University of La Verne

Mathematics Program Review

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Executive Summary

The mathematics program, which includes three full-time faculty and (currently) five part-time faculty, is one of the three programs, which collectively comprise the Mathematics/Physics/Computer Science Department. The department is structured as one academic unit within the Natural Science Division, which also contains the departments of Biology and Chemistry, although there are two separate budget lines within the Mathematics/Physics/Computer Science Department, one for mathematics and physics jointly, and one for computer science.

The University of La Verne also grants a B.S. degree in Mathematics at its Athens campus, where there is a mathematics program with a very small staff of full and part-time mathematics faculty who teach essentially the same courses as those provided on the main campus in La Verne. Similarly, a B.S. in Mathematics has been offered by ULV at the Pt. Mugu Naval Air Station for the past 20 years or more, at times graduating up to six students per year in mathematics. For various reasons the program was closed out two years ago, and the last remaining students are now graduating. This review centers only on the ULV main campus program.

The mathematics major requires 41-44 units for the B.A., or 45-48 units for the B.S., plus 10 units for supporting courses. The program also offers a minor. The mathematics program has been approved by the State of California for a Subject Matter Waiver for teacher credentialing. Although the number of majors in the program is small, the program offers significant number of support courses for other programs and for General Education.

The learning outcomes include (a) acquisition of fundamental grounding in a core of mathematics skills and attitudes which are transferable to any situation requiring problem-solving, synthesis and persistence; (b) preparation of mathematics majors to qualify to teach mathematics at the secondary school level or pursue other related career paths; and (c) the pursuit of advance degrees.

Assessment procedures include a comprehensive senior exam, the GRE Mathematics Subject exam, an Alumni Survey, a focus group of current majors and a review by an outside team.

Highlights of findings include:
1. On average, senior students pass the comprehensive exam at the 80th percentile with the minimum-passing criterion of 67th percentile. The performance on the GRE varies somewhat, providing a different perspective.
2. Faculty is on the most part knowledgeable, approachable and supportive. However, some faculty, full-time and part-time, could be more accessible, be more open to inviting student questions, and be more responsive to student needs.
3. Courses are challenging and prepare students well.
4. Greater emphasis may be put on applied aspects of the field and earlier advising of students on various career paths.
5. The program can use more majors to provide a stronger critical mass to offer advanced courses more frequently.
6. The curriculum could be tweaked to meet student needs and interest
7. Program could use an additional faculty member

Highlights of Action recommendations

1. Consider developing a mathematics internship.
2. Offer structured senior project seminar to help students integrate their learning.
3. Rethink the core requirements of the program to address the needs of the larger number of student who pursue the single subject credential.
4. Use senior projects as a tool for assessing student-learning outcomes at the program level.
5. Re-evaluate the appropriateness of the use of the GRE and the content of the comprehensive exam.

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OUTSIDE TEAM REVIEW

Introduction and Brief Overview of the Department Structure

This document presents a detailed examination of the mathematics program at the University of La Verne. The mathematics program, which includes three full-time faculty and (currently) five part-time faculty, is one of the three programs which collectively comprise the Mathematics/Physics/Computer Science Department. The department is structured as one academic unit within the Natural Science Division, which also contains the departments of Biology and Chemistry, although there are two separate budget lines within the Mathematics/Physics/Computer Science Department, one for mathematics and physics jointly, and one for computer science. (See Table 9 for more detailed budget information). This is largely a holdover from an earlier era when the computer science program was housed within the American Armenian International College (AAIC), which is no longer in existence. It should be noted that the ULV administration refers to the Natural Science Division as both a "division" and a "department", depending on who is doing the referring and in what context, but the science faculty themselves refer exclusively to their academic unit as a "division".

Within the Mathematics/Physics/Computer Science Department, the program chairs of Physics and Computer Science (Sarah Johnson and Seta Whitby, respectively) report to the department chair (Michael Frantz), and the department chair reports to the Natural Science Division Chair (Robert Neher), as do the chairs of the biology and chemistry departments. Although this description sounds quite formally regimented and segmented, in point of fact, the natural science faculty all work very closely with one another with regard to both academic and budgetary issues, meet formally once a month as a division, and in general constitute the most collegial and cooperative faculty group on campus. The Mathematics/Physics/Computer Science Department faculty also meet separately on a monthly basis to handle department issues, and each of the three academic groups within the department meet frequently on an informal basis to discuss needs for individual programs.

The University of La Verne also grants a B.S. degree in Mathematics at its Athens campus, where there is a mathematics program with a very small staff of full and part-time mathematics faculty who teach essentially the same courses as those provided on the main campus in La Verne. This program is considered as a part of the main campus program, and as such is subject to all regulations and policies established by the main campus faculty, although in reality any major (and even minor) changes in policy are done in conjunction with the approval of the Athens faculty. Similarly, a B.S. in Mathematics has been offered by ULV at the Pt. Mugu Naval Air Station for the past 20 years or more, at times graduating up to six students per year in mathematics. For various reasons the program was closed out two years ago, and the last remaining students are now graduating. This review will center only on the La Verne central campus program.

Mathematics Program Mission Statement

Mathematics is a universal language, a part of the common base of knowledge through which people of different races, nationalities, and cultures can communicate.

While acknowledging that some students may never make use of all of the specific mathematical techniques learned in our courses, and others will use very few techniques, we also recognize that mathematics has historically been a central part of the liberal arts. The educated person studies mathematics for the discipline it brings to one's thinking and because knowledge of mathematics enables one to better comprehend an increasingly technological world and to understand those who speak the scientific languages of nature and technology.

In our liberal arts mathematics courses for non-majors, we emphasize basic skills, as well as applications of mathematics in various career areas. An underlying philosophy of our teaching is that students enjoy more, and derive more benefit from, that which is fun, and well as from that which they clearly see a need to investigate.

In all of our courses we try to foster an appreciation of the beauty of mathematics and to demonstrate the nature of human searching for patterns and order in the world.

By upholding certain standards while remaining sympathetic to the difficulty many students have in mathematics, we stress ethics and disciplined study, as well as humanity.

In small classes and directed studies, we encourage students to take on increased responsibility for their own education, to seek knowledge actively, rather than to receive it passively.

Those who major in mathematics may not spend their lives as professional mathematicians, so we teach skills and attitudes which are transferable, which will serve students well in any situation requiring problem-solving, synthesis and persistence. We encourage students to wonder and ask not only “how?” but also “why?” At the same time, we provide a solid grounding in a core of mathematics, to enable those who are singularly motivated to pursue graduate studies.

Many ULV mathematics majors are motivated to serve society through teaching, while others have taken technical positions in industry. Many mathematics majors also seek a second area of concentration. Recent graduates have done significant course work in biology, computer science, economics, physics, and even psychology.

In consideration of the diverse group of students at our University and in the mathematics program, we actively seek to fit our instructional and assessment methods to the needs of the individual student. The department attempts to recruit and maintain a diverse faculty. The mathematics major, as well as the teaching credential program, are reviewed each year to keep the programs current and consistent with national and state guidelines.

Departmental Purpose and History

The mathematics program serves three primary purposes within the university. The vast majority of resources are committed to providing service courses for other academic units. Listed in approximate order of decreasing amounts of resources required, these would include: College Algebra and Mathematics in Society classes for mathematics graduation requirements in general education (as well as their prerequisites, Intermediate Algebra and Math Workshop); Precalculus, Calculus I and Calculus II courses for biology, chemistry and computer science majors; Mathematical Methods for Business and Economics for various majors in the School of Business and Global Studies; and a mixture of lower and upper division courses for students pursuing an education degree with a concentration in mathematics which will allow them to teach mathematics up through the middle school level.

The second purpose served by the mathematics program is in preparing mathematics majors who will be qualified to teach mathematics at the secondary school level, whether by completing a Subject Matter Program in Mathematics at ULV which has been approved by the state (see Appendix H), or by completing a B.A. or B.S. degree in mathematics and subsequently passing the state CSET exams. This group of students constitutes by far the largest component of the mathematics majors.

The third purpose of the program is to provide a small subset of the mathematics majors with adequate preparation to either continue on in graduate school with advanced studies in mathematics, or to directly enter the job market in many types of technological or corporate settings in industry. The number of students pursuing advanced degrees in mathematics (master's level) in the past 20 years is seven, or about one every three years.

In terms of the history of the department, there was only one full-time mathematics faculty member up until 1982, when one more was added, and then there were two until 1992, when a third was added. As will be observed elsewhere in this document, the need for a fourth member is perhaps the most pressing need within the program. The department has always included the mathematics and physics programs jointly, and in 1993 the computer science and computer engineering programs were added (when AAIC left the university) to form the present Department of Mathematics, Physics and Computer Science.

Faculty Information

Biographical Profiles (full-time faculty)

The Department Chair, Michael Frantz, has been at the University of La Verne (ULV) since Fall, 1983, has held the Department Chair position since Fall, 1994, and is a full professor. His research interests lie in the areas of environmental/conservation/wildlife modeling, atmospheric modeling, biomathematics, applications of fluid dynamics to fuel cell technology, and an emerging interest in the intertwining of mathematics, art and music, developed over the past two years through a series of honors seminars and an advanced general education core class team-taught with an art professor. Rick Simon has been at ULV since Fall, 1982 and is being considered for promotion to full professor this spring. His research interests lie in the areas of statistics and mathematics education. Xiaoyan Liu has been at ULV since Fall, 1992 and is also being considered for promotion to full professor this spring. Her research interests lie in the areas of interpolation and approximation theory and wavelets. Full details of the backgrounds of the faculty can be found in their curriculum vitae listed in Appendix A. In terms of diversity, the full-time faculty include two Caucasian males and one Chinese female; currently the part-time faculty include three men and two women.

