.g., how a faculty designs a co-requisite remediation program). Their use requires continual faculty engagement with evolving pedagogical developments.

Students enrolled in first-year courses constitute the overwhelming majority of students in college level mathematics courses ([2]). Supporting **new student success** – via placement processes, in developmental courses, in general education courses, and in service courses – is incumbent upon the mathematical science community. Although assessment practices are necessary for major and minor academic programs, special attention is needed to determine the success of these particular students.

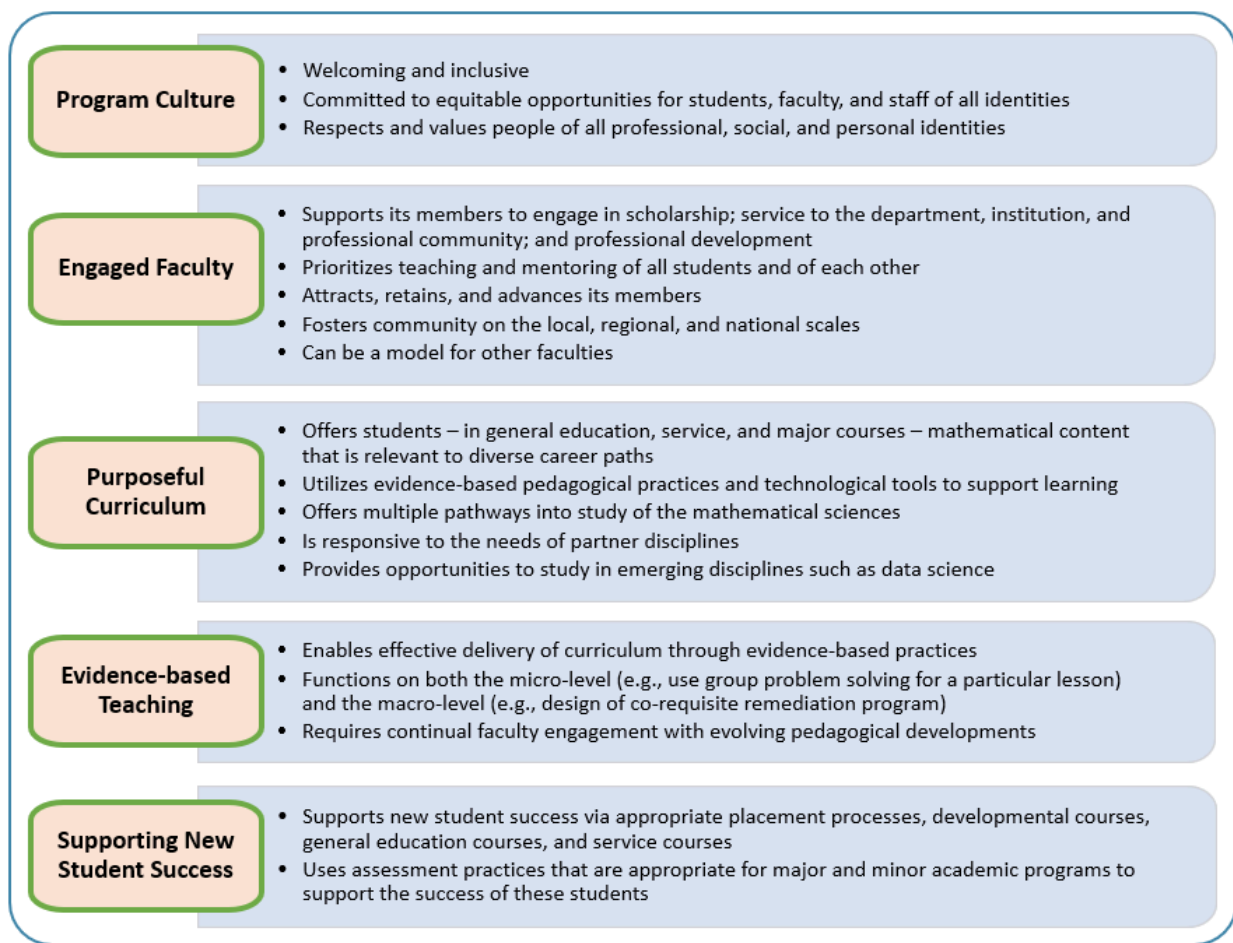Figure 2 summarizes these important ideas in a visual format.

Figure 2. Organizational Themes**.**

How to use this guide

This document describes a framework for undertaking a program review and is intended to complement institutional guidelines and focus on the particular concerns of programs in the mathematical sciences. This framework was developed by a team of mathematicians who are diverse in the types of mathematics they practice, the institutions they are affiliated with, the types of students they teach, and their race, gender, and other personal identities. This is described in more detail in [Contributors to this Document](#).

We will talk about "program" review in the most inclusive sense, noting that a department is an administrative unit to manage a group of faculty who, collectively, offer academic programs in one or more academic disciplines. A program review should assess the quality of the academic programs, not the administrative organization of the institution (although the two are linked).

The context for a review may be a department-wide review encompassing multiple undergraduate programs, graduate programs, and remediation programs, as well general education and service courses. Conversely, a review may only be for one of those foci. The principles and strategies described here are intended to address the needs of programs at two-year and four-year institutions, as well as in other postsecondary programs in the mathematical sciences.

Program Review Process

A program review is most effective as part of a dynamic cycle that includes reflective self-study, recommendations from colleagues outside the department, action planning, and implementing an iterative cycle of assessment and improvement. The cycle is pursued in three phases (Figure 3).
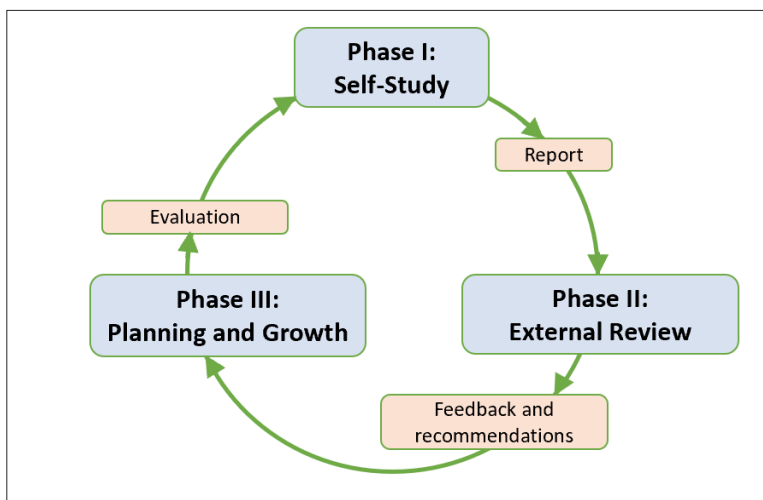

Figure 3. The Program Review Cycle.

Phase I, which constitutes the bulk of the faculty's work, includes creating a self-study team, revisiting goals from previous reviews, collecting and interpreting qualitative and quantitative data, setting preliminary goals, and presenting those findings in a report to stakeholders. In Phase II, the self-study findings are provided to an external team of consultants, who then conduct a site visit in the department and provide a report of their observations and recommendations. In Phase III, we arrive at the objective of this entire process: to use all that has been learned from the self-study and the external review to set goals that are SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) and to develop concrete plans to achieve them. This document will provide guidelines and recommendations for each of these phases in the program review, which will typically span approximately one year, with implementation of any recommendations extending beyond that time.

While practices differ among campuses, an external team of consultants is typically invited by the dean. The dean's selection of consultants is usually based in part on recommendations from the program faculty, so those recommendations should be provided early in the process. Once the dean issues invitations, schedule a site visit of between 1.5 and two days to take place later in the process. The work of the external consultants is discussed in more detail later in this document.

Phase I: The self-study

A self-study offers a chance to tell the program's story. It is a process of faculty reflecting on the big picture of the program's role in the university and its goals for growth. It provides an opportunity to:

- refine the department's mission and examine how its mission supports the institution's mission;
- reflect on where the department has been and where it is now, and develop specific, measurable, achievable, relevant, and time-bound (SMART) goals to guide the department toward the faculty's vision for its future;
- strengthen the quality of academic programs, including curricula for majors and foundational courses for non-majors;
- strengthen relationships among students, faculty, and staff, including tutoring, centralized advising, and other support staff and services;
- gather data to support scheduling decisions, curricular revisions, staffing needs, budgetary requests, and grant proposals; and
- engage in dialogue with colleagues in partner disciplines to clarify their needs and expectations and identify opportunities for interdisciplinary collaboration.

