Proposed New Track for the B.A. Curriculum in Mathematics

Executive Summary

The present B.A. curriculum in mathematics is appropriate for students who plan graduate study in mathematics, and this proposal does not address it. It is proposed to establish a new track to the B.A. degree in mathematics that will better meet the needs of students who intend to become mathematics teachers at the secondary school level. It can be combined in a four-year program, as a second major, with Mathematics Education; or it can be part of a five year curriculum leading to the B.A. degree in mathematics (awarded after year four) and ultimately the M.Ed. degree with certification to teach mathematics at the middle/high school level.

Until recently, the College of Education's Department of Mathematics Education had a curriculum in Secondary Education that led to certification to teach mathematics at the middle/high school level. In response to the No Child Left Behind Act, the Pennsylvania Department of Education (PDE) now requires all applicants for certification at the secondary level to have completed a major in the subject that they will teach. The PDE has specified a set of mathematics courses that should be included in the curriculum of any program that certifies high school mathematics teachers.

The Mathematics B.A. curriculum requires courses that the PDE does not, and the PDE requires courses that would be electives in the present curriculum. The track that is the subject of this proposal is closely aligned with the PDE curriculum. It requires two more credit hours than the present B.A. curriculum. Students in this track will normally be required to complete a number of courses in pedagogy. In particular, it is possible to complete the required courses of the program in seven semesters, leaving the final semester for student teaching and an education seminar.

Although this track is designed to meet the needs of a specific group of students, there is nothing to prevent any mathematics major from following the track to the B.A. degree. If there were such a barrier, then we would not be able to tell the PDE that students who had completed the track had met the requirements for a degree or second major in Mathematics.

The Curriculum

Students who aim to be certified as high school mathematics teachers will need to take 42 semester hours (s.h.) of courses in pedagogy. The number of semester hours of mathematics courses in the proposed track is 48, including two electives. Because two of the required pedagogy courses are among the courses that can be used as mathematics electives, students in this B.A. track can complete a

Bachelor's degree in Secondary Mathematics Education with a second major in Mathematics, and thus satisfy the certification requirements in four years.

Freshman year (8 s.h.)

Calculus I (Math C085) Calculus II (Math 0086)

Sophomore year (13 s.h.)

Calculus III (Math 127)	Linear Algebra (Math 0147)
Basic Mathematical Concepts (Math W141)	Number Theory (Math 0203)

Junior year (18 s.h.)

Modern Algebra I (Math W205)	Modern Algebra II (Math 0305)
Real & Complex Analysis I (Math 0241)	Real & Complex Analysis II (Math 0242)
Elective	Probability (Math 0233 or Stat 0021)

Senior year (6 s.h.)

Statistics (Math 0234 or Stat 0022)
Modern Geometry (Math 0271)
Elective

The electives in the junior and senior year may be any mathematics course numbered 200 or above, or one of the following two courses from Secondary Mathematics Education: 0146, 0366.

This program has two capstone courses: Mathematics W205 is the writing capstone, and Mathematics 0271 is the theoretic capstone.

Many students matriculate to Temple unprepared to take calculus as freshmen, and the Department of Mathematics has a sequence of three courses, Elementary Algebra (Math 0045), College Algebra (Math C073), and Pre-calculus (Math C074), to fill gaps in a matriculant's high school background. If any or all of these courses are required, the student's time to degree will be lengthened.

Comparison with the present curriculum

The following differences are noted.

- In the freshman year, B.A. majors are required to take a computer programming course, either Design and Abstraction (CIS 0067) or Computer Programming in C (CIS C071). These courses are not included in the proposed track. This will leave up to 13 credit hours per semester in the freshman year for General Education courses.

- In the sophomore year, B.A. majors take Differential Equations (Math 0251). In the proposed track, Number Theory (Math 0203) replaces this course.