Faculty Load

Current standard faculty load is 24 semester units per year. Since virtually all mathematics courses are 4 units each, this is usually seen as 6 courses per year. The normal load would be three or four courses per semester (with four being considered an overload course), or perhaps two in one semester and a January course for the sixth one. History of Mathematics is taught every other January, and Mathematics in Society is offered every January but does not always receive enough enrollment to actually be taught. These are the only two courses we have at the moment which we feel are manageable by students in doses of four hours of mathematics per day for 15 days in a month. The department chair receives a one course release and $1500 annual stipend for his additional duties as chair. At the moment, there is a controversy brewing about faculty loads, due to changes in the general education program in 1995. In that year, general education was broadened and many of its courses reduced to three hours to accommodate the added courses, including special interdisciplinary courses team-taught by two professors in the classroom at the same time. As an incentive for professors to become involved in this team-teaching, load credit was given to each faculty member for four units for these three unit courses. Over time, many departments restructured to three units from a university standard of four units, even their major courses, and still received a four-for-three load credit, although this was an abuse of the system as it was initiated. These abuses have come under public scrutiny in the past year, and there is a lot of smoke and heat and motion about making changes, but just what form those will take is not known, as there seems to be a lot of resistance from some faculty to returning to a 24-unit standard, even though the science faculty have been adhering to that all along.

Another issue with faculty loads is that 24 units is normally regarded as a full load at institutions where only teaching is expected, i.e., it really leaves no time for research and publishing efforts, while at the same time expectations for research and scholarship are being ratcheted up without accommodations being made for the extra time this will take. This is of serious concern to any faculty wishing to involve themselves in research and scholarship outside of the classroom.

A final load issue dovetails with the previously mentioned one to just about make it impossible to find the time to do scholarly mathematical work: low salaries. The salaries of the faculty are low enough (in an area with a rather high cost-of-living) to make many faculty (including in mathematics) feel obligated to take on overload courses to help pay the bills (see Table 8). This of course takes precedence over the need to use the time for scholarly mathematical work, particularly when in the past the actual requirements for tenure and promotion have been so vague. Compounding the issue is the need to cover all the upper division courses with full-time faculty, to have full-time faculty involved with at least one general education course per semester, and to provide team-teachers for interdisciplinary core general education or honors classes. In a nutshell, without an additional full-time faculty member, it is impossible to cover all the bases that need covering without full-time contracting for overloads. This adds considerably to the stress and strain of mathematics faculty lives, leaving no time for the reflection and serious quiet downtime necessary to do mathematics research, and even keeping faculty on the edge all the time, working in a "just got it done in time" mode, whether it be preparing for class, grading papers, working on new class projects, or completing paperwork for committee meetings and department assignments. Yes, it is probably this way for faculty at schools all across the country, but with smaller teaching loads, and larger salaries.

Scholarship and Research

The amount of scholarly and research activity varies widely within the mathematics program, and is in no small part due to the content of the university document (PEPPIT) regulating the minimum standards in scholarship and research for tenure and promotion. The relevant passages read as follows:

> "teaching effectiveness, including academic advising, constitutes the single most important, though not the only, basis for evaluating professional experience for reappointment and for promotion to the ranks of assistant and associate professor. For promotion to the rank of full professor and for tenure a high rating in teaching performance is required, but the faculty member must also have made significant contributions in at least two other performance areas. In evaluating faculty the performance areas listed in IIIB.7 shall be considered."
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> [Note: IIIB.7 includes: teaching effectiveness (with 8 descriptors), scholarly competence (with 7 descriptors), service to the university (with 4 descriptors), and service to the community (with 5 descriptors). In particular, considerable latitude has traditionally been given in the interpretation of what constitutes scholarship.]

The university has traditionally (for over 100 years) regarded itself primarily as a teaching institution, priding itself both on the teaching quality of its faculty and its ability to produce graduates who will become teachers par excellence. In the past, there has been little or no incentive (or even support) for those faculty who aspire to conduct research in their fields. The past few years has seen the beginning of a sea change in those attitudes toward more encouragement, support, and specific incentive for increasing the amount of scholarship and research carried out by all faculty. This was spearheaded by a group of faculty, and slowly (almost reluctantly) picked up by the administration, but has now reached the point where all departments have been required to submit detailed minimum standards within their disciplines for research and scholarship as applied to consideration for tenure and promotion. These are now being reviewed by the Faculty Personnel Committee for consistency and appropriateness. The proposed policy for the mathematics program is listed in Appendix C. The policy makes it clear that future mathematicians hired at ULV will have expectations for research and scholarship much more in line with perceived expectations at other colleges and universities. Although it does not apply to current faculty, there is the very real hope that it will serve as encouragement to all existing faculty to recognize the importance and value of maintaining a significant research and scholarship program, for personal growth, for the benefit of the students, and for the benefit of the university overall in terms of the image presented to peer institutions, public and private granting organizations and foundations, and the public at large.

The effect of little or no research being required for 100 years manifests itself in the mathematics program in a wide variation of activity which is more dependent on personal ambition than motivated by university standards. Some faculty (in the mathematical sense of one or more) attend professional meetings and workshops (including local, national and international), present contributed papers, have papers published by peer reviewed journals, apply for (and have received) external and internal grant monies, engage their students in their own scholarship, and play a significant role in local and national professional organizations. Some of these activities are undertaken by faculty on a regular basis, some on an occasional basis, and some rarely or not at all. Details are available within faculty vitae in Appendix A. One member has been very active in grant solicitation, and hopes to be successful with a second submission this spring of a CSEM grant for scholarship funds to attract students from underserved populations into mathematics and computer science. A grant was obtained in 1991 from the Michael and Margaretha Sattler Foundation for four copies of Mathematica as a seed for possible expansion into the curriculum for that software. The department has since focused more heavily on Derive for financial and pedagogical reasons.

In addition to a greater expectation in the future for scholarly activities, grant writing would also appreciably benefit by the university procuring or dedicating a staff member to identifying funding sources and assisting in the writing of grant applications. Currently those tasks are taken on as “extracurricular activities” of a person in the Alumni Development office.

Overall, the perception is that expectations and actual performance in scholarship and research in the mathematics program are substandard to where they ought to be, but that until relief is obtained both from the heavy teaching loads (24 units per year) and from the perceived need to teach extra units to supplement salaries which are below the mean of peer institutions, it will be difficult to translate desires and expectations for more scholarship and research into actual accomplishment of these goals.

Teaching and Evaluation

Teaching performance of the faculty is evaluated in several ways. Every faculty member is required to distribute official university course evaluation forms within the last two weeks of every course (see Appendix D). These surveys have both numeric data and written free responses. Beginning in the fall of 2002, the survey instrument was made available online in order to make collection, transcription and return of data to faculty both easier and faster. In this case, results are made available to faculty within a few weeks, otherwise it takes several months to get results back. Many faculty have yet to adopt the new method for fear of biasing the results, as students may fill out the forms on the web at the time and place of their choosing, rather than in a controlled environment. The mathematics and physics faculty are rather skeptical to date, and the matter is an ongoing concern in the university as a whole. An additional concern is that the university officially only distributes these evaluations to classes of size seven or larger, and since many upper division mathematics classes may be smaller than this, they are only evaluated if the instructor makes a special request for the forms, which does not always happen.

In addition, all faculty (both full-time and part-time) in the Mathematics/Physics/Computer Science Department are required to administer an unofficial midterm class evaluation devised, distributed and analyzed by the department around the middle of each term. These forms (see Appendix D) are returned directly to the instructor the same day, evaluated, and discussed with the class at the next class period, after which they then go to the department chair, who consults with each faculty about them.. In this way the faculty hope to be able to spot problems cropping up in the classroom early enough to be able to address them in the current class, rather than waiting until the middle of the next term for the results of the official evaluations to come back, long past the point when anything could be adjusted to affect the actual students writing the evaluations. The department has found this highly successful, particularly with new faculty and in “problem courses” or with faculty who tend to have a higher degree of student dissatisfaction.

Peer review visits are another tool used in evaluating faculty in the classroom. The Dean of the College of Arts and Sciences generally makes one classroom visit in the fall of the year when a faculty member is up for promotion or tenure, as does the department Chair. Department faculty are encouraged to visit each other’s classrooms (on either a formal or informal basis), and the division chair has agreed to fund lunch for both parties to discuss the results afterward, although this seems to be a rare occurrence thus far.

The teaching quality of the full and part-time faculty ranges from exemplary to marginal. The overall quality is quite good, but there are problem areas which re-emerge periodically in both the full and part-time arenas which, if dampened out, would contribute positively to the overall image of the program.

Advising and Counseling

All advising of mathematics majors is in theory done by one of the three full-time faculty, although there are occasions when a freshman may be advised by the Advising Office staff if no program faculty are available in the summer. In practice, there are still the occasional students floating around on campus who are seen by other advisors even though they profess to be mathematics majors. The biggest stumbling block to correcting this problem is the fact that there is no official enforced administrative method for students to declare their major until their application for graduation at the end of their junior year. Advising loads vary from a few to perhaps fifteen advisees over the three full-time members of the department, and are determined in two ways: either new students (or students transferring into the mathematics major from other majors) are handed to the department chair, who designates an advisor, or else students self-select their own advisor from a choice of three, based on personal experience. No part-time faculty are involved in academic counseling, and the full-time faculty are often involved in summer counseling of non-majors as well. All are well-informed about advising and academic policies for graduation as well as within the major, and all are capable of doing an excellent job of advising. The department holds this activity to be extremely important, and thus is understandably frustrated when confronted with students who show up claiming to be mathematics majors but who have been ill-advised by others for one or more semesters. The school is on the verge of moving to online registration, and it is crucial from the viewpoint of the department that a way be found to guarantee that a student meet with an advisor and discuss options before selecting courses online.

Part-Time Faculty

The bulk of the general education mathematics courses for non-majors are taught by part-time faculty. The minimum academic qualification for a part-time teaching position at ULV is a master's degree in mathematics, although graduate students who are close to graduating have frequently been allowed to teach, with very good results. The number of part-time mathematics faculty fluctuates between five and seven, depending on the semester (spring is lighter than fall enrollment-wise), the number of overload units that full-time faculty are prepared to take on, and the loads that the part-time faculty can handle in a given semester. Somewhere around 60% of the mathematics units taught are handled by part-time faculty, at a pay rate of $2500 for a standard four semester hour course. The department feels that this ratio needs at the very least to be inverted, if not brought down to the 20% or lower range (ideally, 0%, of course). Although some part-time faculty are very dedicated in the classroom and excellent teachers, their time

resources are limited, and they do not have the connection and loyalty and dedication to the university as a whole that full-time faculty do, not to mention the readily available access of full-time faculty. It is unfortunate that the vast majority of student experiences at ULV with mathematics will be with part-time faculty through general education courses, simply because the skills and experience of the full-time faculty are needed to deliver the more advanced courses. The department has made appeals for four or five years now to add a full-time position, but has been turned down for budgetary reasons every year (see the latest proposal for a new full-time position in Appendix E). The department will continue to plead the case to reduce the part-time / full-time ratio, but the prospects for the immediate future look bleak.

