# MATHEMATICS FOR THE UNDER-PREPARED UNDERGRADUATE

**H. Lionel Rosen**
**Lynn University**

Lynn University is a private university located in Boca Raton, Florida. Formerly the College of Boca Raton (until 1992), Lynn offers bachelors and masters degrees, and a new doctoral program in education. There are approximately 2,000 students, many from foreign countries with varied backgrounds, interests and athletic capabilities. There are undergraduate majors in business and management; hospitality, tourism and recreation; education; funeral service; liberal arts; communications; science and health; the recently acquired Harid conservatory of music; and those that are undecided and uncommitted. There is no mathematics major offered, and the mathematics department is therefore a service department dedicated to fulfill the diverse requirements of the university community. The math department is comprised of two full-time and one adjunct professor, who share the load of roughly eight different courses spread among fifteen sections entertaining and enlightening over 400 students each semester. Every undergraduate student is required to complete at lease two math courses in his/her program, and this is where the fun and challenge begins. In the school of business and management, where calculus is a graduation requirement, the path to successful math completion is clear: college algebra and calculus. Students in science and health who require probability and statistics skills take a course in those topics. Those students in business and management who cannot pass a placement test to take algebra are immersed

in a one- semester three-hour course in getting algebra skills up to speed, and then move into the college algebra/calculus stream. Those who for whatever reason (even after several tries) cannot master the algebra placement challenge and therefore cannot move on to college algebra and calculus usually change majors, and fall into the stream of applied math courses with the multitudes of students in other disciplines. These are the ones about which I am spending most of my talk today. I will describe the applied math courses we give, the way we tailor them to different disciplines, and some of the strategies we use to develop interest, enthusiasm and competency, and in some rare cases, a desire for more.

To start, I will illustrate with anecdotes some of the specialized tailoring we do to accommodate our various majors. For the undergraduate majors in hotel, restaurant and hospitality we offer poolside mathematics, with important examples in how to mix drinks given different levels of alcohol content, and how to allocate resources to in restaurant and hotel operations. Future education administrators and teachers, of course, need highly specialized training in mathematics. Their most useful applications will be in the areas of high finance and investments, given the big paychecks they can expect upon entering this most noble and lucrative profession of education. In funeral service, we emphasize mathematics for the dead and grieving, including topics in choosing casket sizes, weight allocation of pallbearers, and time required to dig graves of various dimensions. Our new musicians are given problems relating to audience capacities and performance scheduling including revenues and costs, with emphasis on maximization of profits and minimization of expenses. For those in liberal arts, communications, and the undecided and

uncommitted, we offer a number of generic math applications which hit home and may prove useful in the real world.

Overall, we have several important objectives worth mentioning. These include problem analysis and logical thinking, the ability to interpret what is required to solve a problem, and to forecast an approximation or range of what a sensible answer might be. Why have these become so important? Simply stated, many of the students have become accustomed to punching numbers into a calculator or computer, and accepting the results or output as a correct final answer. They have not been exposed to the possibility of data error or miscalculation, nor have they been trained to estimate the correct answer. Regis Philbin would be appalled and flabbergasted if he were to learn that final answers are accepted so lightly and without additional thought and scrutiny. In turn, with enough varied examples and checking the validity of answers, students develop a sense of comfort and competency with numbers, and how they work.

Specifically, in the applied mathematics courses we cover a number of different topics in an order we believe make sense and tie into one another. First, we ensure the student has a good grasp problem solving using real life situations, including percentages and percentage change under a variety of circumstances. A good set of examples include choosing from two or more competing long distance carriers or car rental companies with different rates, and when it makes no difference which one is chosen. Then we proceed to an explanation and examples of ratios and proportion, and how they apply to real problems such as taxi rides (different rates for the first part and the latter part of the trip, and how far you can go with a certain amount of money, with or without a tip). Third, we consider several job offers which seem to be the same on the surface, but which offer

different raises at different time periods. At this point it is wise to bring in a lawyer (or at least discuss the legalities) to determine what the job offers really mean. Finally on this topic, we talk about flat income tax and structured income tax systems, and the benefits and pitfalls of each given certain levels of income and tax payable. And in order to fulfill our desire to contribute to society by giving a certain amount in taxes, how must much we go out and earn to write that check to Uncle Sam? We now have captivated students' interest through the time honored and indisputable notion of greed; the great potential of making money and saving money using mathematics. Some of the above require the development and solution of fairly simple equations, but that does not present any major problems. Now we have the students where we want them, so we move on to more mundane and esoteric topics. Enter set theory and Venn diagrams, with universal sets, subsets and many of the trappings and a few interesting applications that go with this topic. We use set theory as a preamble to number theory, which as a topic in general takes up a good few weeks. We deal with prime and composite numbers and the fundamental theory of arithmetic, and use set theory union and intersection concepts to come up with lowest common multiples and greatest common factors of sets of numbers. We then deal with the nemesis of many students, the addition and subtraction of fractions. Using lowest common multiples as least common denominators, we use the union of the prime factors of the denominators to come up with the LCD, and generate the required numerators using the remaining prime factors. The notion of relatively prime numbers is then briefly discussed as a by-product of LCM's and GCF's. A natural sequence to this topic is a discussion of rational and irrational numbers, using perfect squares and radicals as a starting point. Simplification of radicals is then explained using

