Dear Calculus Student,

I'm turning to you in my hour of need. I just got a call from my boss, Mr. Arbeit. He reminded me about the Happy Hog project that I was supposed to do some work on. Now he has to talk to the Board of Directors about the project and he needs me to provide him with some data analysis. I completely forgot that the project needed some calculus knowledge. I had calculus fifteen years ago, and I'd really appreciate some help.

One of the things I need to do is to take a list of measured weights for a hog and come up with a best estimate of the weight. For instance here are some weights for Daisy (all measured in pounds): $243.5, 244.2, 245.0, 243.8, 242.7$. Now I'd just take the average and call it good, but Mr. Arbeit was quoting the USDA Economics, Statistics and Market Information System at me and saying we had to find the number W which minimized the sum of the squared differences. I guess that means making $(243.5 - W)^2 + (244.2 - W)^2 + (245.0 - W)^2 + (243.8 - W)^2 + (242.7 - W)^2$ as small as possible. Can you figure that out? I've got to do that sort of thing for a billion examples, so if you could figure out the answer for any old list of weights that would be great. I guess the list of weights would be something like $W_1, W_2, \ldots, W_n$.

The whole point of this Happy Hog project is to see whether playing Pachabel to the porkers helps them grow better. We have some figures for the amount of extra weight gained for hogs who've had more or less Mozart played over the speakers. Here's the result of a typical experiment:

Hours of music (H)	1	2	4	8	10
Extra weight gain (E)	0.6	1.3	2.2	3.8	5.6

We're pretty sure that the extra weight is pretty much proportional to the hours of music. So we think the relationship is something like $E = kH$. Mr. Arbeit figures you could work out H sort of like you worked out W; by picking the k that minimized the sum of squared differences between the actual E's and the ones the formula would predict. Again, it would be great if you could do this example but also tell me how to handle any experiment.

Just one more thing. Whatever calculations you do you'll have to explain them carefully. Mr. Arbeit needs to go into the meeting confident that he knows how this stuff is worked out. If the directors call him on things and he can't back it up, he'll take it out of my hide. Please help!

Yours sincerely,

Carl "Freddy" Gauss
Porcinitude Meats
Suluclac, NE

Projects

Your project report 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.

Your report

Your group should write up a short paper (2 and a half to 5 pages would be reasonable) 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. 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.