Equally troublesome is the forecast for our ability to attract qualified part-time mathematics faculty in the future. Some years ago when the standard salary for a four unit course was $1900, mathematics instructors were given special dispensation to be paid $2500. With the standard salary now at $2200 and competitors paying $3500 to $4500 for the same work, ULV salaries look dismal by comparison. We have already lost some of our best people to higher-paying jobs, but the administration shows little promise of significant improvement in this area, and it is an issue of grave concern.

Overall Program Review

General Education Course Offerings

As noted previously, one of the primary roles of the department is to provide support for the general education curriculum. The university has a general education graduation requirement of a minimum of College Algebra or Mathematics in Society (which can also be met by Precalculus, Mathematical Methods for Business and Economics, Calculus I or Calculus II). Both College Algebra and Mathematics in Society have a prerequisite of Intermediate Algebra, which is a thinly disguised high school algebra course. The department has tried to designate the course as not acceptable to count toward graduation units, but the best we have been able to do is to label it so that it can be taken only for credit or no credit, and not for a letter grade.

The exception to this is the School of Continuing Education (SCE) adult education degree program, which allows statistics (taught outside of the department) to be used for meeting the mathematics requirement. This has long been a bone of contention with the mathematics faculty, since the level at which it is taught is much lower than College Algebra, as evidenced by the fact that it has no mathematical prerequisites, and in fact is taught by at least four different departments: Behavioral Science, Psychology, Health Services Management, and Economics/Business (the last department does have appropriate prerequisites). The mathematics faculty have attempted to change this in the past, only to be rebuffed by cries that the adult students will all go somewhere else for their degrees if mathematics at the level of College Algebra is required. The battle is ongoing. The department chair has firm plans to develop a new mathematics course in summer of 2003 called Elementary Statistics, which would have Intermediate Algebra as a prerequisite and would be taught at the mathematical level of College Algebra. The course would emphasize hands-on data collection, real (large) data sets, and the use of technology for data analysis. It is hoped that this course could be developed in consultation with other departments and so meet their individual departmental needs for statistics while simultaneously allowing the students to meet the mathematics graduation requirement. An effort would also be made when the course is introduced (presumably in spring of 2004) to have it be the new graduation general education requirement even for SCE students.

Although the primary course taken by students to satisfy the mathematics graduation requirement for general education is College Algebra, the mathematics faculty have offered another course for some ten years, Mathematics in Society, which they unanimously feel is a much better “fit” for students taking a terminal mathematics course to prepare them for life as an informed citizen. The course started out with enrollments large enough to mostly fill two classes each semester, but in recent years the enrollments have dropped to one small course in fall and not enough for even one course in the spring. The cause of this seems to be a perception by the students, other faculty, and advisors that the course is “all word problems” and that it would be easier to get through College Algebra, which for most is at least 75% a re-hash of a decent high school algebra course. The text used has always been For All Practical Purposes, published by COMAP;

a detailed syllabus is available in the addendum which includes all syllabi. Each and every one of the faculty are excited to teach the course, as it allows us to talk about concepts that are relevant to student lives right now and that appear in the news as often as once a week. Most students that actually get into the course discover that it is fun, useful, and yes, a lot of work as well (usually including a research paper or survey project, depending on who is teaching it). An effort was made several years ago to get the word out to advisors about how much more appropriate than College Algebra this course was for almost all non-science and non-business majors, and for a year or so, enrollments showed an increase, but have since dropped again, and nobody has the energy to go out and flog the course to the students and advisors and faculty every semester. Suggestions are welcome. One thought is to simply let it die a quiet death, and try to build interest in the new statistics course to be made available soon, but we do all love to teach it and feel strongly that if a student had to take just one mathematics course before graduating, that in most cases Mathematics in Society is very much more appropriate than College Algebra. The new proposed MAA standards appear to address this issue as well.

Supportive Course Offerings for Non-Mathematics Majors

Non-mathematics majors taking mathematics courses fall into the two categories of science and non-science. Non-science students generally do not take any mathematics courses beyond College Algebra, with two exceptions. The business/economics students are required to take Mathematical Methods for Business and Economics, a course which has gone through several evolutions over the past 20 years, and has been at the foundation of a struggle between the mathematics and business programs which seems to finally have been successfully ended. The business program has always required a mathematics course of some kind, but taught by their own faculty because they felt that the mathematics faculty raised the mathematics bar too high and did not understand the business applications well enough. Since the course that business taught never had any mathematical prerequisites, and was often taught by faculty with very little mathematical expertise, it was never certified by the mathematics faculty as meeting the mathematics graduation requirement. At various times in the past two decades, courses have been revised, and agreements have been made (and broken) to use mathematics faculty to teach the business math courses. In the most recent development, with a push for a greater quantitative emphasis in their graduates than ever before, the new Dean of the business school, with the business faculty obviously requiring very little from their students mathematically, has handed control of the Mathematical Methods for Business and Economics course over to the mathematics faculty, assuming they will work in consultation with certain business faculty to be sure that their application needs are being met. This goes into effect in the fall of 2003, and if it bears up in the future, will prove to be a happy ending for a longstanding Hatfield and McCoy's type feud.

The other exception to the above non-science description is in the Liberal Studies program, which prepares students to teach at the K-8 level. Liberal Studies majors electing a mathematics emphasis take a number of courses from options including

Mathematics in Society, Calculus I, Discrete Mathematics, Foundations of Geometry, and History of Mathematics. In the old Liberal studies program which is being phased out, the courses also included Calculus II and Probability. This caused problems, in a class like Probability, which is designed for mathematics majors, because of the bimodal distribution of talents. With changes in the Liberal Studies program going into effect this year, that challenge will hopefully be ameliorated.

The mathematics program also provides support for the biology, physics, chemistry and computer science programs. Of these three, the mathematics requirements are the weakest for the biology majors, where only Calculus I is required. The perception among mathematics faculty is that this is not sufficient to prepare biology students for careers today in a world where mathematics and biology are becoming increasingly interdependent. At the same time, the biology students often give poor showings in Calculus I, and with a few exceptions, the biology faculty do not seem eager to embrace integration of more mathematics into their courses.

Physics requires the most mathematics of their majors, namely, Calculus I, II and III. Arguments could be made for differential equations and vector calculus also being appropriate supporting courses for that major, since a fair amount of the content of those two courses is already built into required physics courses; having the physics students learn it in mathematics courses would free up more time for delving more deeply into the physics content.

Chemistry is somewhere between biology and physics, requiring "competency in mathematics (or Calculus I and II)". Some years back, they had required Calculus III as well, but dropped it without consultation with the mathematics faculty because it apparently was creating too high of a hurdle for the chemistry students. It should be noted, however, that some physical chemistry students asked one of the mathematics faculty for help recently on homework, and were working from notes in class which could have easily been taken out of the second half of a differential equations class, so it is not clear that there is a valid reason for reducing the mathematics requirement.

This is a good place to point out that the Calculus II-III curriculum at ULV has a distinctively different sequence flavor than at almost all other schools, for historical reasons. The current sequence of topics, set over twenty years ago, moved partial derivatives and some three-dimensional topics into Calculus II because a number of students would need them in physics and chemistry. (Back then only Calculus I and II were required.) Polar coordinates and infinite series were moved to Calculus III were, while topics and theorems of vector analysis are now in Vector Calculus. As a result, courses like Calculus II and III at other schools rarely articular exactly with our MATH 202 and 311, but we make do. Several times in the past five years we have thought to revamp the sequencing, but again, we seem to be so overloaded that nobody ever has the time to follow through on it.

Finally, the Computer Science majors all take Calculus I and Discrete Mathematics, and

additionally, Calculus II for the Engineering and Software Concentrations, and Probability and Numerical Algorithms for the Web Computing Concentration.

Course Offerings for the Mathematics Majors

The "standard" mathematics major would begin by taking the Calculus I and II sequence the first year, then Calculus III the fall of the second year, at which time they could also start taking additional mathematics courses concurrently with Calculus III. The actual requirements for the major (and minor) are listed in Tables 1 and 2. Table 3 offers a look at all courses currently offered, how often they are offered, prerequisites, and text used. Table 4 lists where each course fits into a two year cycle, as most upper division (300-400) courses are taught only every other year, due to small enrollments, and some are offered only on a directed study basis. Table 5 shows suggested four-year schedules for mathematics courses for majors, depending on what semester they take Calculus I, and taking into account the scheduling of upper division courses every two years. Table 7 lists enrollments for mathematics classes over the past nine years. As a look at Table 1 will indicate, mathematics majors all go on to take Transition to Advanced Mathematics (newly required as of Fall, 2002), C++ (and a prerequisite programming course if necessary), Linear Algebra, and then for a B.A. have a choice of Vector Calculus or Abstract Algebra, and Number Theory or Probability, plus two more electives. For a B.S., the additional courses include Differential Equations, Abstract Algebra, and three more electives. All mathematics majors must complete a senior project and pass comprehensive exams in mathematics, and take Engineering Physics I and II with labs as a supporting requirement (also newly required as of Fall, 2002).

Although on the surface this program does not seem to be terribly stringent, it does pose great difficulties for many of our mathematics majors. We have only had 37 mathematics graduates from the main campus since 1984, averaging about two per year, and while some of these have been stellar students and have gone on to graduate work and/or highly skilled positions, others have only made it through by re-taking courses and the comprehensive multiple times. The greatest difficulty for the faculty lies in providing a curriculum for mathematics majors with only three full-time faculty and upper division classes of size two to seven that simultaneously prepares students to be high school teachers of mathematics, prepares them for work in industry, and prepares them for graduate study in mathematics. Clearly, something has to suffer in this mix, and for the most part it is the students heading on to graduate school, who blessedly are the ones most capable of independently making up for our shortfall in courses. As mentioned elsewhere in this document, such students are encouraged to take a baby analysis course or topology course or complex analysis course independently in their last year to help prepare them adequately.

