

Building a Vibrant Advanced Mathematics Program by Adding AP Statistics to Your School Offerings: A Successful Case Study

With Tips for Persuading Your Principal and Your School Board

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Throughout most of my teaching career, I have been frustrated by the fact that many talented mathematics students in my district entered senior year with only the option of taking either AB Calculus or BC Calculus. We have carefully built a culture that encourages all students to take many mathematics courses; many strive to schedule the most advanced mathematics courses (as well as courses in other subjects) regardless of the level or appropriateness of those courses. While we have offered a non-Advanced Placement Statistics course for years, many of our students have never perceived this non-AP course as a serious option for them.

Our high school is a comprehensive school with an enrollment of 1440 students. Despite our best efforts, most of our students saw our Calculus courses as only for the exceptionally talented mathematics students. We continue to have a large number of good mathematics students who either take Calculus because they see it as the only Advanced Placement option or choose not to take a math course as a senior.

For many years, mathematics educators and statisticians have worked to provide an appropriate and important option for these students. Recognizing the increasing importance of Statistics in the development of informed citizenship, they petitioned the College Board for Advanced Placement status for a college-level Statistics course that met the need of good mathematics students and satisfied the criteria of the statistics community. The College Board approved their request, and, in 1997, the first Advanced Placement examination in Statistics was administered to approximately 7,000 students.

The introduction of Statistics into the family of AP courses provided a meaningful and attractive alternative to AP Calculus for a huge number of good mathematics students for whom Calculus was not an option relevant to their own plans. In addition, many of the students who were interested in taking one of the AP Calculus courses saw AP Statistics as an option to experience a college-level applied mathematics course that would complement their experiences in the more theoretical mathematics courses leading to and culminating with a Calculus course.

The relevance and appropriateness of AP Statistics for a larger population than the "Calculus types" is demonstrated by the growth of the program since its inception in 1997. Since its initial administration to approximately 7,000 students, the number of AP Statistics examinations has grown in a linear fashion with an increase of approximately 8,000 per year. It is expected that in 2003 there will be approximately 50,000 exams. Thus, in less than a decade AP Statistics ranks in the top 10 in popularity of AP courses. This fact is not surprising given the intention of its creators to provide an important course of study for all good mathematics students, not merely the exceptionally talented students.

The nature of AP Statistics is conceptual, not mechanical. Because of this distinction, the suggested minimum mathematics prerequisite for AP Statistics is successful completion of Algebra 2. The fact that AP Statistics does not involve a great deal of algebraic manipulation opened the course to a great number of students who had the capacity for conceptual understanding in mathematics but did not possess a high level of proficiency in algebraic manipulations. That is not to say that AP Statistics is a simple course. Quite the contrary is true.

AP Statistics consists of four major topical areas: Descriptive Statistics, Design, Probability and Statistical Inference. For students to succeed in this course, they must possess a capacity for conceptual understanding and a high degree of intellectual maturity as demonstrated by critical thinking skills. For this reason, our school and many others require that AP Statistics be taken concurrent with or after successful completion of a Trigonometry course.

Paralleling the growth of AP Statistics across the nation, our district has grown from 17 students in AP Statistics in 1997 to the present 90 students in 2003. Of these 90 students, approximately 60% are taking AP Statistics in addition to another math course, generally one of the AP Calculus courses or a Trigonometry course.

The approval of AP Statistics in our district was not without some difficulty. Some members of the high school administration and of the School Board held the opinion that we had sufficient AP offerings and that addition of more AP courses would negatively impact the enrollments of the current courses. Below please find the arguments that I used in convincing the high school community of the need and the value of AP Statistics for a larger number of our students.

1. Statistical thinking is vital to successful citizenship in the 21st Century for all students.

One of the clear descriptors of life in the 21st Century is that we are living in the Information Age. Citizens are inundated with tremendous amount of information and data on a continuous basis. Successful citizenship requires that individuals be able to organize, analyze, and interpret quantitative and qualitative data. All students need to study Statistics but generally do not enroll in "regular" electives in Statistics. The Advanced Placement credential is extremely useful in recruiting good mathematics students to AP Statistics, particularly those who would not consider an AP Calculus course.