And maybe most important of all, a self-study provides an opportunity for department members to collaborate, stepping away from day-to-day responsibilities. Faculty can consider the larger role and goals of the department, examine what has worked and what hasn't, make

plans and decisions, and implement change. This process will allow members of a department to move forward with a shared understanding, vision, goals, and commitment.

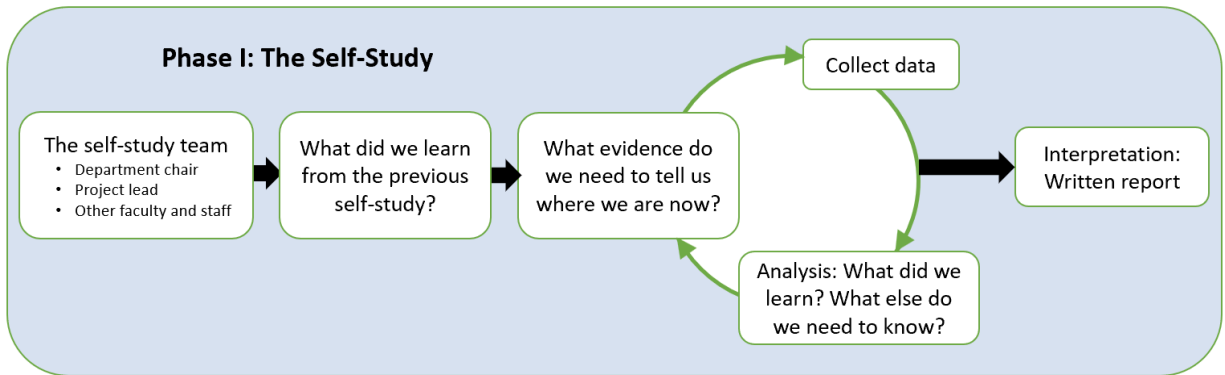The process for the self-study is shown in Figure 4.

Figure 4. Phase I of the Program Review: Self-Study

Step 1: Identify the self-study team and engage the faculty

Organization

An effective self-study needs clear leadership, engagement and commitment from faculty and staff, and explicit norms and expectations. The leadership for a program review includes the program chair, who is ultimately responsible for both its completion and for the implementation of any recommendations that result from the review. In larger departments, there may also be a project manager who is responsible for daily oversight of the review and responsibility for the completion of specific tasks.

Often, small teams of faculty and staff are given assignments to complete specific parts of the review. For example, small teams may be formed to compile data, to answer specific questions, or to draft a response to an institutional prompt.

Finally, the entire faculty and staff is responsible for engaging with, and supporting, this key element of the department's work.

Appendix 1 contains more information about the roles of the program leader and the project manager and Appendix 2 provides a sample site visit schedule for the external consultant team.

The chair, and project manager if there is one, launch the program review by bringing the department faculty and staff together to set the context for the review and the expectations about outcomes. Consider a retreat in a setting away from everyday demands (including email). The chair, or their designee, should lead everyone involved in discussions about:

- The purpose of a program review, and of the self-study in particular.
- Institutional guidelines and expectations for the review.
- The institution's mission, strategic goals, and budget priorities.
- How the review will be conducted, how it will be used, and the benefits for the department.
- Available resources for conducting the review: what data is provided by the institution and what the department might have already, or needs to generate itself; time resources; and other institutional commitments.
- The responsibilities of each member of the department towards the completion of the review.
- The process as outlined in this document, and how it can be adapted to meet the specific departmental context and goals.

Time Commitment Recommendations

A program review takes time, making it essential to establish clear expectations and realistic timelines. Planning to conduct the self-study over a period of approximately one year can minimize overloading department members. Include time to ask questions, reflect, and identify opportunities for improvement.

Schedule meetings only when necessary to achieve a specific goal, and keep them short and focused. Work from an agenda of discussion items and desired outcomes. Minimize the number of meetings by circulating data and findings, providing time for review, and incorporating feedback as needed outside of meeting time. No analysis or word-smithing during meetings! Use the meetings for reporting, making final modifications, and ratifying decisions.

The complexity of the program review process and of the self-study team is closely connected to the size and complexity of the programs under review. A program with three full-time faculty has different resources available than a program with thirty full-time faculty. Similarly, the complexity of a program review of a graduate program in applied mathematics may be very different from a program review of the undergraduate department consisting of multiple major programs.

Step 2: Understand the Current Institutional Context

It is important for program faculty and staff to have an accurate understanding of the institutional context within which they operate. This involves reflecting on the institution's mission, vision, and values and determining how the program's mission aligns with that of the institution. Consider also the current institutional strategic goals and how those impact the program.

For example, the institution may have moved to a research-focused mission; online education; standardized assessment practices; undergraduate professional programs; or a liberal arts core. The institution may be undergoing dramatic demographic changes in its student population. Or, the institution may be undergoing significant financial changes that affect things such as faculty workload or the range of programs offered.

The mission and vision of the program are often lost in the day-to-day work of the department, but they are critical to its success. A department's mission describes what it does on a regular basis – we "prepare students to …" – while the vision provides exactly that, a vision, typically framed as "if successful, we will see the following …" Alignment of institutional and programmatic missions and visions, as well as alignment of resources and energy with those missions and visions, is essential to the well-being of a program.

Step 3: Understand the Past: Re-visit the previous review

Begin by re-visiting the previous program review (assuming it is available) to understand the context within which the department is operating. Questions such as the following can guide conversation.

- What were the environmental factors at the time of the previous review?
  - What external factors, such as benchmarking with peer institutions, or the status of STEM nationally, impacted the program?
  - What institutional factors were especially influential at that time?
  - What was the influence of guidelines from professional associations, such as the MAA, on curriculum, pedagogy, and assessment?
- What majors, minors, and other (graduate, certificate, etc.) programs were offered?
  - What was notable about student enrollment in courses and programs?
  - What made the department's programs stand out? Why did students choose the department's programs?
  - In what ways did the department collaborate with other disciplines?
- What pedagogical and assessment trends were utilized?
  - What were students expected to learn?
  - What instructional methods were used?
  - How was learning assessed?
  - What was the state of evidence about effective teaching?
- What characterized the program's faculty, staff, and students?
  - What were the faculty, student, and staff demographics?
  - If the data were reported separately by gender, race, ethnicity, or other characteristics, were there any notable differences in outcomes? (See also Step 4: Collect and interpret data)

- What service and outreach activities did faculty and students engage in?
- What was the administrative organization of the department?
- What resources (library, technology, staffing, and so on) were available?
- What recommendations and goals were made in the previous program review? How did the department respond to the recommendations?
- What has changed since the previous program review?
  - What institutional changes have occurred?
  - What changes have taken place within the program?
  - What were the drivers for these changes?

Step 4: Collect and interpret data

The self-study team should make an effort to gather and organize data according to the program review themes identified earlier (see Organizational Themes), each of which contributes to the inclusive excellence of the department. Many resources are available to assist the team in identifying and organizing different data sources. (See Appendix 3)

Define questions first, then look for answers.

While it can sometimes be worthwhile to explore data without a structure, effective data collection and analysis follow from clearly defined questions. Institutional guidelines and program priorities will identify topics, if not specific questions, that the program should aim to respond to. Institutional guidelines often identify standard data sets that it expects the program to reference, which may come from a wide range of units within the institution, including but not limited to

- Admissions Office
- Advancement
- Alumni Office
- Career services
- Departmental records
- Finance Office
- Institutional Research
- Provost's Office
- Registrar's Office

After addressing institutional topics and questions, the department should ask what additional matters need to be addressed. Many of these additional matters will arise from reading the previous review and assessing what has changed, programmatically and institutionally, since that time (as described in Step 3). Based on the previous review and what the department

knows about departmental and institutional priorities, begin by crafting questions that the self-study team is looking to answer. These questions could include:

- Are there new degree programs, courses, curricular innovations, or facilities? What are their success and goals for growth?
- What changes have occurred within the faculty (diversity, size, retirements, balance among permanent, visiting, and non-tenure track faculty)? Do those changes respond to departmental needs and priorities?
- How has the student body changed? What different resources does the current population need?
- Have expectations from allied disciplines or the institution changed? Is the program meeting those expectations?