Students wishing to teach mathematics in high school have a choice of completing a mathematics major and then passing the CSET exams, or taking a prescribed set of courses above and beyond the content of the major (but approved by the state of California), thereby exempting themselves from the CSET exams (see Appendix H). It

should be noted that three of those courses required by this program (Mathematics Field Experience, Foundations of Geometry, and Statistical Theory) are currently offered on a directed study basis only, i.e., the student does not attend a class, but rather works on homework independently, consulting with the faculty member as necessary, and taking exams at times chosen jointly by the student and faculty member. Many students attempt courses in this fashion; none finish without time extensions, and relatively few finish at all.

In addition to the fact that upper division courses (other than Calculus III) are only offered every other year, a look at the mathematics course listings in the university catalog is somewhat deceptive in that Mathematics Field Experience, Foundations of Geometry, Statistical Theory, Numerical Algorithms, Topics in Applied Mathematics, Real Analysis, Complex Analysis, and Advanced Engineering Math are only offered on a directed study basis, simply because enrollments do not support offering them in the classroom, even with a minimum class size of two and offered every other year. The administration has been flexible enough to allow the program to offer advanced courses ever other year with enrollments as small as two, when the minimum number is supposed to be seven, if the courses are part of a requirement for the major. A new dean for the College of Arts and Sciences is in the process of being hired, so the future status of that flexibility is unknown.

Curricular weaknesses that might be pointed out in the program could possibly include the lack of a requirement of Real Analysis (Advanced Calculus?), Probability, and Statistics for all students.

Assessment for Placement in Mathematics Courses

All entering freshman and transfer students go through a placement testing process to determine what the appropriate mathematics course is for them to register in. The placement exam used was originally a part of the ELM placement process used by the Cal State schools, but it has not been upgraded since it was instituted over 15 years ago. For several years, although the tests were administered to students entering Intermediate Algebra and College Algebra, the students still self-selected which courses they thought they were ready for. Based on the correlation between the placement test scores and the actual grades received by students in the two classes, cut-off points were determined in a minimal sense, e.g., in the "A" test of 40 questions, virtually no students who got fewer than 17 right were able to pass College Algebra, so students need to score 17 or higher to take College Algebra (or pass the prerequisite course of Intermediate Algebra). This does not guarantee that students who score 17 or higher will pass College Algebra, but it indicates that they have a fair shot at it. Students scoring between 10 and 16 take Intermediate Algebra, and students scoring below 10 take a "C" test which further determines whether they are ready for Intermediate Algebra, or should take Math Workshop (not applicable toward graduation). A similar "B" test determines whether students are ready for Calculus I or Precalculus. Students self-select to take the "A" or "B" tests, depending on whether or not they wish to eventually take precalculus or calculus.

At the time this test was instituted, other placement tests were available from the MAA, but the department could not afford the cost. It is probably time to take a hard look at the entire placement system, with an eye toward standardized national tests and computer administration of the tests, as cost is less of an issue, administrators are clamoring for the convenience of online placement testing, and there are too many cases of students finding a course “way too easy” or “much too difficult”. In all fairness to the tests themselves, students seem to be ever more creative at finding ways to talk the registration personnel into “overriding” the prerequisite requirements. (I just finished Intermediate Algebra at a JC but the grades haven't posted yet", etc.) The mathematics faculty have complained numerous times to the registrar about students slipping through the process and being detected only by "hand auditing" by the department chair of the Banner system which stores all student records, a painfully slow and tedious process.

Assessment of Graduates

Mathematics majors must complete a senior project during their last year, and take a pair of comprehensive exams. The senior project can take one of several forms. Some students opt for a project which consists of exploring a branch of mathematics which has piqued their interest, perhaps being mentioned obliquely in a course, and that stimulates them to want to investigate more on their own. The product is a paper of significant depth and breadth of mathematical content regarding the results of their explorations. Other students who wish to go on to graduate school find that a particular course is missing from their undergraduate experience, like real analysis, complex analysis, or

topology, and they are encouraged to basically work through one of these courses on their own as a directed study or independent study, depending on whether the course is listed in our catalog or not. Some students who are headed for careers in mathematics education wish to work on a project which will prove to be of value in their future jobs, and so write a research paper regarding some relevant aspect of mathematics education. Finally, what might be the most desirable type of senior project but which is the most rare in reality, is for a student to select some sort of problem of interest (in concert with an advisor) and apply mathematical knowledge gleaned from multiple courses in order to achieve some type of solution to the problem, which would quite often and appropriately be some type of applied mathematical modeling problem rather than a pure mathematical problem. A database of past senior project titles and abstracts would be useful for current and future students to give them a better feel for our expectations, but that has not been assembled at this point.

An oral presentation of the senior project is required in a public setting, currently an arranged audience of mathematics majors and mathematics faculty (and any interested physics or computer science faculty), but ideally as the culmination of a senior seminar-type class which has yet to materialize, due to the small number of majors in any given year.

Senior comprehensive exams are required: both a two hour departmental exam, revised from a standardized exam developed by Kalamazoo College, and the Advanced GRE Subject exam in mathematics; students must perform at a satisfactory level (as defined by the department) on at least one of these exams. Twenty years ago, the only exam required was the GRE Advanced Subject Exam in Mathematics. It was felt that that exam should be retained in order to have a baseline reference for future mathematics students with past graduates, but that it really was not the most appropriate exam in content for ULV students since less than 20% go on to graduate school. At the time, Kalamazoo College had come out with an exam for mathematics majors which had 60 multiple choice questions on precalculus (7 questions), calculus (33 questions), abstract algebra (10 questions), and linear algebra (10 questions). For a small fee they provided scoring and norming services with the results from some 200 other schools around the country who also were using the exam. They had created the exam after ETS stopped distributing and supporting a national exam for mathematics undergraduates. Our students average at about the 80^{th} percentile, and we do not allow them to pass with scores below the 67^{th} percentile (they can repeat it after six weeks, and six have had to, over the years). Even this exam is too general to really test our students on a lot of the coursework they have had, so periodically there are conversations within the department about coming up with something better, but for lack of time, nothing happens.

As previously mentioned, the GRE exam is retained to give the department a baseline for performance dating back as far as 30 years, even though most of our students do not attend graduate school. Students average around the 27^{th} percentile, with top students getting into the 60's and 70's, and intermediate students in the 30's and 40's. The departmental exam also serves as insurance that when a student returns a GRE score of

5th or 8th percentile, which a few have, we still have some way of measuring that they are leaving the school with some minimal acceptable amount of mathematical knowledge.

Appendix F has a summary of assessment procedures now in place.

Success of Graduates

Although it is difficult to know exact numbers, the latest information obtained from various sources shows that since 1984, mathematics has approximately 37 graduates from the main campus in La Verne, about 128 from the Pt. Mugu Naval Air Station campus, and 20 from the Athens campus. Little to nothing is known about the alumni that are not graduates from the main campus. Of the central campus graduates, three are high school teachers in the Mathematics Department of South Hills High School in Covina (including the department chair there), approximately 12 others are teaching in various high schools around the state or country, one is employed at JPL, one at an environmental engineering firm, one works in information technology for San Bernadino County, one is a troubleshooter for IBM, one is a university mathematics part-time instructor, one is high up in management at U.P.S., one works for the L.A.P.D. Probation Department, one works in a printing shop, one in a computer technology company, and it is not known how the rest are currently employed.

Seven graduates have obtained master's degrees in mathematics, from Cal Poly San Luis Obispo, Cal State Fullerton, Claremont Graduate University, University of Wisconsin at Madison, Iowa State University, and the University of California at San Diego. Only one graduate has earned a Ph.D., from the Claremont Graduate University.

Leadership by the Department/Program Chairs

The Math/Physics/C.S. Department Chair position is appointed by the Dean of the College of Arts and Sciences, in consultation with the other members of the department. Although the formal term of appointment seems to be three years, the previous chair served for some 25 years, and the current chair seems destined to serve until he resigns from the position or the dean or department members deem it necessary and appropriate to change, whichever comes first. The chair convenes the monthly meeting of the department, which includes physics and computer science members, to deal with issues relative to students, classes, programs, faculty, curriculum, and endless administrative inquiries, demands and paperwork.

The three program chairs for mathematics, physics and computer science individually take care of most of the day-to-day nuts and bolts operations within their programs, but that department structure at times makes it difficult to make the most efficient use of meeting times. At the monthly department meetings, there are often issues which need to be discussed which may only pertain to one of the three disciplines and hold little interest for the other faculty, but require the participation of and input from the department chair. In computer science and physics, since these programs have only two full-time faculty each, it is a relatively simple matter for the program chair to talk with the one other faculty member, and then consult with the department chair as necessary, but it is more difficult with three faculty in mathematics to get together to discuss concerns of a purely mathematical nature, especially considering that because of wide variations in schedules and labs and class and committee meeting times, it is almost impossible to find even one

90-minute period per month for all seven department members to get together. The organizational lines are further blurred by the facts that (1) mathematics and physics share the same budget line, which is separate from the computer science budget line, even though the department chair holds authority over all budgets, (2) the university administration considers all the natural sciences as the Natural Science Department rather than Natural Science Division (composed of the Biology, Chemistry, and Math/Physics./C.S. Departments), and (3) only the Natural Science Division chair is invited to the monthly department meetings convened by the dean. Consequently, when information or requests are sent out to the "department chairs", one never knows if it has gone to all three program heads, or just the division chair, or the real department chairs. Confusion reigns and drains more time from faculty that could be put to more productive uses.

One notion that has come up for discussion is the possibility of breaking the department into two or three individual departments, and although there would be positive aspects in that, there would also be negative ones, so it is a step that has been considered cautiously, but probably deserves to be looked at every year or two.