prime factors of radicands, and the students are well prepared to perform various operations using radicals. The notion of rationalization of denominators appeals particularly well to students of psychology when explained that irrational divided by irrational give very irrational results. The psychology students are put at ease when denominators are rationalized, yielding less bizarre answers and therefore more psychologically sound.

The next major topic covered is sequences and series, with the students' first and probably only exposure to mathematical rigor. Funeral service students claim that they have enough exposure to rigor, so assurance that this exercise will not produce any more dead bodies than necessary is essential to the well being of the class. So the rigorous exercise of deriving the nth term and sum of n terms of an arithmetic series is carried out, followed by some interesting and important examples worth mentioning. The class is assigned the happy problem of collecting money for a gift for their favorite mathematics professor. With a starting point and incrementing by a constant amount with each successive student, the following questions can be posed. In any given seat, how much must a student contribute? If a student has a certain amount of money and wants to donate all of it, can it all be donated and where should he/she sit? How much does the entire class contribute? If a certain total amount is required, where does the collection stop? These and similar problems generate some challenging work, and some end up requiring the solution of quadratic equations for those students who can handle it. Similar work can be done with geometric sequences, requiring elegant solutions when exponents with the possibility of same bases are manipulated.

Some consumer-oriented applications are worth mentioning. Simple interest and compound interest investment options are worth comparing. Car purchasing/financing and leasing are also excellent topics. The topic mortgages is useful, from both buying and selling points of view. Using different criteria for mortgage financing, the determination of income requirements needed to buy a certain property is a useful case study. Another would be the possible values of properties which can be acquired given certain levels of income and expenses under varying conditions. These and similar case studies should be fully understood by performing some hand calculations, and verified and expanded by using spreadsheet calculations. This sets a good example for estimating a solution by hand, and verifying results using a computer. Emphasis placed on this type of exercise helps alleviate the problem of over-reliance on computergenerated results, with an eye toward sensible answers instead of rapid and possibly wrong results. A surprising and useful result of these exercises are total amounts paid for these properties over the life of the mortgages, and the income tax advantages generated by owning properties. For shock value and some degree of entertainment, I show a one-hour Public Broadcasting System tape on Andrew Wiles dedicated effort of almost a decade in solving Fermat's Last Theorem. Students walk away in disbelief after experiencing such incredible dedication, commitment and perseverance in solving an almost useless problem. Their math problems pale compared to Wiles, they come to realize.

Testing students on the ideas presented is of course important, and ensure everyone has grasped the ideas and that no one rides on the coattails of anyone else. During the testing process students may run into problems, and I use the idea that help (with some cost) can be forthcoming during tests. If a student needs a kick-start or push on a question during a

test, he/she can ask for help and lose half marks for that problem. If more help is needed on that problem, another 25% of the value of that problem is deducted. After two help sessions no more assistance is available. This alleviates some of the frustration in tackling problems that may otherwise go unanswered, and helps students who may be either stuck or uncertain as to how to proceed. Using this method it behooves the instructor to assign marks for each question in multiples of four for easy grading. The benefits to the above approaches in selecting topics, sequencing, applications and testing processes have proven to be beneficial in serving the interests of the students, and making most of them competent in dealing with applied mathematical topics. Problem analysis, assessing options, estimating sensible answers, exploiting technology and giving students multiple opportunities to succeed have helped them come to terms with a heretofore undesirable subject. Included in the mix are humor, relevance, challenge and sensibility. Rather than despise mathematics, many student have made great strides in progressing to merely a mild hatred for the subject. Those who we have managed to brainwash have come to like the subject, and surprising they may take other math courses as electives. Parental feedback has been truly overwhelming, combining disbelief with great pleasure in seeing their offspring turn from analytical nothings to adept analysts, noting with some shock that their students claim that math is not so bad after all. In closing, I would also urge that professors in a similar environment consider some of the above tactics to declare war on mathematical ineptitude and hostility in a pleasant, useful and productive way. Let us do a great favor and not a disservice to the many students who for various reasons have become turned off by math. We should strive to turn as many of these students as possible into competent analytical adults.