These and other questions that a department might ask as part of its self-study are detailed in Appendix 4. The Appendix 4 question lists are adapted from the COME-IN framework developed by Transforming Post-Secondary Education in Mathematics (TPSE- Math) ([10]).

For each question, ask:

- What type of information is needed to form an adequate response?
- What relevant data is readily available? For example,
    - Departmental Records
        - Curriculum maps and assessment reports
        - Pass rates for courses
        - Progress rates through the program(s), including remedial, service, and general education courses, as well as majors and minors
        - Placements of graduates
    - Records from the institutional research, admissions, or other campus offices (as listed above)
    - Policy documents (undergraduate handbook, faculty handbook, university policies, etc.)
    - Course descriptions and recent syllabi
    - Interviews with current & former students, faculty, or staff
    - Surveys of stakeholders
    - Institutional reports
- What information do you need that is not readily available? How can it be found, or what is the closest proxy?
- How can this data be disaggregated to identify needs of various sub-groups of students, faculty, or staff?

What is evidence?

Evidence includes both quantitative and qualitative data. Answers to _who_, _what_, _when_, and _where_ often rely on quantitative data communicated through numbers, graphs, statistics, and other metrics. Qualitative data—documents, policies, observations, interviews, photographs, biographies, etc.—describe _how_ and _why_. For example, suppose the department is trying to answer the question, _What are the outcomes of our placement processes for first-year students_? You might collect quantitative data on student grades and pass-rates in first-year courses, and observe that white students perform better than students of color. Such numbers are important, but can't tell _why_ those numbers are what they are: Do current policies inhibit the ability of students of color to access the resources they need to thrive? Are placement exams only capturing students' previous opportunities for achievement instead of their potential? Is the departmental culture, among its students or its faculty, perceived as unwelcoming? Is the department over-placing or under-placing students in their first course? Are students being "tracked," either intentionally or unintentionally? Qualitative data can also suggest important questions to investigate through quantitative data, or the reverse.

Both quantitative and qualitative data are needed to obtain a complete understanding of the department's work. Throughout these guidelines, we use the word _data_ to include both qualitative and quantitative data. Colleagues in other academic departments and administrative offices might provide invaluable guidance in collecting and analyzing both quantitative and qualitative data.

If important data isn't available, document why the missing information is important and how it would be used—in evaluating barriers to promotion, for example. If the missing data is needed to make evidence-based decisions, propose a SMART action for obtaining it.

Analyze and interpret data

Collecting data is often an iterative process. When gathering data, look for summaries, patterns, differences, and trends over time. This process may generate insights that lead to more questions, which in turn may lead to the collection of more data.

To really understand what's happening within your program, it may be necessary, and appropriate, to _disaggregate_ both quantitative and qualitative data into any number of different categories. Depending on the population of students, faculty, and staff, these categories might include gender, race/ethnicity, socioeconomic class, disability status, first-generation college attendance, commuter vs residential, rural vs urban, and domestic vs international. In some institutions, religious affiliation might matter. Depending on the departmental context, the self-study team might disaggregate faculty data by rank, or student data by major.

All people are affected by multiple parts of their identities (race, class, religion, gender identity, etc.), which overlap to create outcomes different from what might be seen by examining these categories independently. This phenomenon, referred to as *intersectionality*, is conceptually similar to a statistical interaction in analysis of variance.

With any data, some cells can be small enough that they can jeopardize anonymity, especially when disaggregating data. Be careful to protect privacy and anonymity when describing findings, particularly for students when complying with FERPA regulations ([11]). For example, the category "Indigenous women students" might be too small to protect these individuals' anonymity. Instead, consider reporting on women of color or students of color in aggregate. Even that category might be too small; colleagues in social science research, statistics, or your IRB office can recommend some additional strategies.

Focus on outcomes

When collecting data, focus on the *outcomes* for students, faculty, and staff that support program goals, as policies and practices sometimes have unintended consequences. Even a policy that appears equitable on its surface can have differential outcomes. For example:

- Prioritizing course registration for students based on how many academic credits they have already earned sounds like a reasonable policy–until we see that students who enter without advanced placement credit or who have other legitimate reasons for having a lower credit total will persistently be behind their peers.
- Students who are caretakers, working, or have other responsibilities may not be able to participate in late afternoon colloquia?
- Do department faculty members have equitable access to resources and opportunities? Do they all know about the resources and opportunities available to them?
- Does a required second course in algebra support the needs of students studying applied math or not planning to go to graduate school?
- Do the (implicitly or explicitly) approved pedagogies used by the department favor, or disfavor, students with different learning styles?
- Do the (implicitly or explicitly) approved assessment practices accurately capture the learning achieved by a diverse group of students?
- What rubrics, metrics, or other criteria are used to ensure consistent and equitable experiences and opportunities? How do these take into account barriers to student participation?

Compare to benchmarks

To provide a broader context for interpreting the evidence found, it can be helpful to compare your institutional data to the state's data on higher education and to data from other relevant sources, such as:
- American Mathematical Society annual survey
- Conference Board of Mathematical Sciences survey
- Integrated Postsecondary Education Data System (IPEDS) data
- National Science Foundation Indicators

Beware of bias

Each of us carries both conscious and unconscious biases that impact our ability to interpret data fairly. We all know quite a lot about the departments, programs, and institutions in which we work. However, striving to see beyond our assumptions and provide alternative perspectives on what we "know" can illuminate important patterns and outcomes. In this section, we identify a few common biases documented in social science literature that could affect a program review. For a deeper dive into this topic, see [6] as well as listings in the General Resources.

- *Implicit biases* are unconscious beliefs and attitudes that may shape our responses to social groups. These learned biases may contradict our explicitly held beliefs and attitudes.
- *Halo effects* occur when one positive trait of a person causes us to assume other positive traits.
- *Availability heuristics* are in play when we allow easily recallable information to be valued over information that is more difficult to recall or to obtain.
- *Recency and latency effects* occur when we remember the most recent and most distant events as most relevant.
- *Ingroup favoritism* occurs when we prefer individuals similar to ourselves.
- *Confirmation bias* happens when we strive to confirm a priori beliefs or expectations, to the exclusion of contradictory evidence.
- *Objectivity bias* occurs when we don't challenge our own assumptions about fairness and objectives.

These biases are largely unintentional and can be difficult to avoid without explicit attention. To avoid being susceptible to unintentional bias, start by questioning your research methods and data sources. Expanding the types of sources used can provide different perspectives. Actively seek out alternative hypotheses, including explicitly seeking data that contradict your conclusions.

Step 5: Write the Self-study Report

The self-study report summarizes the process, findings, and conclusions of the self study, based on everything that the team has learned. The goal of the report should be to present an argument for why the department is achieving inclusive excellence, or an argument for an action agenda and the resources the department needs to achieve inclusive excellence. There are several audiences for this one report: department members, academic administration, and the external consultants. It is important for the department to write to any broader issues that are identified during the self-study, in addition to those that might be of concern to external bodies. This is a key opportunity for the department to articulate its own sense of mission, vision, and needs.

We recommend that the report be organized according to the five thematic topics adjusted as needed according to the focus, priorities, and findings of the department and institution. As noted above, Appendix 4 contains questions that a program might ask itself in each of these categories. A possible self-study report outline is as follows.