Finally, since the department chair is also the program chair for mathematics, he is responsible (in consultation with the other mathematics faculty members) for generating the annual strategic plans for the mathematics program, the last six of which are catalogued in Appendix B

Relationship of the Program to other Departments/Programs

The mathematics faculty is in frequent dialogue with faculty in other disciplines that it supports, as indicated in the earlier section on supportive course offerings for non-mathematics majors. They try to be very responsive to any requests for modification to courses, but of course need to maintain certain curricular standards so that standard courses will transfer without problems. A concerted effort by mathematics faculty to sit down and have lunch with other science faculty to discuss how we might be able to improve our curriculum for them would probably be a wise move, even though it is quite likely that most of them feel that they could approach mathematics faculty at any time to discuss such things.

The recent collaboration between business and mathematics faculty has already been noted. Last year, the mathematics faculty instituted a requirement of two semesters of calculus-based physics with lab for the mathematics majors, which will help the physics program to strengthen their enrollments for those courses as well as better prepare the mathematics majors, and in a symbiotic move, the physics faculty are strongly considering requiring differential equations of their majors. Any issues that come up with the mathematics content as related to computer science are easily brought up within the department itself. The Mathematics Department Chair and the Biology Department Chair (effective fall of 2003, Jeff Burkhart) attended a joint math/biology workshop at

Carroll College in Montana several years ago sponsored by the MAA and NSF to try to stimulate more cooperation between the two disciplines. The most concrete result was the development of a research methods class taught by the biologists, but there is still a lasting bond and interest between the two disciplines a as result of that workshop.

The department chair has been involved for four semesters now in team-teaching two new courses that he and an art professor developed, one an honors freshman seminar called Bridges Between Art and Mathematics, and the other an upper division core general education class, The Mysterious Dance of Art, Mathematics and Music. It would be nice to some day be able to offer a variety of similar kinds of classes that would offer enough mathematics content to meet the mathematics graduation requirement, much as Pomona College has a smorgasbord of some 10 or so classes offered periodically. The chair has also collaborated on research with a biologist who retired two years ago, and is currently involved in a large-scale modeling project with the chemistry chair, who is developing advances in fuel cell technology based on new patents of his own design, and using government and private funding in the many hundreds of thousands of dollars.

Administration and Support Services

The department is supported administratively by two persons. Sharla Geist is the administrative aide for the entire Natural Science Division, shared by all departments within the division (and supervising several student workers whose services are available for appropriate tasks), and by the full-time administrative aide for the computer science program, Christine Wade, although she is located in a building about two blocks from the mathematics and physics faculty. There are two work-study student positions for the Math/Physics/C.S. Department that are devoted just to mathematics and physics, although many times the specialized work (like paper grading or tutoring) is not suited to the capabilities of the work-study students, and so others must be paid out of department funds, for which there is a $2500 annual budget.

In terms of development support for faculty, the Faculty Professional Development Committee administers funds up to $1670 per year per faculty member to simply attend ($350, $500, $650), participate in ($500, $725, $950), or present ($650, $950, $1300) at conferences and workshops, including (for participating or presenting) up to $300 for two nights of lodging and $70 for two days of meals. The three dollar amounts are determined by whether the function is within 1500 miles or not, or international in nature.

Support for grant-writing is minimal; a small portion of one person's time (Jay Jones) is earmarked for grant writing, but the school really does not have anyone devoted full-time to helping faculty write grants. This situation is being reviewed by the administration. The department submitted a grant proposal a year ago to the NSF for CSEM funds to provide up to $100,000 in scholarships over four years to primarily minority students interested in mathematics or computer science. The proposal was denied but with very positive feedback, and revised accordingly and re-submitted in spring of 2003. The principal investigator is Xiaoyan Liu, and Michael Frantz and Jay Jones assisted in the

grant writing. It is somewhat miraculous that a major grant proposal was written and has a pretty good chance of being funded, with as little support as the administration gives and with the less than zero amount of free time the faculty have.

Physical Facilities, Technology Support, and Library Services

The physical facilities for the mathematics program are comprised of the classroom spaces, the faculty offices, and the computer laboratories. Most mathematics classes are taught in the Mainiero Building (where the mathematics faculty offices are located) and the adjoining Founders Hall, with whiteboards, and perhaps a third of them in smart classrooms with a mounted computer projector, and podium with full complement of computer with internet connection, VCR, DVD player, and stereo amplifier. The number of these smart classrooms has been increased dramatically over the past few years, and continues to grow, hopefully to the point where every single mathematics class can be taught in one.

The faculty offices are adequate, and the university is now on a replacement cycle program to replace faculty computers every 3-4 years, which seems to be adequate. The math/physics and computer science programs each have their own laptop and a portable projector and computer on a cart for wheeling to "dumb" classrooms as needed.

Although there are no computer labs dedicated purely to mathematics students, there are two labs of 24 computers each in Founders Hall for general student use (and classroom teaching), and a small study area on the first floor of the Mainiero Building with four computers, a refrigerator, and microwave, which is dedicated to use by mathematics, physics and chemistry students. A similar (but larger and more nicely furnished) room is available on the second floor of Mainiero for biology students, although crossover is permitted and encouraged. Several other computer labs exist at various places around campus, so it is not terribly difficult for students to get computer access for assignments, although the labs are usually not open very late at night. If a faculty member does not meet a class in a smart classroom, it can be difficult to negotiate a time in one of the labs for the whole class to come in for a session, due to the full scheduling of the teaching lab.

All the mathematics faculty are devotees of computer assisted algebra systems on computers as opposed to calculators, and as such make assignments in their classes which require the use of Derive (the CAS of choice at ULV), or Matlab, or perhaps Mathematica (although we are only licensed for seven concurrent users with that program). Only one faculty member makes much use at all of graphing calculators in the classroom, deferring instead to computer technology. Response times from the Office of Information Technology (OIT) for computer-related problems are generally good, with notable exceptions.

The university librarian (retiring this year after 35 years) has been very good to the mathematics program, ordering almost all of the books ever requested by the faculty, and some that were not! A comprehensive list of over 400 books ordered in the last 15 years is available in Table 10. The students have a good selection of mathematical resources to choose from, and if they (or faculty) need something that our library does not own, as long as it belongs to one of 28 libraries around the state in the Link Plus system (including the Cal State libraries), they can get it within 3-4 days at no charge.

Curriculum Review and Comparison with Other Department Requirements

Some concerns regarding the curriculum for the major have been addressed in the earlier section on course offerings for the mathematics majors. Table 6 contains specific requirements for the mathematics major at eight schools varying in size and status, but including the "sister" colleges of La Verne (Elizabethtown College, Juniata College, Manchester College, McPherson College), as well as Macalaster College, Occidental College, Pomona College, Whittier College, Azusa Pacific University, the University of Redlands, and California State Polytechnic University at Pomona. A review of those requirements illustrates the range and variation in requirements at various schools, but also points up some common traits, some of which are adhered to here at ULV and some of which are not and perhaps ought to be. The latter category might well include *required* courses in discrete mathematics, abstract algebra, and (introductory) real analysis. These should be considered by the mathematics faculty. Another option might be to consider various tracks for majors, depending on whether they ultimately want to end up in industry, in the classroom, or in graduate school. This has been considered before by the department but deemed too difficult to implement, due to the very small numbers of students that would be taking a much wider range of courses spread out over possibly three tracks. Perhaps it should be considered again with an eye to keeping as many common courses as possible and distinguishing them only by a few key courses.

Summary Assessment and Future Goals, Plans and Directions

A general overall assessment of the mathematics program would probably state that it is a relatively stable environment, is placed within an environment of other caring and cooperative science faculty (perhaps the most well-adjusted group of faculty on campus), has faculty who are dedicated, knowledgeable, overworked and underpaid, majors who are well-intentioned but for the most part struggling and a source of frustration for the faculty, and has both the flexibility and ability to effect rapid curricular change as necessary. The biggest strength of the program lies in the kind of personal attention and time that the students can get from the faculty, both in the classroom and in and out of offices. At almost every Southern California MAA meeting, students accompany some of the mathematics faculty to listen to talks and view presentations and poster sessions. None have made any poster presentations yet, perhaps because the faculty have lacked the courage to push the students to project levels of sufficient sophistication to feel comfortable in sponsoring them as presenters. Also, every fall, the department hosts a picnic in a nearby park for the mathematics, physics, and computer science students to socialize and get to know one another and the faculty a little better.

What would the program look like if a magic wand were available? There would be at least one more, if not two, full-time faculty, perhaps one specializing in mathematics education. There would be enough mathematics majors to offer most if not all of the upper division courses with 7-10 students, every two years. The faculty workload would be reduced to allow time for research and scholarship, but increased again for faculty not following through with those efforts. The faculty would feel compensated adequately enough to not have to teach overload courses to supplement their salaries. The students would have an average SAT of 1250 rather than 1050, and thus be better equipped to work through the courses required for a mathematics major. (The last statement clearly points out the need to work with what we have, rather than what we wish we had, but sometimes it is very difficult.) Every mathematics class could be taught in a smart classroom, and a computer lab could be made *easily available* for days when the whole class needs to work on problems with the instructor present. Some (many?) classes would have lab components incorporated into them just like physics and chemistry and biology. Every student would be capable of producing a senior project that could be shown at meetings. The chair would have one course release per semester (rather than one per year) to adequately administer the department.