- In the junior year, B.A. majors take Advanced Calculus I, II (Math 0247,0248). In the proposed track, this course sequence is replaced with Real and Complex Analysis I,II (Math 0241,0242 — new courses). Students in the proposed track take two additional courses: an elective, and

either Introduction to Probability Theory (Math 0233) or Statistical Methods and Concepts (Statistics 0021). This allows all of the mathematics requirements to be completed in the fall semester of the senior year, leaving the spring free for Student Teaching in Secondary Education (Education 0384). The probability/statistics option is included because the PDE requires it, and because it is a topic that high school teachers are asked to teach. Math Ed 0146, Methods & Materials in School Mathematics, or Math Ed 0366, Teaching of Problem Solving, which are required courses in the Secondary Mathematics Education curriculum, may be chosen as the elective.

- In the senior year, the B.A. majors take four courses: Senior Problem Solving (Math W363), Introduction to Functions of a Complex Variable (Math 0347), either Topology or Differential Geometry (Math 0365 or 0377), and a mathematics elective numbered 0200 or above. In the proposed track, students would take only three courses, all in the fall: an elective, (a required Math Ed course, 0146 or 0366, may be used as an elective), Modern Geometry (Math 0271) and either Introduction to Mathematical Statistics (Math 0234) or Selected Statistical Topics (Statistics 0022).

  Probability and statistics are topics that the PDE requires for the curriculum. Modern Geometry, also mandated by the PDE, is a course that would be more of interest to secondary school teachers (who will have to teach courses in Euclidean geometry) than topology or differential geometry. Complex variables is a topic that is covered in the new two-semester sequence of courses, Real and Complex Analysis, that was taken in the junior year.

Why is this change being proposed?

In the March 2005, the College of Education's Secondary Mathematics Education curriculum was reviewed by the PDE. In the review, it became clear that this track is needed if the College of Education is to be allowed to certify mathematics teachers at the secondary level. This program has been developed as the result of a joint effort by the Colleges of Education and Science & Technology.

Do all of the courses in the proposed track currently exist?

Only the Real & Complex Analysis sequence (Math 0241,0242) does not currently exist. When it is created, it will draw enrollment from Advanced Calculus (Math 0247,0248) and Introduction to Functions of a Complex Variable (Math 0347). There will still be demand for the Advanced Calculus and Complex Variable courses from students taking the B.S. mathematics curriculum and B.A. students whose career objectives are not secondary education.

The new courses are intended present the core of mathematical analysis in a more compact form than the present three-semester suite of courses do. Expe-

rience has shown that the analysis courses form a hurdle for many mathematics majors, including those who are seeking careers as high school mathematics teachers. The subject cannot be omitted without debasing the mathematics curriculum, but the proposed course puts into a more student-friendly package by omitting key topics from each of the three courses in the Advances Calculus–Complex Variable suite.

Is the proposal of a new track a one-time occurrence?

Similar changes can be expected to accommodate those students who intend to teach science courses — Physics, Chemistry, Biology — at the high school level. For students who plan to teach science at the middle school level, a proposal for a new, interdisciplinary B.A. degree in Natural Science is in preparation.

Will the proposed track improve the graduation rate, and the ability of graduates to find appropriate employment

The purpose of the proposed track is to remove obstacles and to present material that will be well-suited to the needs of the pre-service high school teacher. It should therefore improve the graduation rate for that population.

The track is part of a certification program to qualify graduates to mathematics at the middle and high school level. There is a severe shortage of mathematics teachers, and the high populations of students in the Mathematics 0045, C073, C074 remedial sequence of courses attests that the schools need to do a better job presenting mathematics in high school. The teachers who are graduates of this program will be well prepared, both in content knowledge and in pedagogy, to meet the challenges necessary to improve mathematics achievement in high schools. They will be employed.

The track can also be used as part of the five-year program that leads to a B.A. in mathematics, and M.Ed. with certification to teach mathematics at the middle and high school level.

Constraints external to Temple University

The No Child Left Behind Act demands that all teachers are "Highly Qualified." To meet this standard, it is necessary for a teacher at the high school level to have completed a major in the subject area and be state certified. The PDE has accepted the responsibility to move the schools, and the universities that educate and certify teachers toward this goal as quickly as possible without causing a disruption. It thus supplies the external constraint that makes this track necessary. **This track is a response to regulations imposed by an accrediting body. These are state mandated requirements that were instigated by a provision in federal law.** There are no competitive concerns. An exemption from the General Education Quantitative Literacy requirement will certainly be granted.