I. Introduction – context for the program review
II. Summary
   ○ Executive summary of high-level findings
   ○ Open questions and unavailable data
   ○ Preliminary statement of action agenda
   ○ Questions, concerns, and focus areas for the consultants
III. Summary of Organizational Themes
   ○ Program Culture (mission, institutional fit, informal curriculum)
   ○ Engaged Faculty
   ○ Purposeful Curriculum for majors and minors, general education, service, and remediation
   ○ Evidence-based Teaching
   ○ Student success, particularly in the first two years
IV. Appendices, which might include many more forms of data and evidence.
   ○ The external consultant team report from the previous program review
   ○ Data addressing Organizational Themes
      1. Program Culture
         a) Summaries of student activities for the past several years
         b) Lists of program co-curricular activities
         c) Reports on the numbers and placement of graduates
         d) Department mission statement
         e) Summaries of student experience surveys

2. Engaged Faculty
    a) A definition of who counts, institutionally, as faculty.
    b) Curriculum vitae for faculty members and other evidence of engagement
        ○ Lists of recent publications
        ○ Lists of grant proposals submitted and funded
        ○ Lists of professional development involvement
        ○
        ○ Lists of recent service activities (internal and external)
        ○ Lists of recent awards
    c) Faculty demographics
3. Purposeful Curriculum
    a) Requirements for majors
    b) Student learning outcomes and a curriculum map
    c) General Education and service courses taught and their enrollments
    d) Student demographics
    e) Number of majors per year
    f) Catalog descriptions of courses
    g) Course enrollment data for the past five years
4. Evidence-based Pedagogy
    a) Sample syllabi, exams, projects, etc.
    b) Reports on department initiatives
5. Assessment Practices
    a) Assessment and evaluation tools
    b) Assessment data for the past five years

Phase II: External review

Once the self-study report is complete, external consultants are engaged to provide feedback on the self-study report as well as additional perspectives from the consultants themselves and from the voices they hear within and beyond the department. While practices differ among institutions, the consultant team is usually invited by the dean, based in part on recommendations from the department faculty. The external consultants review the self-study report, conduct a site visit of approximately two days, and produce a report, containing recommendations, to the dean (not the chair). (See Figure 5.)
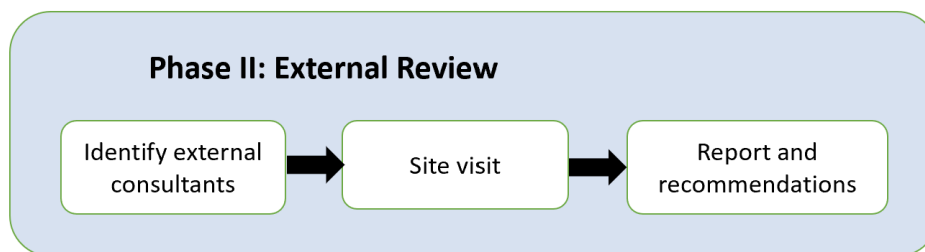
Figure 5. The external review.

The Consultant Team

We strongly encourage the use of at least two consultants as a team, to include varied perspectives and to allow team members to discuss and interpret their findings together. The size and composition of the external consultant team depends in part on the size of the program faculty, ideally designed to allow consultants to meet with all members of the faculty, individually or in small homogeneous groups. While some administrators might recommend using a single consultant, often as a financial consideration, this only makes sense in exceptional circumstances for a very small program. For larger departments offering multiple programs, or departments with many faculty, a single consultant would generally not have close knowledge of the range of disciplines, would be unable to provide the diversity of perspectives possible in a larger team, and would not be able to speak to department faculty members individually.

This last point is critical because graduate students, part-time faculty, non-tenure-track faculty, and junior faculty may feel less comfortable being forthright in group conversations that include senior faculty. Individual or small subgroup conversations between faculty and the external consultants may be accommodated by virtual meetings before or after the actual visit, but these events need to be arranged with appropriate confidentiality.

For mid-sized institutions, we recommend a team of three consultants in order to provide an optimal degree of expertise and diversity of perspectives. The team should ideally include individuals who collectively have:

- Experience with program reviews
- Knowledge of national curricular guidelines and practices
- Broad expertise in the mathematical sciences disciplines
- Willingness to assess the department in its own context
- Commitment to diversity, equity, and inclusion
- Familiarity with similar institutions
- Experience in academic leadership

Whenever possible, the consultant team should include individuals of different races, genders, and/or ethnicities so that department members of these identities can feel comfortable speaking openly about their experiences.

Structure of the site visit

The self-study report should be provided to the consultant team at least four weeks before their visit. This gives the visiting team a chance to read the self study, and identify additional information that they would like to obtain, articulate preliminary questions, and suggest meetings for the site visit.

The chair (or project manager) should schedule the site visit in consultation with the visiting team. The site visit should include meetings with the dean, chair, program faculty and staff, program majors and non-majors, and graduate students. The particular goals and concerns of the department may necessitate additional conversations with representatives from the tutoring center, Admissions, Advising, IT, or faculty in allied disciplines. Often, these conversations arise at the last minute, so time should be reserved in the schedule to allow for them.

Sufficient time also needs to be allocated to meet separately with faculty and students with identities currently underrepresented in mathematics, to ensure that their voices and concerns are represented in the review. Provide these individuals with opportunities to meet with team members privately or in small groups; whenever possible, have at least three people (consultants, students, and/or faculty) present at each meeting to avoid future misunderstandings. Keep in mind that individuals of underrepresented identities may not feel safe to speak openly in some settings, and consider ways to help them feel safe and valued–for example, by interviewing them along with their peers or including others of similar identities in the meetings. In addition, it is sometimes worthwhile to hold these conversations outside the department walls in order to protect both perceived and actual confidentiality.

A detailed schedule of the site visit agenda should be broadly available to stakeholders two weeks before the visit. Suggestions for this agenda and the site visit schedule are found in Appendix 2.

At the end of the visit, the consultants will discuss their preliminary findings with the chair and, if possible, the faculty as a whole before formally presenting them to the dean. This initial verbal report will highlight high-level conclusions, address priorities identified at the onset of the site visit, and advocate for appropriate institutional support in terms of funding, personnel, and other resources. The dean should then expect a final written report from the consultants within four to six weeks. Prior to that, the consultants may share a draft report with the chair to fact-check the evidence cited.

The MAA offers Guidelines for External Consultants and a list of potential consultants who have been trained to provide this service ([7]).

Phase III: Evidence-based action planning and growth

The team report and feedback from the external consultants lay the foundation for identifying goals and actions that can lead to building on the program's strengths and addressing some of its limitations. Often, this work is included in a formal response to the external consultant report required by the institution, but we suggest investing the time and effort to make this document a valued, productive guide to the work of the department in subsequent years.

The department now has the tools needed to begin the iterative process of setting *goals* for future growth of the department, using those goals to develop specific *actions* the department can take toward those goals, and *implementing* those actions for growth. What was learned from the self-study report, its supporting data, and the consultant report? What were the most promising strengths and the most concerning gaps identified? How do these strengths and gaps compare with departmental and institutional priorities? Begin from this *foundation of evidence* in brainstorming as many goals as possible, and then selecting the highest priorities for action. A model for this is shown in Figure 6.

Figure 6. Planning for the future
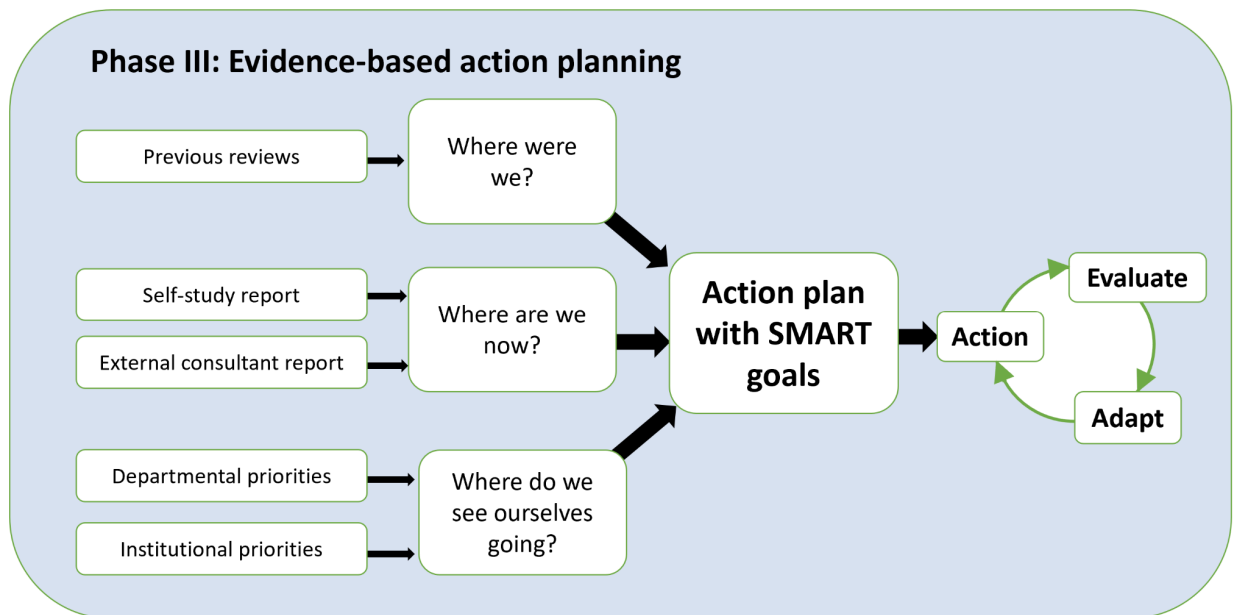
The MAA recommends:

- Include *short-term goals and action plans* (what can the department begin right away), *medium-term goals and action plans* (what can the department start within the next semester or year), and *long-term goals and action plans* (where does the department want to be by the subsequent program review).
- Describe each goal in terms of an action plan that makes it SMART.

- (Specific) What is the specific goal? State the expected outcome of the goal.
- (Measureable) How will the department know if the goal has been achieved? Develop a set of metrics to assess progress and success.
- (Achievable) What is the strategy for attaining the goal? Which people and other resources does the department need?
- (Relevant) How will achieving this goal help move the department forward?
- (Time bound) What is the timeline?
- Record the goals and action plans in detail, and make them available for all members of the department to refer to. This record will help the department to plan its work and to keep itself accountable.

Note that "Achievable" includes identifying the resources needed to achieve it. Is it a goal that the department or program can achieve with its internal resources – for example a more efficient system of creating a course schedule and distributing teaching assignments? Or does the goal require external resources, such as administrative commitment to invest in a new software package, or to hire an additional faculty position? From an administrative perspective, having and achieving internal goals supports requests for external investment.

The chair, or another designated member of the faculty, should serve as the champion for staying on track toward this action plan. An even better model is to assign each goal a specific faculty member who is responsible for its completion.

The final steps in any action plan are to evaluate progress using the metrics that are part of each goal, which may lead the department to adapt the goal or its process, or even to set new goals. This iteration can then become normalized in the department as an ongoing process of growth, sustaining the work until the next program review.

Appendices

Appendix 1: Self-Study Team Organization

The self-study team often includes the chair, along with other faculty and staff members who will collaborate with the chair to manage all parts of the process. At the outset, the team should agree who will assume the following roles and responsibilities:

Leadership

- Elicit the engagement of all stakeholders, within and beyond the department, and facilitate engagement throughout the process.
- Communicate a vision for the self study as an opportunity for department renewal and individual professional development.
- Ensure that faculty understand the review process and the institution's strategic goals and budget priorities.
- Clarify and communicate expectations of all stakeholders to the department members.
- Advocate with faculty, staff, administrators, and colleagues in other departments for access to data, funding, timeline, and anything else that is needed to support the process of the self study and the ensuing plan for action.
- Ensure that the process leads to a clear delineation of SMART actions and goals that are based on the evidence from the self-study report and site visit.
- Lead the department in creating and pursuing detailed action plans based on the evidence-based goals.

Project management

- Provide and maintain a roadmap and timeline.
- Delegate responsibilities to faculty and staff for all steps in the process.
- Develop processes for managing and maintaining data.
- Recommend a team of at least two external consultants for the site visit to the dean or provost.
- Manage the logistics of the external team's visit.
- Establish the role of the external team as advisors who are independent from the department's self-study team.
- Include all members of the department team in making decisions.

Appendix 2: Sample site visit schedule

Meetings to include:

People	Suggested Time
Dean (opening meeting)	30 min
Department chair (opening meeting)	45 min
Program faculty, individually if possible	45-60 min each
Other department chairs (as a group)	1 hour
Group of program majors	1 hour
Group of first- and second-year students, or non-majors	1 hour
Group of graduate students or other populations in the department	1 hour
Drop in, private, conversations	1 hour
Admission Office representative	45 min
ITS representative	30 min
Tutoring Office Director	30 min
Department chair (de-brief)	1 hour
Dean (wrap up)	1 hour
Program faculty (wrap up)	1 hour

Sample schedule (1.5-2 days)

Day	Activity
0	*Evening*: Consultants arrive, possible meeting with department chair
1	*Morning*: Orientation and priorities from Dean/Provost, program chair
1	*Late morning*: begin conversations with individual program faculty
1	*Lunch* with program majors or chairs of other programs
1	*Afternoon*: conversations with individual program faculty, some outside program
1	*Late afternoon*: meeting with chairs of other programs or with program majors
1	*Dinner* with program faculty
2	*Morning*: finish conversations with faculty, those outside program
2	Planning time for consultants
2	*late morning or lunch*: wrap-up meetings with Dean/Provost and with program faculty

Appendix 3: Resources, Examples, and Templates

General Resources

Two important documents that a program should produce as part of its review are a curriculum map and a history of its course enrollments.

A Curriculum Map provides an explicit connection between the courses students take and the program's learning objectives. The map suggests where formative and summative assessments of the objective might occur, as well as enabling the faculty to see redundancies or gaps in the curriculum.

A spreadsheet of course enrollments since the prior program review, or at least over the past several years, allows the faculty to see the efficiency of its resource allocation. A simple spreadsheet, such as the one shown in this Course Enrollments Template, is often more useful than institutional data about average course size or the number of under enrolled courses because it also displays the frequency of each course and the information about student preferences among courses.

There are many resources available that address issues of departmental leadership and project management. We list a few here to help you begin to address these topics. This list is far from comprehensive.

1. Read more about SMART goals here and here.

2. Cobb, A.T. (2012). *Leading Project Teams: The Basics of Project Management and Team Leadership 2nd Edition*, SAGE Publications. https://doi.org/10.4135/9781483349169.

3. Wergin, J. (2003). *Departments that Work: Building and Sustaining Cultures of Excellence in Academic Programs.* Wiley.

In the Compare to Benchmarks section of these Guidelines, we identified several national sources of organized data. For completeness in our list of resources, we include them here again.

4. American Mathematical Society. The Mathematical and Statistical Sciences Annual Survey. https://www.ams.org/profession/data/annual-survey/annual-survey

5. Conference Board of Mathematical Sciences (CBMS) Survey. (1970-2020). https://www.ams.org/profession/data/cbms-survey/cbms-survey

6. National Science Foundation. Science & Engineering Indicators. https://ncses.nsf.gov/indicators

7. United States Department of Education: National Center for Education Statistics. Integrated Postsecondary Education Data System (IPEDS). https://nces.ed.gov/ipeds/

Addressing issues concerning program culture and inclusiveness are relatively new to academic conversations, so we have identified a collection of resources to assist a department in beginning its work to understand and address bias, diversity, and inclusion.

8. Gino, F.& Coffman, K. *Unconscious Bias Training That Works*. https://hbr.org/2021/09/unconscious-bias-training-that-works

9. Kahneman, D. (2013). *Thinking, Fast and Slow*. New York: Farrar, Straus and Giroux.

10. Mathematical Association of America (2023). Professional Development. https://maa.org/programs-and-communities/professional-development

11. Staats, C. (2016). Understanding Implicit Bias: What Educators Should Know. *American Educator*. 39(4): 29-33.

12. Stewart, A.J., Valian, V. (2018). *An Inclusive Academy: Achieving Diversity & Excellence*. Cambridge, MA: MIT Press.

The following sources provide a variety of tools and resources to guide faculty in collecting and interpreting data to support program assessments.

13. Bensimon, E. M., McNair, T. B., Malcom-Piqueux, L. (2019). *From Equity Talk to Equity Walk: Expanding Practitioner Knowledge for Racial Justice in Higher Education.* United States: Wiley.