In reading through the complete document, certain areas of need and opportunity present themselves, with the first two items being the most pressing needs, and all the rest in no particular order, although some might certainly be considered much more important than others:

1. Add a full-time faculty member and reduce the part-time / full-time ratio

2. Explore strategies for increasing the number of qualified mathematics majors in order to reach "critical mass"

3. Review the major curriculum to bring more into line with other schools, adding or deleting requirements and/or courses as necessary

4. Review the mathematics placement program, with an eye to more accurate placement and online diagnostic testing; review registration procedures to prevent students from skirting around mathematics prerequisites

5. Initiate a senior seminar class/requirement for mathematics faculty/students to aid in the development and presentation of senior projects

6. Define more clearly the level of achievement required for the senior project

7. Review the current senior comprehensive exams; consider whether or not to keep the GRE exam, and whether or not to seek an alternate departmental exam or write one internally

8. Review the topic sequencing in Calculus II-III to bring it more into line with standard courses

9. Explore the problem of night classes meeting two to four hours at a time, and how to take advantage of the students who are seeking mathematics degrees that can only attend at night

10. Consider the role we want distance learning to play in our program

11. Examine the organizational structure of the department programs to determine if it is optimal

12. Consider how to take advantage of the explosion in collaboration between mathematicians, computer scientists, and biologists which will remain an area of growth for some years

13. Explore the notion of and possibilities for mathematical internships for majors

14. Explore how to increase part-time and overload salaries from $2200-2500 up to $3500

15. Develop strategies for reviving enrollments in Mathematics in Society, and/or develop "more popular" and yet mathematically appropriate optional courses for meeting the mathematics graduation requirement for general education, such as a statistics course, or others relating mathematics and the arts

16. Determine a way to be able to offer more major courses on a biennial basis rather than as directed studies

17. Revive the Mathematics Club from many years ago

The largest hurdle to seriously addressing the issues above is undoubtedly the time needed by faculty away from teaching, class preparation, paper grading and committee work, in order to think about, discuss and explore the various possibilities. These opportunities and areas of need and exploration have been determined through self-analysis, and it is hoped that the external program review team will now be able to perhaps help the mathematics faculty focus on what is most important, what is feasible, what has been missed, and perhaps will even propose some strategies for accomplishing some of the goals above.

Table 1: Degree Requirements for a Mathematics Major

Core Requirements

MATH 201 Calculus I (4 units)
MATH 202 Calculus II (4 units)
MATH 305 Transition to Advanced Mathematics (4 units)
MATH 311 Calculus III (4 units)
MATH 320 Linear Algebra (4 units)
CMPS 367 Object Oriented Programming Using C++ (4 units)

Supportive Requirements

PHYS 203 Engineering Physics I (with lab, 203L -- 5 units)
PHYS 204 Engineering Physics II (with lab, 204L -- 5 units)

Additional Core Requirements for the B.A. (one each of the following two pairs)

MATH 319 Vector Calculus (4 units)
or
MATH 328 Abstract Algebra (4 units)

MATH 325 Number Theory (4 units)
or
MATH 351 Probability (4 units)

Electives for the B.A.: A minimum of 8 semester units in upper-division mathematics courses.

Additional Core Requirements for the B.S.

MATH 315 Differential Equations (4 units)
MATH 328 Abstract Algebra (4 units)

Electives for the B.S.: A minimum of 12 semester units in upper-division mathematics courses.

Culminating Requirement:
MATH 499 Senior Project (1-4 units)
Comprehensive Examinations – Departmental Exam *and* GRE Advanced Subject Exam in Mathematics (0 units)

Total unit requirements: 41-44 units for the B.A., or 45-48 units for the B.S., plus 10 units for supporting courses.

Table 2: Guidelines for a Mathematics Minor

Option 1	Option 2
Math 201 Calculus I Math 202 Calculus II Math 311 Calculus III Math 320 Linear Algebra ***or*** Math 328 Abstract Algebra	Math 311 Calculus III Math 320 Linear Algebra ***or*** Math 328 Abstract Algebra
Plus 2 upper division electives	***Plus*** 3 upper division electives
Total: 24 semester hours, including division 16 hours of upper division work.	Total: 20 semester hours of upper work.

- The exact program of courses should be worked out with the approval of a faculty member of the department. A minor contract must be filed with the Registrar.

- Courses included on the major contract cannot be used on the minor contract

Insert Table 3 Here: Courses currently offered (listed) by the mathematics program

Table 4: Two-Year Cycle for Mathematics Courses

Offered Fall Even Years (Fall, 2002)	**Offered Fall Odd Years (Fall, 2003)**
1. MATH 001: Math Workshop 2. MATH 102: Intermediate Algebra 3. MATH 104: College Algebra 4. MATH 105: Precalculus 5. MATH 170: Mathematics in Society 6. MATH 172: Math. Methods in Bus/Econ 7. MATH 201: Calculus I 8. MATH 202: Calculus II 9. MATH 210: Intro. to Computer Utilization 10. MATH 301: Programming Concepts 11. MATH 311: Calculus III 12. MATH 328: Abstract Algebra 13. MATH 489: Developmental Math 14. MATH 499: Senior Project, Exams	1. MATH 001: Math Workshop 2. MATH 102: Intermediate Algebra 3. MATH 104: College Algebra 4. MATH 105: Precalculus 5. MATH 170: Mathematics in Society 6. MATH 172: Math. Methods in Bus/Econ 7. MATH 201: Calculus I 8. MATH 202: Calculus II 9. MATH 210: Intro. to Computer Utilization 10. MATH 301: Programming Concepts 11. MATH 311: Calculus III 12. MATH 320: Linear Algebra 13. MATH 375: Mathematical Modeling 14. MATH 489: Developmental Math 15. MATH 499: Senior Project, Exams
Offered January Odd Years (Jan., 2003)	**Offered January Even Years (Jan., 2004)**
1. MATH 170: Mathematics in Society	1. MATH 170: Mathematics in Society 2. MATH 482: History of Mathematics
Offered Spring Odd Years (Spring, 2003)	**Offered Spring Even Years (Spring, 2004)**
1. MATH 001: Math Workshop 2. MATH 102: Intermediate Algebra 3. MATH 104: College Algebra 4. MATH 105: Precalculus 5. MATH 170: Mathematics in Society 6. MATH 172: Math. Methods in Bus/Econ 7. MATH 201: Calculus I 8. MATH 202: Calculus II 9. MATH 210: Intro. to Computer Utilization 10. MATH 301: Programming Concepts 11. MATH 305: Transition to Advanced Math. 12. MATH 315: Differential Equations 13. MATH 327: Discrete Mathematics 14. MATH 351: Probability 15. MATH 489: Developmental Math 16. MATH 499: Senior Project, Exams	1. MATH 001: Math Workshop 2. MATH 102: Intermediate Algebra 3. MATH 104: College Algebra 4. MATH 105: Precalculus 5. MATH 170: Mathematics in Society 6. MATH 172: Math. Methods in Bus/Econ 7. MATH 201: Calculus I 8. MATH 202: Calculus II 9. MATH 210: Intro. to Computer Utilization 10. MATH 301: Programming Concepts 11. MATH 305: Transition to Advanced Math. 12. MATH 327: Discrete Mathematics 13. MATH 319: Vector Calculus 14. MATH 325: Number Theory 15. MATH 489: Developmental Math 16. MATH 499: Senior Project, Exams

See important notes on the following page.

red = required core course for all math majors; green = required course for the B.S. in math
blue = one of several choices of required courses for the B.A. in math: one of Vector Calculus or Abstract Algebra, and one of Number Theory or Probability. Note that CMPS 367 C++ (with a prerequisite of CMPS 301) and PHYS 203/204 Engineering Physics I and II are also required and should be worked in during light semesters. Two elective courses (8 units) are required for the B.A., and three elective courses (12 units) are required for the B.S. Other classes not listed, such as Foundations of Geometry, or Mathematical Statistics, may be taken as directed studies, or may be offered if a sufficient number of students show an interest. Other (electives) are in parentheses.

Table 5: Four-Year Suggested Schedules for Math Majors

(Determined by when Calculus I is first enrolled in)

Fall Even Year Calculus I	**Fall Odd Year** Calculus I	**Spring Even Year** Calculus I	**Spring Odd Year** Calculus I
January Odd Year non-math electives	**January Even Year** non-math electives	**Fall Even Year** Calculus II	**Fall Odd Year** Calculus II
Spring Odd Year Calculus II	**Spring Even Year** Calculus II	**January Odd Year** Non-math electives	**January Even Year** (History of Math)
Fall Odd Year Calculus III	**Fall Even Year** Calculus III	**Spring Odd Year** Trans. to Adv. Math (Probability)	**Spring Even Year** Trans. to Adv. Math
January Even Year (History of Math)	**January Odd Year** non-math electives	**Fall Odd Year** Calculus III Linear Algebra (Math. Modeling)	**Fall Even Year** Calculus III (Abstract Algebra)
Spring Even Year Trans. to Adv. Math (Vector Calculus) (Number Theory) (Discrete Math)	**Spring Odd Year** Trans. to Adv. Math (Differential Eqns) (Probability) (Discrete Math)	**January Even Year** (History of Math)	**January Odd Year** Non-math electives
Fall Even Year (Abstract Algebra)	**Fall Odd Year** Linear Algebra (Math. Modeling)	**Spring Even Year** (Vector Calculus) (Number Theory) (Discrete Math)	**Spring Odd Year** (Differential Eqns) (Probability) (Discrete Math)
January Odd Year Non-math electives	**January Even Year** (History of Math)	**Fall Even Year** (Abstract Algebra)	**Fall Odd Year** Linear Algebra (Math. Modeling)
Spring Odd Year (Differential Eqns) (Probability) (Discrete Math)	**Spring Even Year** (Vector Calculus) (Number Theory) (Discrete Math)	**January Odd Year** Non-math electives	**January Even Year** (History of Math)
Fall Odd Year Linear Algebra (Math. Modeling)	**Fall Even Year** (Abstract Algebra)	**Spring Odd Year** Senior Project, Exams (Differential Eqns) (Probability) (Discrete Math)	**Spring Even Year** Senior Project, Exams (Vector Calculus) (Number Theory) (Discrete Math)
January Even Year (History of Math)	**January Odd Year** non-math electives		
Spring Even Year Senior Project, Exams (Vector Calculus) (Number Theory) (Discrete Math)	**Spring Odd Year** Senior Project, Exams (Differential Eqns) (Probability) (Discrete Math)		

See important notes on the following page.

red = required core course for all math majors; green = required course for the B.S. in math
blue = one of several choices of required courses for the B.A. in math: one of Vector Calculus or Abstract Algebra, and one of Number Theory or Probability. Note that CMPS 367 C++ (with a prerequisite of CMPS 301) and PHYS 203/204 Engineering Physics I and II are also required and should be worked in during light semesters. Two elective courses (8 units) are required for the B.A., and three elective courses (12 units) are required for the B.S. Other classes not listed, such as Foundations of Geometry, or Mathematical Statistics, may be taken as directed studies, or may be offered if a sufficient number of students show an interest. Other (electives) are in parentheses.