Impact of the new track on the Department of Mathematics

The Department has the capability to teach all of the courses in this program; in fact, all courses except for the new Real and Complex Analysis sequence are regularly offered. There are numerous faculty members, and one associate dean, who are qualified to teach the new sequence.

How will enrollments be affected?

The Differential Equations course, Math 0251, will be displaced by Number Theory,(Math 0203). However, its enrollment will not be significantly affected, because it is an important service course for science departments and the College of Engineering. Because Secondary Math Education majors already take probability, statistics, number theory, and modern geometry, enrollments in these courses will be unaffected. It is possible that students who would have taken the B.A. mathematics track and do not intend to teach in high school will opt for the new track. This could drive down the enrollments of the advanced calculus, complex variable, topology, differential geometry, and senior seminar courses. The courses might have to be offered less frequently than they are now. It is difficult to predict how many traditional mathematics majors would prefer the proposed track: It isn't allowed for those in the B.S. curriculum, and it is a bad choice for B.A. students who intend to apply to graduate schools (the Department recommends the B.A. for students who plan to apply for graduate study in Mathematics).

How will credit hours generated by the department be affected?

The Mathematics Department generates a large number of credit hours, but has relatively few majors. The new requirements imposed by the PDE will increase the the enrollment in mathematics courses that would have been offered in any case. The effect on teaching effort will be negligible, but there will be a small percentage increase in credit hours generated.

How will the ratio of lower division to upper division courses be affected?

The change will be negligible from this point of view.

How will the number of classes and sections be affected?

Most of the classes and sections taught by the Mathematics Department are lower division. Most of the mathematics courses taken by mathematics majors, whether or not they would be in the proposed new track, are upper division. It

is expected that students following the proposed track will take seats in sections that would run without their presence. The effect on the number of classes and sections taught will be negligible.

Are there other departments that offer similar courses and curricula?

No. Students majoring in Secondary Mathematics Education have always relied on the Department of Mathematics for "mathematics content" courses.

List the programs that the Department of Mathematics offers.

1. Mathematics, B.A.
2. Mathematics, B.S.
3. Intercollegial Mathematical Economics, B.A.
4. Interdisciplinary Mathematics and Physics, B.S.
5. Combined B.A. or B.S. and M.A. program in Mathematics (a five-year program)
6. Five-year B.A. and M.Ed./Secondary Education Certification program
7. Minor in Mathematics
8. Pure Mathematics, M.A.
9. Applied Mathematics, M.A.
10. Mathematics, Ph.D.

How many students have declared majors or minors in mathematics?

In the fall 2005 semester, the following populations were obtained from a Web-Focus report:

Mathematics	86
Mathematical Economics	4
Mathematics & Physics	2

The report does not include a count of minors in mathematics, and it does not say how the 86 mathematics majors are split between the B.A. and B.S. degrees.

What is the impact of the proposed new track on students?

The program will lead to teacher certification in the most efficient path. There will be little time for free electives for students who are pursuing teacher certification — they are double majors.

How will current students be affected?

Current students in the Mathematics B.A or B.S. programs can continue in those programs, which will still be available, or they can transfer to the new track if they prefer. Students who minor in mathematics will have the option of taking one or both semesters of the new Real and Complex analysis Course (Math 0241, 0242) among the required five electives.

How will time to graduation be affected?

Students who matriculate as freshmen ready to take Calculus I (Math C085), and follow the path outlined above will complete the program in four years.

If the requirements are changes, what accommodations will be made?

The requirements are not changes, this is a new track to the B.A. degree.

How will the program be phased in?

It will be available to students immediately after it is approved.

Conclusion

The proposed new track to the B.A. in Mathematics is designed to be an efficient path that allows just enough space for the student who majors in mathematics to complete courses in pedagogy necessary for certification to teach high school mathematics, and satisfy the General Education requirements. It is also the best track for students who choose the combined, five-year Mathematics B.A/M.Ed/Secondary Mathematics Education Certificate program.