14. Transforming Post-Secondary Education in Mathematics (TPSE-Math). Creating Opportunities in Mathematics through Equity and Inclusion (COME-IN). https://www.tpsemath.org/come-in

15. American Association for the Advancement of Science (AAAS). STEMM Equity Achievement Change (SEA Change). https://seachange.aaas.org/

The MAA has published many resources that can be of assistance to a department undertaking a program review and planning changes in the way it offers its programs. Among these are the MAA Notes Series (https://maa.org/press/notes/browse), which offer member-generated answers to various relevant questions. More formally, the MAA provides specific guidance in each of the thematic categories. Below are links to many of these documents, which are updated periodically.

I. Program Culture

1. MAA Committee on Faculty and Departments (2017). *Guideline Statement #1: Best Practices in Recruitment, Retention, Development, and Evaluation of Faculty in College and University Mathematical Sciences Departments*. https://www.maa.org/programs-and-communities/professional-development/committee-on-faculty-and-departments/guideline-statement-1

2. MAA Committee on Faculty and Departments (2020). *Guideline Statement #3: Best Practices for Student Support*. https://www.maa.org/node/2166166

3. MAA Committee on Faculty and Departments (2022). *Guideline Statement #6: Best Practices for Justice, Equity, Diversity, and Inclusion*. https://www.maa.org/node/3487772/

4. MAA Committee on Faculty and Departments (2018). *The Importance of Mathematical Sciences at Colleges and Universities in the 21st Century.* https://www.maa.org/node/1566047

II. Engaged Faculty

1. MAA Committee on the Undergraduate Program in Mathematics (2015). *Curriculum Guide to Majors in the Mathematical Sciences: Departmental Responsibilities in Curricular Reform*. https://www.maa.org/node/789688

2. MAA Surveys and Reports .https://www.maa.org/programs-and-communities/curriculum-resources/survey-and-reports

III. Purposeful Curriculum

1. Schumacher, C.S., Siegel, M.J., & Zorn, P., ed. (2015). *2015 CUPM Curriculum Guide to Majors in the Mathematical Sciences*. Washington, DC: Mathematical Association of America. https://www.maa.org/programs/faculty-and-departments/curriculum-department-guidelines-recommendations/cupm/2015-cupm-curriculum-guide

IV. *Evidence-based Teaching*

1. Abell, M.L., Braddy, L., Ensley, D., Ludwig, L., & Soto, H. (2018). *MAA Instructional Practices Guide*. Washington, DC: Mathematical Association of America. https://www.maa.org/programs-and-communities/curriculum%20resources/instructional-practices-guide

2. MAA Committee on Faculty and Departments (2018). *Guideline Statement #2: Required Resources and Recommended Technology for College and University Mathematical Sciences Departments.* https://www.maa.org/node/1565208

3. MAA Committee on Faculty and Departments (2020). *Guideline Statement #4: Best Practices for Curriculum and Teaching*. https://www.maa.org/programs-and-communities/professional-development/committee-on-faculty-and-departments/guideline-statement-4

V. *New Student Success*

1. MAA Committee on Faculty and Departments (2020). *Guideline Statement #5: Best Practices for Program Review, Assessment, and Accreditation*. https://www.maa.org/node/2414839

2. MAA Committee on the Undergraduate Program in Mathematics (2015). *Curriculum Guide to Majors in the Mathematical Sciences: Articulation Issues*. https://www.maa.org/node/789691

3. MAA Committee on the Undergraduate Program in Mathematics (2015). *Curriculum Guide to Majors in the Mathematical Sciences: Assessment of the Mathematics Major*. https://www.maa.org/node/789792

4. Möbius MAA Placement Test Suite by DigitalEd. https://www.maa.org/node/259

Appendix 4: Questions for the self-study process

The questions in this section encourage the self-study team to look at the department overall. Keep in mind *all* people who are part of the department: students, faculty, and staff. As the team collects qualitative and quantitative data, disaggregate that data as much as needed to describe the different experiences and outcomes for people of different races, ethnicities, gender identities, nationalities, disability status, nationalities, and other aspects of their identities.

Although some of these questions may seem to have obvious or simple answers, as we often see in mathematics, sometimes the most interesting findings are hiding within the "obvious," it is important to look at evidence (refer to the discussion of bias above).

As described earlier, the MAA's intent is to have each department and program striving for inclusive excellence – providing each student and faculty member the opportunity and resources to succeed. We have identified five program review categories that contribute to this goal, and repeat them now.

     I.   Program Culture
    II.   Engaged Faculty
   III.   Purposeful Curriculum
   IV.   Evidence-based Teaching
    V.   New Student Success

This appendix is organized around these five categories. It is also extensive, so most programs cannot, and probably need not, focus on everything here. Use institutional priorities and goals to identify which questions are most relevant for the program review focus.

Institutional Context

Department mission

0.1.   Does the program have a mission and/or vision statement? How is it communicated to faculty, staff, and students? How was it developed, and how often is it reviewed and revised?

0.2.   How does the program's mission align with the institution's mission? With the current audience of students?

Department Context

0.3.   What academic programs are in the department, including undergraduate majors and minors, graduate programs, bridge programs, REUs, and interdisciplinary programs?

0.4. What role does the department play in foundational courses for the general undergraduate population?

0.5. What extracurricular activities and programs are in the department, including student clubs and organizations, honors programs, specializations, and internships?
- How do these activities align with the department's mission?
- How do students learn about these programs? Is information equitably available to all students?

Department People

0.6. How many undergraduate, graduate, postdoc, faculty, and staff members are in the department, separately by race, ethnicity, gender identity, and any other personal or professional identities?

0.7. How do these numbers compare to benchmark data, such as the CBMS survey, AMS annual survey, NSF reports, or institutional demographics?

0.8. How do these numbers compare with the previous self-assessment?

Department Leadership and Governance

0.9. Is there effective and consistent leadership? What is the leadership structure?

0.10. Are there documented processes and policies (e.g., in a handbook)?

0.11. How are faculty members engaged in departmental and university governance?

0.12. How are faculty selected or assigned to leadership positions? Are these roles equitably available? Is workload distributed fairly?

I. Program Culture

Community and Belonging

1.1. Do students, faculty, and staff have a sense of community and belonging? How do you know?

1.2. Does the community include people of all races, genders, ethnicities, nationalities, and other personal characteristics?

1.3. What events or programs contribute to building community?

1.4. Is the department attentive to wellness and satisfaction of students, faculty, and staff? How is this information gathered?

1.5. Are non-tenure track faculty included in departmental events?

Policies and practices related to Equity, Diversity, and Inclusion (EDI)

1.6.　Does the department have an explicit statement or stated values about equity, diversity, inclusion, and belonging?

1.7.　How does the department ensure that legal requirements, including dealing with sexual assault and harassment, disability accommodations, and Title IX requirements, are implemented appropriately for students, faculty, and staff? This may include
   - Sexual harassment and assault training;
   - Services available to victims and those accused of sexual harassment or assault;
   - Required EDI or cultural competency training;
   - How violations are handled, protecting the privacy and safety of all stakeholders.
   - How these resources and policies are communicated to department members

1.8.　Are faculty and staff encouraged or required to receive training on EDI? Do they receive training on how to cultivate inclusive work and classroom environments? Does the department provide resources to support the use of culturally sensitive curricula? Are cultural competency and other EDI issues included in mentor or advisor training?

1.9.　What responsibilities do faculty and staff have for promoting EDI? How are faculty and staff rewarded for EDI-related work? What is the impact of this work on evaluation and promotion?

1.10.　How is EDI reflected in invited talks, colloquia, seminars, other events, and the event organizers? How is EDI reflected in department communications (websites, printed materials, etc.)?

Flexible Timelines and Caregiver Support

1.11.　What are the policies and practices regarding personal and family leave and caregiving responsibilities? For example, do classes and other scheduled activities accommodate students, faculty, and staff who have caregiving or other responsibilities?

1.12.　Do students, faculty, and staff have access to family care resources, including childcare and lactation rooms?

1.13.　How is personal or family leave or the use of flex-time reflected in evaluation, including salary, promotion and tenure, research funding, eligibility for awards and honors, student funding, and other benefits before, during, and after returning to work?

1.14.　How are a faculty member's teaching, advising, mentoring, committee assignments, and other departmental service handled during personal or family leave?