Outside Team Review

REVIEW OF UNIVERSITY OF LA VERNE MATHEMATICS PROGRAM
By
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Alan Knoerr, Associate Professor of Mathematics, Occidental College

The present review of the Mathematics Program at the University of La Verne is based primarily upon 1) careful consideration of the Mathematics Program Review prepared by Program Chair Michael Frantz, and 2) a site visit on Monday, May 5, 2003, that included interviews with mathematics faculty members Michael Frantz, Xiaoyan Liu, and Rick Simon; Natural Science Division Chair Robert Neher; Dean of the College of Arts and Sciences John Gingrich; and seven ULV mathematics majors, as well as informal conversations with ULV Physics Program faculty members David Chappell and Sarah Johnson. Our review is informed also by our experience at our own institutions (a small private comprehensive university with a liberal arts emphasis and a private liberal arts college, respectively); by our participation in discussions of undergraduate mathematics education at regional and national conferences and in professional publications; and by recent recommendations from the Mathematical Association of America, the National Research Council, and other leading voices in undergraduate mathematics education.

Observations

The University of La Verne mathematics faculty, science faculty, and administration have a clear and well-articulated view of the importance of mathematics within a liberal arts education. The mathematics faculty strives to organize its work to meet its goals of providing meaningful mathematical experiences for all university students, from those who need to learn basic mathematics skills to those who wish to major in and pursue careers in mathematics.

The mathematics faculty is extraordinarily hardworking. The teaching load is substantial, with each faculty member teaching at least three courses and (usually) three preparations each semester, often including an extra course (often an extra preparation) taught as an overload. Faculty members are available for many hours for individual consultation with students, in their offices and via telephone and e-mail. They offer many directed study courses to individual students, with no compensation or reduction in other teaching responsibilities. They frequently design new courses or modify existing ones, and they rotate courses amongst themselves with each faculty member teaching virtually every course in the curriculum over an 8- to 10-year period.

Both full- and part-time mathematics faculty members, in courses ranging from the pre-college level to upper division, work very hard at and are very skilled in helping weak to average students succeed in a notoriously difficult subject. They attempt to meet all students in all courses "where they're at" and then to work closely and carefully with students to raise their level of understanding, thinking, and execution. Instructors provide a variety of classroom experiences, from group work to student presentations to computer laboratory instruction to traditional lecture. They employ mid-term evaluations to gage students' satisfaction and success with classes. The overall quality of mathematics classroom instruction seems to be quite high, with teaching and learning most accurately described as "student-centered".
Full-time mathematics faculty members give an extraordinary amount of individual attention to students, both in and out of class, and students appreciate the faculty's efforts to meet their individual needs. Students majoring in mathematics describe the three mathematics faculty members as demanding and challenging, yet extremely caring and accessible. In addition to the faculty's many office hours, students appreciate activities the faculty organizes for them, such as trips to local mathematics conferences. Students also value their dedicated study space in Mainiero Hall, including its computers and its proximity to mathematics faculty. There seem to be just as many, if not more, women as men majoring in mathematics.

The mathematics program offers courses for underprepared students (Math Workshop and Intermediate

Algebra). It offers general education courses designed to illustrate both the beauty and the applicability of mathematics (Mathematics in Society, The Mysterious Dance of Art, Mathematics and Music) and to impart specific skills to students in specific majors. It offers courses especially for the future elementary school teachers majoring in liberal studies (Developmental Mathematics) and for business and economics majors (Mathematical Methods for Business and Economics). Finally, it offers a calculus sequence (Calculus I, II, and III, Differential Equations, and Vector Calculus) tailored to meet the needs of students majoring in biology, chemistry, computer science, and physics, as well as mathematics.

While the majority of its course offerings consist of the service courses just described, the mathematics program also offers a fairly broad curriculum for mathematics majors, exposing them to many areas of mathematics and to both pure (theoretical) and applied mathematics, albeit through infrequently offered courses and/or directed study courses. Besides topics courses, course offerings for mathematics majors include the Transition to Advanced Mathematics course and the Senior Project, which currently is completed as a directed study. The majority of mathematics majors intend to become high school mathematics teachers, with a few preferring to pursue careers in industry or government. A few mathematics majors pursue graduate study in the mathematical sciences, but not always immediately after graduation from ULV.

The mathematics faculty is committed to using technology (primarily computer algebra systems) in mathematics instruction, but currently teaches only about one third of its classes in "smart" classrooms. Instructors can schedule computer laboratories for class sessions only occasionally. Otherwise, instructional spaces seem adequate. Faculty offices also seem adequate, as do the study spaces for science students in Mainiero Hall.

We observed a high degree of collegiality between mathematics and physics faculty members (we didn't speak with any computer science faculty members) and between mathematics/physics faculty members and their division chair, Robert Neher. Mathematics program faculty and, more generally, science division faculty, appear to have close, cordial, and effective working relationships with one another. The mathematics faculty also appears to have a friendly, open, and effective relationship, based on mutual respect, with Dean of Arts and Sciences John Gingrich.

Despite their heavy teaching loads, mathematics faculty members engage in a fair amount of scholarly activity, grant-writing, service to the mathematical community, and service to the university. Their dedication to teaching, their grant-writing efforts, and their committee work on campus are evidence of their commitment to the success of the university. They represent the university well off campus by their involvement in the local section of the Mathematical Association of America, their participation in national and international conferences, and their work in administering intercollegiate athletics.

The mathematics program already has in place a planning and assessment process. Indeed, the majority of our recommendations are intended to achieve goals articulated in the program review prepared by Program Chair Michael Frantz.

Recommendations and Rationale

Staffing and Compensation

The mathematics program's reliance on part-time faculty is far too high. The two part-time instructors we observed seemed very competent, but part-time faculty members generally have little commitment to a university and its students. At the currently low level of compensation, retaining good part-time instructors is difficult, making recruiting and managing these faculty very challenging for the Program Chair.

Part-time faculty members should be paid at least $3000 per course, perhaps with a requirement of a minimal number of office hours. They might be contracted for $2500 per course plus $500 for a specified number of office hours.

Since part-time faculty members are used primarily for lower level courses, the university might consider hiring a full-time instructor or lecturer to teach 8 sections of these courses per year with a certain number of office hours and possible committee expectations. The mathematics faculty should plan to make this instructor an integral member of the program, participating in departmental, division, and university decision-making and social activities.

Ideally, the university would hire an additional tenure-track faculty member who could help teach and invigorate major offerings as well as service offerings. Even more ideally, the university would hire both a tenure-track mathematics professor and a mathematics instructor.

In scheduling, the Program Chair should attempt to reduce the number of preparations for each faculty member by, for instance, assigning two sections of a course to the same faculty member. Faculty should stop taking on overloads, especially those that involve extra preparations. The university should increase faculty pay and program staffing so that faculty do not feel obligated to teach overloads. Directed studies should be counted in faculty teaching loads. Two directed studies should count as one course, but, perhaps, as a starting point, six directed studies could count as one course (or one overload).

Support for the Mathematics Program and Faculty

The university administration should continue to appreciate the special demands of teaching in a discipline that requires such a large amount of contact time with students both in and out of class. We recommend that mathematics faculty members be among the first to receive work-study assistance (for tutoring, paper-grading, and office work), assistance with grant-writing, support for travel to workshops and conferences, and even differential pay. We particularly recommend that the administration provide (and that mathematics program faculty members take advantage of) course releases for curriculum development. Participation in curriculum development should be regarded favorably for promotion.

We appreciate faculty initiatives to require scholarship for promotion, but caution faculty to include teaching-related professional activity as an acceptable form of scholarship. This would help ensure that all faculty can relate their scholarship to their teaching and that teaching remains the faculty's primary mission. Faculty and administrators should recognize that faculty teaching loads are not uniform across campus. In order to give all faculty the opportunity to engage in scholarly activity, the university should take steps to reduce teaching loads in programs with very heavy teaching loads, including mathematics.

The university should continue to expand and improve classroom technology by making more classrooms "smart" and by providing adequate computer laboratories. The university should set up one classroom computer laboratory in which mathematics courses could meet regularly.

Service Courses

The mathematics program should continue to offer interesting and exciting service courses, such as The Mysterious Dance of Art, Mathematics and Music; Mathematical Methods for Business and Economics; Mathematics in Society; and, of course, Calculus I, II, and III.

We encourage the faculty to carry out its plan to design and offer a "thinking" statistics course featuring collection and interpretation of real-world data sets. This course should be marketed to biology majors as well as to business and social science majors, with the eventual goal of having these programs require the course for their majors.

We hope that the interesting and exciting Mathematics in Society course survives; however, if it ends up

being supplanted by the statistics course, the business course, the mathematics and the arts courses, and/or an applications-based College Algebra course (see below), then so be it. In order to encourage students to take Mathematics in Society, mathematics program faculty might bar students who have placed solidly into Precalculus or Calculus I (or higher) from College Algebra but not from Mathematics in Society.

We recommend following national curriculum recommendations for College Algebra [9] by integrating real world modeling and problem solving into the course. (Also see [13].) We very much like Professor Frantz's suggestion of an approach drawing on environmental problems and modeling. This should appeal to many students, fits in with wider university curricular themes, and may be supported by recent textbook development.

These recommendations should make College Algebra more interesting and relevant, and certainly much less like the standard high school courses students may be repeating when they take College Algebra. Students frightened by such an approach (and there will be some) may flee to Mathematics in Society or another general education course, but this would be a desirable outcome. Whether Mathematics in Society gains in popularity or continues to be overshadowed by College Algebra, the result of modifying College Algebra should be that all ULV students would complete a concepts- and applications-based mathematics course – again, the desired outcome.

We also recommend that mathematics faculty investigate ALEKS [1] or another web-based mathematics tutorial system. Such a system may be very helpful in assisting students with skills development and concept mastery in elementary courses such as College Algebra. With less class time needed for fundamentals, more emphasis could be placed on the higher-order thinking skills the revised course would demand. We caution, however, that such tutorial systems are not magic; some students may also need human tutors.

While offering an even broader range of general education and other service courses would be desirable, we believe program faculty already are stretched too thin in offering existing courses. Unless program staffing is increased substantially, service courses beyond those discussed here should not be added to the curriculum.

