

PROJECT: MATHEMATICAL REASONING

Basic Guidelines:

1. The project is a creative or scholarly undertaking in which you demonstrate your understanding of a mathematical concept, your ability to use mathematical thinking, or how mathematical thinking can be used in everyday life.
2. The project can take any form which is appropriate to communicate your idea. One exception: No board games.
3. The grade is based on three components: mathematical content, creativity, and quality. They are evaluated based on the following criteria.

Mathematical Content The creation of the project required the student to understand a mathematical idea. The mathematical ideas in the project are not simply copied (or paraphrased from) another source. If the project is a paper, explanations of mathematics must be clearly explained in a way that another math 110 student would understand them.

Creativity The topic is approached in a creative way or from an unusual angle. Or the project itself required creative thinking in its production.

Quality The project is well made. Care and effort went into its production. Written projects have a clear thesis or main idea, are clearly organized, and logically presented. Sources are used appropriately and cited correctly.

Here are some ideas to explore, but you are encouraged to come up with your own topic:

1. Book Review: Perhaps a non-traditional textbook would be more appropriate for this class. Would *The Visual Display of Quantitative Information* by Edward R. Tufte be a better book for this class? Or another one of Tufte's books? Some other book?
2. There is disagreement about the size of the crowd present at the peace rally held in San Francisco on February 16, 2003. The San Francisco Chronicle reported on February 24, 2003 that the size of the crowd was much smaller than originally thought. What techniques are used for estimating the size of a crowd? How were they used in the San Francisco peace demonstration?
3. In *Interaction of Color* Josef Albers mentions the Weber-Fechner Law, which describes the intensity of color. Use your understanding of mathematical thinking to explore this idea.

4. Come up with a political question with a mathematical component. How does our voting system compare with those of other countries? What sort of voting do they use in Australia? Ireland? From a mathematical perspective, what are the advantages and disadvantages of these voting systems?
5. Voting theory also plays a role in the BCS.
6. Have you heard about the Great Internet Mersenne Prime Search (Their web page is <http://www.mersenne.org>)?
7. The field of stylometry uses mathematics to determine who wrote a given text. This has been applied to the Federalist Papers and to the works of Shakespeare.
8. People and their clothing are three dimensional. However, fabric and patterns are two-dimensional. What sort of mathematics is needed to design patterns which can be used to sew flat pieces of fabric into three dimensional clothing?
9. Some of the plays of Tom Stoppard (*Rosencrantz and Guildenstern are Dead* and *Arcadia* for two) contain mathematical ideas.
10. The mathematicians Brent Morris and Persi Diaconis are experts on magic and card shuffling. Look into the mathematics of card shuffling. One article about this is found in the October 2002 issue of *Discover* magazine.
11. The ZIP code, the Universal Product Code (UPC), credit card numbers, the International Standard Book Number (ISBN), drivers licenses (in some states — maybe not in TN), and the serial numbers of Euro notes all have rich mathematical structures. Consider one or more of these (or some other) methods of encoding data.
12. In a few of the essays in *The Man Who Ate Everything*, Jeffrey Steingarten (the food columnist for *Vogue* magazine) makes connections between math and food. See the essays “Staying Alive” and “Salt” for two examples.
13. There is a fascinating book called *Mathematics Elsewhere* by Marcia Ascher. See how people in Africa, the Pacific Islands, and elsewhere use mathematical patterns in their traditions.
14. Some people say that the Golden Ratio can be found everywhere from ancient Greek buildings to the United Nations building. What sort of mathematics is used in architecture?
15. There is mathematics in marching band formations.
16. Do four dimensional (or even higher dimensional) versions of the Platonic Solids exist?
17. Graphs used the media and the results of polls are often used in misleading ways. Former British Prime Minister Benjamin Disraeli once said, “There are three types of lies: lies, damned lies and statistics.” Is the public being deceived by the misuse of numerical data?

18. Cryptology is an important subject with a long and rich mathematical history. Describe some aspect of the mathematics used to send data securely.
19. The Association for Women in Mathematics holds an essay contest. (See: <http://www.awm-math.org/biographies/contest.html>)
20. Baseball sometimes seems to be nothing more than a bunch of statistics. The book *Moneyball* by Michael Lewis describes how the Oakland A's used statistics to their advantage.
21. There are many calendar systems besides the Gregorian calendar that we use. Many of these involve modular arithmetic or other mathematical ideas.
22. Mathematics meets the graphic arts in the \TeX typesetting system designed by mathematician and computer scientist Donald E. Knuth.
23. How many ways can a motif be used to form a repeating pattern which fills the plane? What about a strip pattern? Find the answer by learning about the wallpaper groups or the frieze groups. These sorts of patterns are central to the culture of the Bakuba people.
24. There are several unsolved mathematical problems for which a million dollar reward is being offered for the solutions. Write about one of these problems. (See <http://www.claymath.org>.)
25. The fiber artists Ruth MacDowell and Jinny Beyer use mathematics in quilt design. Neither the University library nor the Knox County public library have their books about these topics, so you would have to plan ahead and use inter-library loan.
26. Look at the *Innumeracy* by John Allen Paulos, *Mathematics and Democracy: The Case for Quantitative Literacy* by the National Council on Education and the Disciplines, the article "Can't Read, Can't Count" from the October 2001 *Scientific American* or another similar book (or article) and argue what mathematical knowledge is important for the average person in society.
27. How is mathematics used in the field of archeology?
28. A mathematical idea known as "fractal dimension" has been used to analyze the paintings of Jackson Pollack (there was an article in *Scientific American*). Consider this relationship or another relationship between math and art.
29. We didn't cover the fractal chapter of the textbook. Explore some other idea about fractals.