1.15.　What policies and resources apply to staff and part-time and non-tenure track faculty?

1.16.　How does personal or family leave affect degree progress and retention?

II. Engaged Faculty

Recruitment, Hiring, and Retention

2.1. Does the department have hiring and retention practices that build on institutional practices in the following areas?
- Identification and communication of interpersonal skills, including those related to EDI; specification of which skill sets and experiences are required, and which are optional.
- Recruitment practices designed to generate a diverse pool of candidates across the range of personal and professional identities.
- Analysis of the composition of the applicant pool, short-listed candidates, interviewees, those who receive job offers, and those who are hired.
- Selection and training of search committees.
- Assessment and correction of salary inequities.
- Regular assessment of turnover in department-, institution-, or grant-funded positions.
- Regular reviews of faculty and staff satisfaction; exit interviews to survey the culture and climate of the department.

2.2. What are the department's onboarding practices?

2.3. Where do faculty and staff continue their careers after they leave?

Non-tenure track faculty: visitors, instructional staff, graduate TAs, adjunct faculty, lecturers

2.4. What is the role of these groups in teaching, advising, and other roles with students?

2.5. What career pathways and professional development opportunities are available for these faculty?

2.6. How are they evaluated? How are expectations communicated?

2.7. What input do they have in curricular decisions?

2.8. What is the evidence that these faculty feel valued? How is their workload respected?

2.9. Is their workload equitable?

Teaching Roles

2.10. Who teaches introductory undergraduate classes? How are courses assigned? How do faculty provide input on course assignments?

2.11. Do faculty receive training on how to create inclusive classroom, lab, and work environments when working with both non-majors and majors?

2.12. Is workload equitable and transparent? What is the mechanism for making invisible labor visible?

2.13.   Are there mandatory, or recommended, practices to enable instructors to use evidence-based teaching practices?

Professional Development

2.14.   Do faculty receive ongoing support and professional development for research, including time, funding, students, and personnel support?

2.15.   What training opportunities do faculty receive in pedagogy, advising, and mentoring?

2.16.   How do faculty gain leadership experience? What is the pathway for faculty to move into leadership roles both in the department and in the professional community? What mentoring or professional development do they receive in these roles?

2.17.   What training or other professional development opportunities are available to staff?

2.18.   How are faculty and staff informed of and prepared for advancement opportunities?

2.19.   Do members of the department actively advocate for faculty, students, and staff for internal and external awards and other opportunities? How is the equity of award nominations monitored?

Mentoring and Advising

2.20.   Does the department have a formal definition of mentoring, separately from advising?

2.21.   What training is provided to students, faculty, and staff to be effective mentors and advisors? Are students, faculty, and staff rewarded for excellence in mentoring?

2.22.   How does the department assess and monitor the mentoring needs of its members and whether those needs are being met? How do students, faculty, and staff, especially those from underrepresented groups, learn to cultivate successful mentorship relationships, both as mentors and mentees?

2.23.   How are faculty trained to advise students? What curriculum and advising resources are available?

2.24.   What opportunities do undergraduates, graduate students, and postdocs have to work with faculty mentors? Do they receive mentoring in career development and how to network effectively?

Evaluation and Performance Review

2.25.   What processes are in place to review academic or career progress? How are students, faculty, and staff made aware of these processes?

2.26.   What rubrics and metrics are used for evaluation, tenure and promotion, and feedback? How does the department ensure equitable evaluation and feedback?

2.27.   Who performs performance reviews for students, faculty, and staff? What training is provided or required of those who participate in performance review?

2.28.   What is the tenure and promotion (T&P) process? How are T&P committees formed?

2.29.   How are evaluation results used in policy, staffing, resource allocation, and career progression?

III. Purposeful curriculum

3.1.   What are the requirements of majors/minors?

3.2.   Is there a curriculum map linking course objectives and student learning outcomes to department and program-level outcomes?

3.3.   How often does the department conduct curriculum reviews and make modifications? What is the process?

3.4.   Does the curriculum engage the interests and needs of the current population of students? Does it align with the department's mission? Is the curriculum tailored to the needs of key employment categories?

3.5.   Is there a process for identifying courses that may serve as filters, obstacles, or other pain points? Once identified, how are these addressed?

3.6.   What opportunities are available for students to engage in research? How are students made aware of opportunities? Do all students have equitable access to research? How do undergraduate and graduate students learn to do research?

Disciplines of the mathematical sciences

3.7.   Are students exposed to the range of current mathematical sciences, including applied mathematics, statistics, programming, computer science, data science, math and statistics education, and related fields?

3.8.   Does the curriculum prepare students for productive career opportunities and meaningful professional lives after graduation?

3.9.   What are the differences among the traditions, practices, and stature of the various mathematical sciences disciplines within the department?

3.10.   How do students and faculty interact within and across these disciplines?

3.11.   Which research, career, courses, and other opportunities are available for students in different mathematical sciences disciplines?

3.12.   Are students able to switch between disciplines? Are there patterns in which students enter into or switch among disciplines?

Mathematics and other disciplines

3.13.   What are the department's efforts to recruit undergraduate and graduate students into STEM fields?

3.14. Does the department collaborate with allied programs to coordinate curriculum and scheduling of required courses? What is the process?

3.15. Do department programs address important interdisciplinary topics?

Mathematics and society

3.16. How are the social and ethical implications of the mathematical sciences represented in the curriculum (e.g., model assumptions and bias, bias in data collection and analysis)?

3.17. Are culturally sensitive and culturally diverse examples used in the curriculum?

3.18. Does the curriculum represent mathematical scientists from a diverse range of identities and backgrounds? Are students and faculty expected to credit the work of a diverse range of authors in research and/or teaching (e.g., recognizing that "Fibonacci" sequences were recognized by Indian mathematicians hundreds of years before Fibonacci)?

3.19. Are courses designed to be accessible without separate ADA accommodations?

3.20. Are the mathematical sciences discussed in a social context, including their use and misuse in addressing and sustaining social problems and oppression?

3.21. Is the social context of mathematical sciences discussed, including who succeeds in mathematics and why?

3.22. Does the curriculum reflect interdisciplinarity? Are faculty given the freedom to "experiment" in developing new/non-traditional courses?

IV. Evidence-based teaching practices

4.1. What teaching pedagogies (e.g., flipped classroom, growth mindset learning, guided discovery, collaborative problem-solving) are used in gateway courses?

4.2. Are equitable practices implemented in pedagogy? Is access to online courses and other learning technologies equitable?

4.3. Are curricular materials shared among instructors in course development?

4.4. How is consistency across multiple sections of introductory classes evaluated? Are these courses perceived/implemented as "program-owned"? How is that coordinated?

4.5. What is the format of introductory courses? Who teaches those courses? Are instructors of those courses attuned to the diverse needs of new students? Are there recitation sections?

4.6. What is the format of upper-division courses? Who teaches those courses?

4.7. How does the department encourage and assess the use of inclusive teaching practices in introductory courses? Upper-division courses?

V. New student success

Curricular Pathways

5.1. How are first-year and transfer students placed in their math classes? Do these placements allow them to successfully complete majors in the department and in STEM?

5.2. How are the outcomes of these placements assessed?

5.3. Is there an articulation agreement between four-year and two-year colleges to facilitate the progress of transfer students?

5.4. Are there multiple points of entry into majors and graduate programs for first-year, transfer, and continuing students?

5.5. Are students invited and encouraged to take next-level courses?

5.6. How are students placed into pathways that meet their needs and facilitate their advancement?

5.7. What are the curricular pathways or programs for non-math/statistics majors to enter graduate studies in mathematical or statistical sciences?

5.8. What differences are there in student curricular needs and their progress within the curriculum, based on gender, race, or other personal identities?

Student supports

5.9. What supports (such as tutoring, advising, co-requisites, or an Emerging Scholars Program) are in place to help both majors and non-majors succeed in coursework, exams, research, and other requirements?
   - How are first-year students supported to succeed in their courses?
   - How are transfer students supported in integrating into the program and the department community?
   - How do students receive information on these supports? Are they equally available to all students?

5.10. Are policies, procedures, and requirements transparent and available to all students in clearly accessible and understandable formats?