2. College requirements of Statistics are significantly more common than requirements of Calculus.

Several studies have confirmed that there are many times more students who are required to take Statistics in college than are required to take a course in Calculus. Calculus is important for a very select number of majors whereas Statistics is, in many cases, a general requirement of many if not all majors at some universities.

3. Enrollment in AP Statistics does not negatively impact enrollment in AP Calculus or other AP courses.

There is a great deal of anecdotal evidence that the addition of AP Statistics does not negatively impact enrollments in AP Calculus or other AP courses. This fact is exemplified at my school and at many others that have introduced AP Statistics. As a matter of fact, the enrollments in our AB and BC Calculus courses at our school are both greater now than ever before--even though 90 students are pursuing AP Statistics this year. Most of our Calculus students elect to take both AP Statistics and AP Calculus during their high school years. But it is remarkable that so many students who would not elect Calculus can and are successful in AP Statistics.

4. For very talented students in mathematics, AP Statistics completes their pre-college experience in mathematics and addressed mandated needs for academic standards.

Most of the traditional K-12 mathematical experience is focused on the preparation for Calculus. While this is a noble task, many schools have made the mistake of ignoring the need to have their students experience applied mathematics in the form of Probability and Statistics. The experience of a student in mathematics is not complete unless he or she experiences some applied mathematics in addition to the traditional abstract courses in Algebra and Geometry. The National Council of Teachers of Mathematics in its *Principles and Standards for School Mathematics* (2000) has identified Data Analysis, Probability, and Statistics as a set constituting one of the five critical content areas for all students.

In addition, most state-approved academic standards for mathematics recognize the need for statistical understanding. They mandate that it occur during the K-12 mathematical experience by including standard for Statistics in their official educational mandates. While this requirement can be addressed for most students, the intensity of the more rigorous programs for **very** talented student sometimes does not provide the opportunity to address the Data Analysis and Probability. At our high school, we determined that our most talented mathematics students must take AP Statistics to comply with the Pennsylvania Standards of Data Analysis and Probability.

5. AP Statistics responds to the need for mathematics that is relevant and connected to students' needs and interests.

The overwhelming professional educational organizations agree learning must be relevant and connected to students' experiences. Data analysis and Statistics are topical areas that provide this

relevance and connection for all students. While great strides have been made in the past decade to infuse more of these experiences into the traditional K-12 mathematics experience, it is well recognized that only through a full course in Statistics will students understand the necessary concepts and procedures to achieve real quantitative literacy. AP Statistics is the best course to satisfy this need for a diverse population of mathematically talented students.

6. The value of Statistics is recognized throughout the "real world" and the "world of work."

When addressing the School Board regarding the possible adoption of AP Statistics, I was able to elicit support for the proposal by reminding the business people on the Board of the tremendous amount of data that they must routinely process. Similarly, when conducting Parent Nights and Open Houses, it is clear that most adults recognize the important place that Statistics has in our society and are tremendously supportive of the initiative to equip their children quantitatively through AP Statistics.

In conclusion, the addition of AP Statistics into our district has "humanized" advanced mathematics for our entire high school community. AP Statistics has been a tremendous offering for both our good and our excellent mathematics students. Good students who are not proficient algebraically now have a mathematical course in which to excel. For most of them, AP Statistics will be one of the most important courses they take throughout their high school careers. Excellent mathematics students have benefited by the expansion of their mathematical horizons to include this most important applied mathematics course. Because of AP Statistics in our school, many more of our students now see advanced mathematics as a "do-able" and an accessible option for them. This change in the culture of our school is evidenced by the incredibly high percentage of our students to take at least four years of mathematics. Thanks to AP Statistics, advanced mathematics is not unusual; rather, it has become the expected.