Curriculum Revision for the Mathematics Major

The Mathematical Association of America's Committee on the Undergraduate Program in Mathematics (CUPM) is a good source for information on mathematics curriculum revision. In particular, the Curriculum Foundations Project of its Sub-committee on Calculus Reform and the First Two Years (CRAFTY) has produced a number of reports with recommendations for the preparation of mathematics majors, as well as for the mathematical training of students in other disciplines [10]. More comprehensive guidelines from the CUPM are forthcoming [9]. In addition, the California Commission on Teacher Credentialing has recently adopted new standards for the single subject credential in mathematics [2] and will require all colleges and universities to re-submit credential program applications within the next two years.

While curriculum revision should be informed by recommendations from these state and national organizations, it should be driven primarily by the mathematics program's mission and resources. We believe current resources can support only a very focused program. By deciding which courses are most important and focusing on them, the mathematics program should be able to offer fewer upper division courses overall, but offer more upper division courses as classes rather than as directed studies.

Since most mathematics majors plan to become high school mathematics teachers, it seems to us that the core of the major should be those courses within the credential program. These courses should be required or at least highly recommended for all majors, not just those intending to teach high school mathematics. The new standards for the single subject credential in mathematics issued by the California Commission on Teacher Credentialing, together with the Commission's requirement that all colleges and universities re-submit credential program applications within the next two years, give the ULV mathematics faculty an ideal opportunity to redesign major requirements and upper division course offerings around credential

program goals. It also is important that regular course offerings include at least one course that each full-time faculty member would be really and truly excited about teaching, e.g. courses in biological or environmental modeling or in numerical methods.

The net result of centering the mathematics major around courses required for the teaching credential should be that the same number of courses are offered as regular courses (we don't see how to reduce this number), but that fewer courses are offered as directed studies. We acknowledge that reducing the number of courses offered does have some disadvantages. It reduces student choices, and the soon-to-be-released recommendations of the Mathematical Association of America [9] advocate wider variety in courses with closer attention to individual student interests. But, again, we believe current faculty and student resources at ULV can support only a very focused program.

The primary resource allocation goal should be to make sure there almost always are four or more students in each upper division course, and that each student in the course is prepared to take the course. Nevertheless, the administration should support the occasional course with only two or three students in it, recognizing that the mathematics faculty has done everything possible to streamline course offerings while keeping the program attractive to potential majors.

Directed study courses should be reserved only for students intending to pursue graduate study in the mathematical sciences. Depending on their intended programs, these students would need from two to six additional courses.

The Senior Project should be offered as a yearly spring course, perhaps jointly with physics and/or other programs. It might instead be offered during fall semester or, less ideally, January term if that would help increase the number of students in it and other courses. Another option would be a 1- or 2-unit seminar taken throughout the senior year. Career information could be included in the Senior Project course.

In redesigning the mathematics curriculum, it may be possible to retain a few choices for majors and to distinguish between the B.A. and the B.S. However, it may not be necessary to offer these two degrees. Redlands offers only the B.S. and Occidental offers only the B.A. We note also that the two main features of the highly successful mathematics program at SUNY-Potsdam are its close faculty attention to individual students and its single-track mathematics degree [5].

The mathematics faculty at Potsdam believes that a compassionately taught, fairly traditional, relatively barebones curriculum that emphasizes the development of mathematical thinking skills is the best way to provide students with the knowledge and intellectual skills they need in order to succeed in careers in teaching, industry or government, and/or in graduate study. The ULV mathematics faculty will have to convince their students that a good grounding in mathematical thinking skills should be an excellent preparation for any career or course of graduate study, that the courses required in the program do offer quite a bit of breadth in mathematics and its applications, and that their senior projects will give students an excellent opportunity to get experience in areas of particular interest to them.

While we appreciate the mathematics faculty's support of the computer science and physics programs through course requirements in these areas for mathematics majors, as well as its message to mathematics majors that being able to apply their skills in other areas is important, the mathematics faculty may wish to allow students to choose between the two or to design their own "emphasis" or application of mathematics. Perhaps all mathematics majors would complete a computer programming course but only students earning the B.S. degree would complete the physics courses.

We recommend dropping the GRE as one of the two exit examinations, as we suspect it is demoralizing for weak to average mathematics majors. Other "outside" exams available include those taken by prospective mathematics teachers (currently, the SSAT or Praxis exams) and a more general mathematics assessment exam offered by ETS. (Note: One of the reviewers is an ETS consultant.)

Especially since most mathematics majors intend to become high school teachers, the mathematics faculty should be sure to continue to model a wide variety of instructional styles and to involve students actively in

learning, both in and out of class. Opportunities for tutoring and peer mentoring in mathematics [12] should be expanded for qualified students.

Recruitment and Retention of Majors

With most major courses offered only every other year, it is not possible to maintain viable enrollment levels and meet students' needs to progress through the major while requiring the customary sequence of prerequisites for these courses. Rather, it is important to make sure that most of these courses are accessible to most mathematics majors, meaning that some must be offered at a lower level than might be considered ideal. The Transition to Advanced Mathematics course should be very helpful, especially if offered when all students can take it. However, this course will not magically prepare all students for all upper division courses. Many students will need several semesters of "transition" to higher order thinking skills.

At the same time, faculty and students must be realistic about prerequisites. For example, students will have a much greater chance of success in the probability and statistics sequence if they take Calculus III first.

We hope these measures will help reduce the high number of Incomplete and In Progress grades assigned in upper division mathematics courses. While it is commendable that faculty offer such flexibility in order to help students succeed, neither they nor the students have time for this luxury.

In our focus group with students, they expressed a desire for more help with homework. Help in class was preferred, but an outside-of-class homework session with a little more structure than office hours (much like a recitation section at a larger university) also was attractive to them. They also expressed a desire to be able to re-do homework assignments, a request which seems worth accommodating when possible. As for student complaints that mathematics courses are challenging and time-consuming and that taking more than one of them per semester is unrealistic, the faculty should continue to encourage and help students---and to help them plan schedules containing no more than two mathematics courses per semester! Again, students are unanimous in praising the availability of the mathematics faculty for help and guidance.

Students were also unanimous in expressing appreciation for their study space in Mainiero Hall. Maintaining and improving this space should be of highest priority. Seating might also be provided outside faculty offices so students can wait for faculty there.

Students' already strong sense of community might be further improved by a Math Club and activities, and by additional program-related employment opportunities for students as tutors, peer-led workshop leaders, graders, or even office assistants. Program alumni should be invited to share career information with current students, by visiting campus or via e-mail.

In addition to the improvements already made in the advising of mathematics majors as a result of better college records, mathematics faculty members might use a little class time each registration period for general advising about upcoming courses and to encourage students to meet with them for further advising, and/or hold general meetings for intended mathematics majors (with food as well as advice as incentive) to dispense information. One-page checklists of mathematics major requirements and recommended course sequencing should be distributed to prospective mathematics majors whenever and wherever possible, including in class. Ideally, ULV students would declare their majors by the end of their sophomore year to help ensure better advising and degree completion.

The mathematics faculty should pay even more attention to the calculus sequence, especially Calculus I, as the primary place where they will recruit mathematics majors and minors. Calculus courses must be stimulating and rewarding. The faculty might encourage or even require students who place solidly into Precalculus or Calculus I to take that course rather than College Algebra to fulfill general education requirements. Unless articulation really has become a big problem, we encourage the mathematics faculty

to continue to design its calculus curriculum based on the needs of various ULV programs rather than on external norms.

The faculty also should identify other courses, such as Discrete Mathematics or Bridges Between Art and Mathematics, from which to recruit mathematics majors and minors. Every physics major should have a mathematics minor, if not a second major in mathematics. A mathematics minor should be encouraged for economics and computer science majors.

In addition to encouraging the Admissions Office to recruit strong students, capable of and interested in majoring in mathematics, ask Admissions to identify the best incoming students, regardless of intended major. Encourage these students to take Calculus I early in order to keep open their science and mathematics major and career opportunities.

We hope that all of these actions would increase the number of mathematics majors over the next few years. The university should recognize that increasing the numbers of majors in demanding disciplines such as mathematics depends on increasing the number of high-achieving students it attracts to campus.

Carrying Out Curricular Change

Good collegiality and program management are evident. However, carrying out the curricular changes we recommend will require an even higher level of coordination and mutual inspiration. We note that the mathematics program is planning a faculty retreat for Summer 2003 to discuss our recommendations. We wish to encourage this kind of activity, which strengthens the faculty's sense of community while also addressing program goals.

Here are some other specific recommendations that may be helpful:

- Consider having adjacent offices. This can improve collegiality within the program, though reducing interaction with other science faculty might be a concern.

- Select one to three goals on which to focus for a given year, using importance and feasibility as criteria. After further discussion, have each faculty member in the program commit to specific tasks needed to achieve these goals. Then meet on a regular basis for the sole purpose of making progress towards these goals, excluding discussions of other program or institutional business from those meetings.

- Take a look at some of the recent literature on organizational change ([6],[7],[8]) and faculty learning communities ([3],[4]); consider the applicability of this work to your situation.

Conclusion

The University of La Verne Mathematics Program does a very good job with modest resources. However, a greater focus on its core mission of preparing future mathematics teachers, together with some additional resources from the administration, should enable the program to improve, attract more majors, and be of even greater value to other programs in the university.

References and Resources

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[8] Lucas, A. F. & Associates. (Eds.) (2000*). Leading academic change: Essential roles for department chairs.* San Francisco: Jossey-Bass.

[9] Mathematical Association of America, *Undergraduate Programs and Courses in the Mathematical Sciences: A CUPM Curriculum Guide, Draft 5.1* (July 2003). http://www.maa.org/cupm/

[10] Mathematical Association of America CRAFTY-CUPM Curriculum Foundations Project, *Recommendations on the Preparation of Math Majors in the First Two Years* (May 2001). http://www.mathsci.appstate.edu/~wmcb/CFF/

[11] Preparing Mathematicians to Educate Teachers (PMET) http://www.maa.org/pmet/, http://www.maa.org/pmet/focus.html

[12] The Peer-Led Team Learning Workshop Project http://www.sci.ccny.cuny.edu/~chemwksp/

[13] Center for Problem-Based Learning, Samford University http://www.samford.edu/pbl/