5.11. Beyond course grades, what feedback do students receive on their academic progress?

Student Assessment

5.12. How, and how often, do students receive feedback on their academic progress?

5.13. What evaluation metrics or rubrics are used? Have these methods been validated?

5.14. Are evaluation, feedback, and grading practices standardized across sections of the same course and across courses?

5.15. How are formative assessment (practices that provide feedback on student progress toward learning goals) and summative assessment (practices that measure whether students have achieved the learning goals at the end of some period of time) used in coursework?

5.16. Does the program use alternative forms of assessment, in addition to problem sets and exams?

Assessment of the program

5.17. How does the department assess general education and service courses, and to whom is this information reported?

5.18. Does the program engage in formative assessment and as well as summative assessment of the program itself?

5.19. Does the program assessment process include exit interviews and tracking of graduates of the program?

5.20. Does the program invite feedback from external stakeholders (e.g., employers or graduate schools)?

5.21. Does the program regularly review its assessment data and make adjustments accordingly?

Retention

5.22. What types and how much financial support does the department make available to students (e.g., departmental scholarships or paid student positions)?

5.23. What are trends over time in enrollment, retention, and degree completion, overall and for disaggregated groups of students?

5.24. Are there differences between students who persist and those who leave the department programs, switch majors, or leave the institution?

5.25. How does personal or family leave affect degree progress and retention?

5.26. Are there differences in retention or funding among students of different races, genders, or other personal characteristics?

Professional Development

5.27. Do students have opportunities to participate in research and to attend and present at professional meetings?

5.28. What opportunities are available for students to learn more about pedagogy at both the K-12 and postsecondary levels?

5.29. Are there leadership training and positions for students?

5.30. How are students exposed to and prepared for the range of careers and further educational opportunities within the mathematical sciences?

5.31.   Do students of all genders, races, and other personal identities have equitable access to information about and participation in these opportunities?

5.32.   Where are department graduates, and what are they doing?

VI. Graduate students and postdocs

Recruitment

6.1.   What are the formal and informal processes and strategies for recruitment, and what are the outcomes of each? How are candidates recruited across the range of personal and professional identities?

6.2.   What is the composition of the applicant pool, short-listed candidates, interviewees, those who receive offers, and those who matriculate?

6.3.   Are there articulation agreements with bridge programs, four-year colleges, and minority-serving institutions?

6.4.   How are members of the admissions committee selected? Is the committee formed with attention to equity, both of participants themselves and their support of DEI goals in admissions? Do committee members receive training or documentation about policies and practices?

Advancement, Independence, and Completion

6.5.   What are trends over time in enrollment, retention, and degree completion, overall and disaggregated by personal identities?

6.6.   What is the range and average time to candidacy, degree, or time spent in the graduate program or postdoc positions overall?

6.7.   What is the effect of teaching and other responsibilities on research productivity for graduate students and postdocs? Are graduate student and postdoc responsibilities, such as teaching, similar to that of peer institutions?

6.8.   How are TAs, RAs, GAs, and other student employees evaluated?

6.9.   How, and how often, do students receive feedback on their academic progress? Are both formative and summative assessment used in evaluating student progress?

6.10.   What evaluation metrics or rubrics are used?

6.11.   How are graduate students and postdocs supported in the transition to the next steps of their careers (e.g., seeking funding, writing CVs, or resumes, interview skills, writing a research statement)?

Professional Development

6.12.   What career development opportunities are available (e.g., teaching, leadership, manuscript and grant writing, oral communication, mentoring undergraduate students)?

6.13.   Do members of the department actively advocate for students and postdocs to receive awards and other opportunities? Are these opportunities equally available to students of different identities, including which students faculty advocate for?

6.14.   What types of training and experiences are available (teaching, research, outreach, mentorship, project management, leadership, or other professional skills)?

References

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Contributors to this Document

In 2010, the MAA published two documents that support mathematical sciences program review: *MAA Guidelines for Undertaking a Self-Study in the Mathematical Sciences* and *Guidelines for Serving as a Consultant in the Mathematical Sciences*. Since that time, the MAA Committee on Program Review has maintained and disseminated resources that guide programs and consultants during the review process.

In 2021 and 2022, recognizing the need to revise the existing documents, the MAA convened a series of meetings. An August 2021 virtual kick-off meeting engaged a dozen mathematical sciences leaders in surveying the higher education landscape and discussing the scope and direction of an MAA revision project.

In March 2022, approximately 40 mathematicians with diverse institutional and individual perspectives gathered at the AMS's headquarters in Washington, DC, for a workshop designed to create a framework for updating the program review process and explore a possible "certificates of excellence" system. Workshop participants recognized the widespread lack of inclusive success among students in mathematical sciences courses, in spite of numerous diagnoses and proposed solutions, as being the key problem facing programs across the country. The program review process required by institutional accrediting bodies offers a mechanism for activating systemic change within the mathematical sciences. Based on workshop participants' review of dozens of institutional guidelines, five key elements were identified as necessary for inclusive excellence: inclusive program culture, engaged faculty, current and purposeful curricula, evidence-based teaching, and attentiveness to student learning, particularly in the first two years.

In November 2022, a smaller group of individuals convened at the MAA's headquarters: Ali Arab (Georgetown University), Ron Buckmire (Occidental College), Rick Gillman (Valparaiso University), Abbe Herzig (TPSE), Chawne Kimber (Washington and Lee University), Vicky Klima (Appalachian State University), Alex McAllister (Centre College), May Mei (Denison University), and Deirdre Longacher Smeltzer (MAA). Over a several-day period, this working group fleshed out the principles and framework established at the March meeting and generated a detailed outline to form the basis of an updated edition of the Guidelines.

Following the November meeting, Abbe Herzig crafted the first draft of this document, which subsequently was circulated to nearly 60 readers from across the country for additional input and feedback. Utilizing that feedback, Rick Gillman and Deirdre Longacher Smeltzer created a second draft which was shared with peer organizations of the MAA. Feedback received from those peer organizations was incorporated by the three to create this final version.

After review by the MAA's Committee on Program Review and Council on the Profession, these Guidelines were approved by the MAA Board of Directors in January 2024.

Richard Alan Gillman completed his undergraduate work at Ball State University and earned his Doctorate of Arts at Idaho State University in 1986. At that point, he worked at Valparaiso University until he retired and is currently serving as a Senior Research Professor. Over the years, he served as Assistant Dean for Sponsored Research and Faculty Development, was the founding director of VU's Celebration of Undergraduate Scholarship, was chair of his department, and retired serving as the university's Interim Provost. Rick has served as a program review external consultant for more than 20 institutions and is an active member of the Higher Learning Commission's peer corp. He is a former chair of the MAA's Committee on Program Review and is completing a term as chair of the Council on the Profession.

Abbe Herzig received her undergraduate degree in applied mathematics at Stony Brook University, a masters in Statistics from Yale, and a masters in mathematics and PhD in curriculum and instruction from the University of Wisconsin-Madison. As a member of the Education faculty at the University at Albany and at Rutgers University, her research documented policies and practices that support diversity and inclusion in mathematics. Abbe was the Director of Education at the American Mathematical Society and worked with the AAAS on the development of self-assessment tools for academic STEM departments, professional societies, and institutions to identify and address the impacts of their practices and policies on DEI. She then co-led the team that adapted this framework to create TPSE's COME-IN (Creating Opportunities in Mathematics through Equity and INclusion) resources. She currently teaches incarcerated students through the Bard Prison Initiative.

Deirdre Longacher Smeltzer completed a bachelor's degree in mathematics at Eastern Mennonite University (EMU), followed by an M.S. and Ph.D. in mathematics from the University of Virginia. Deirdre taught for four years at the University of St. Thomas (St. Paul, MN) before returning to EMU, where she served as faculty member, department chair, director of cross-cultural programs, and undergraduate academic dean. As academic dean, Deirdre developed an institution-wide program review process. In 2020, Deirdre joined the MAA staff as Senior Director for Programs, where she managed MAA's portfolio of externally-funded projects, the American Mathematics Competitions (AMC), and Project NExT. Currently, Deirdre is a visiting professor at a residential liberal arts undergraduate program located in southern Oregon. Her professional publications include two co-authored undergraduate-level textbooks, *Methods for Euclidean Geometry* and *Journey into Discrete Mathematics*.