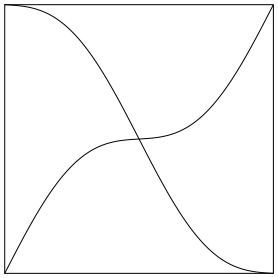
**Math 106-150 - Analytic Geometry & Calculus I** **2nd Semester, '07-'08**
Group Project

Paving the Quad
Due: Thursday, April 10
at the start of recitation

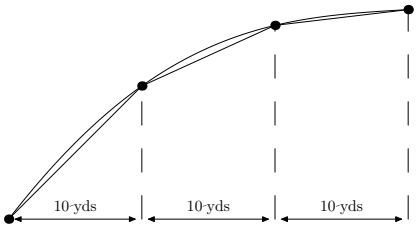


You work for *Concrete 'R' Us*, a company that provides 'concrete solutions' to solve people's paving problems. Your boss wants to prepare a bid on a job at Merrytime University, which involves paving two diagonal paths, on a 100 yard by 100 yard block on campus. Each path is 3 yards wide and 6 inches thick.

To make the paths interesting, the University does not want straight paths. Instead, if the block is bounded by the points $(0, 0)$, $(100, 0)$, $(0, 100)$ and $(100, 100)$ in the $x, y$-plane, then the center lines of the two paths are given by the equations $y = x + 15\sin(\pi x/50)$ and $y = 100 - x + 15\sin(\pi x/50)$. See the picture above.

Your boss wants to know how many cubic yards of concrete it will take to make these paths and how much this concrete will cost. She tells you that good concrete (a limestone/gravel mix that will last) costs \$87.75 per cubic yard. Your answer doesn't have to be exact, but you should be able to explain where you are making approximations instead of exact answers and be able to make some kind of estimate of how much error there is in your answer.

One way to make an estimate, your boss suggests, is to use the length of the center line times the width of the path. Although the exact length of the path is hard to find, you could try dividing the $x$-axis into intervals and approximating the length of the path using straight line segments on each interval (see the figure below). Consider using a spreadsheet to organize your calculations. Include suitable tables in your report.




Estimate how much error your are making in estimating the length of the center line in this way, as well as how much error there is in using the 'length of center line times width' idea. Your boss 'suggested' using the same idea of dividing the $x$-axis, only using intervals of 5 yards instead of 10 yards, to see how the answer changed. Be sure to do this. You are encouraged to find additional ways to estimate the error. Error estimates don't have to be exact, but they should show that your answer is reasonable.

Your boss also wants to know how to improve your answer. Suggest one or two ways to improve the estimate. (If you carry out one of your improved ways, we may give you some bonus points, depending on how much of an improvement it is and how well you carry it out.)

You should prepare a report clearly showing how you came up with your estimates for the volume and cost of concrete, your error estimates, and ways of possibly doing better. Your boss is very busy, so be concise (No 'The purpose of this project is to prove that . . . ', please), clear, and, of course, correct. More detailed advice is on the back of this sheet.

## Project Advice

**Overview.** The project is the solution to an open-ended multistep problem, formally presented. It will probably require several meetings for your group to find a solution to the problem and to present that solution clearly and understandably. Everyone in the group should contribute to the project.

The intent of projects is to expose you to mathematics as you might meet it in the real world, i.e., working as a team. Your group must understand the problem; translate it into mathematics; learn, read about, or develop mathematical methods to find the answer; show that the answer is correct; translate the mathematical answer back into the original problem and, finally, explain the significance of the translated answer. Projects are easier than real world problems, in that we make sure that the problem can be solved using the methods of this course. You may need to learn some new information to do the project.

Preparing formal reports is an important job skill for mathematicians, scientists, and engineers. For example, the Columbia Investigation Board, in its report on the causes of the Columbia space shuttle accident, wrote:

> During its investigation, the board was surprised to receive [PowerPoint] slides from NASA officials in place of technical reports. The board views the endemic use of PowerPoint briefing slides instead of technical papers as an illustration of the problematic methods of technical communication at NASA.

**Project Report.** Your group should write up a short paper explaining the problem and the mathematics you used to solve it, and then discussing the significance of your solution. Your paper should be a grammatically correct, organized discussion of the problem, with an introduction and a conclusion. While you should answer the specific questions asked in the project, your report should *not* be a disconnected set of answers but a connected narrative with transitions. It should conform to proper English usage (yes, spelling counts) and should include appropriate diagrams and/or graphs, clearly labeled. You should show enough relevant calculations to justify your answers but not so much as to obscure the calculations' purpose. In other words, do not include every calculation, but do include sample calculations. Your report should be typed, but it is fine to leave blank spaces and write the equations in.

Explain your results and conclusions, pointing out both strengths and weaknesses of your analysis. Assume that your reader is someone who took a calculus class course a while ago and does not remember all of the details. Be sure to avoid plagiarism.

**The names and recitation numbers of everyone contributing to the report must be listed on the cover page.**

**Group Structure.** To help your group function smoothly, consider assigning each person a role, such as: **Convener:** Arrange times and places for meetings; **Chair:** Ensure everyone is involved and understands the ideas discussed; **Reporter:** Jot down ideas and suggestions as they are discussed; **Scribe:** Prepare first draft of final report.

**Project Grading**

| | | |
|---|---|---|
| Progress Report | | 5 |
| Final Report | Content | 20 |
| | Presentation | 15 |
| Total | | 40 |

**Progress Report.** This is a short statement (a few paragraphs, at most a page), describing how your group is working on the project and what you have done. A progress report showing significant progress will be worth 5 marks towards your group's grade. It is due at the start of class on **April 3**.

**Participation Reports.** Each group member must *individually* fill out a participation report; without a participation report, you may not get credit for the project. You *should not* show your participation report to the other members of your group. Assign a participation score to everyone else in the group. The score is an integer between 0 and 10. A 10 indicates a good-faith effort to understand the discussions, attending the meetings, and doing some work on the project. Give a 0 **only** if you feel that this person should **not get any credit** for the project.

Each person's participation score is the average of the participation scores you receive from other members of the group. If someone's participation score is less than 9, then the score on the project will be multiplied by $(\text{participation score})/10$. I will offer to discuss the project with members of the group, before doing this.

**Project Report.** The report gets two grades: content (out of 20) and presentation (out of 15). Content is self-explanatory—correct mathematical work that does in fact solve the problem. Presentation is partly based on good English usage, for example, using complete sentences, good grammar, and correct punctuation. Most of all, it reflects whether or not you have expressed your content effectively, concisely, and clearly. A good grade on presentation does not require fancy graphics or color printing, but rather clear communication.