

Math 135 – Preparation for Calculus – Group Project 2 – F’15 – Prof. Janeba

Goals:

- To model a realistic event that is not quite a routine homework exercise.
- To gain further experience working formally in groups.
- To practice communicating and explaining mathematical results about functions and models clearly and professionally.
- To gain practical experience working with exponential and nearly-exponential functions.

The Middleburg Police Department is investigating the death of Mr. J. P. Moneybags, renowned banker and millionaire. He was found dead in his living room at 7 a.m. on November 1 by his faithful butler, Jeeves, as Jeeves returned from a week’s vacation. There is no clear cause of death; it could be natural, but it might not be. Many of Moneybags’ business associates could have reason to want him dead.

Airline boarding records clearly show that Jeeves did not arrive in Middleburg until 5 a.m. that morning. Moneybags’ business partner, Jacob Marley, visited Moneybags the evening before his death (Oct. 31), and claims to have left at 11 p.m. to visit O’Murphy’s bar. Several witnesses verify that Marley arrived at O’Murphy’s by 11:15 p.m., and stayed until closing time at 2 a.m. Marley says that Moneybags was fine when they parted.

Crime scene investigators report that Moneybags’ body temperature was 29.8°C at 7:30 a.m., and that room temperature was 18°C . Note that the body temperature measurement could have an error of as much as $\pm 0.2^{\circ}\text{C}$. Examination of the heating system’s thermostat shows the heating system is programmed to maintain a temperature of 18°C , twenty-four hours a day. This is consistent with Jeeves’ report of Moneybags’ habits.

Your job, as forensic analysis consultants, is to advise the police of Moneybags’ likely time to death.

You know that normal human body temperature is 37.0°C , and that the body temperature of a deceased person (in an 18° room) will usually cool 5.0°C in the first four hours after death. You also know that the *difference* between body temperature and room temperature will fall over time, approximately along an exponential curve. (Yes, there are simpler formulas out there, but we need to be more accurate.)

Your report on the time of death must, of course, stand on its own – no one should need to be familiar with the details presented here in order to understand your report fully. Your report may be contested in court; no one yet knows who may be implicated in Moneybags’ death, so give a very thorough explanation of your methods and reasoning. Convince your readers, most of whom will not be mathematically inclined, that you are correct. Consequently, your conclusions AND the calculations should both be formed into a coherent narrative, rather than a bullet-point list of calculations. Of course you will want to present these results in multiple formats, including a graphical format and a symbolic calculation format.

Report guidelines:

Preliminary report: Your group will submit an initial written (typed) report by 4 p.m Friday, November 6, at the Middleburg Mathematical Analysis Department, room 216, Ford Hall. At a minimum, your preliminary written report will present a mathematical model for the deceased's body temperature over time. Both a symbolic (algebraic) and graphical representation will be in your preliminary report. Finally, an explicit plan for how you will proceed to the problem's conclusion will be given.

Final report due: Thursday, November 12, at 4 p.m. at the MMAD office, Ford 216. Late papers will not be accepted.

Other guidelines:

Present your professionally written report to the MMAD office, carefully printed on plain white paper fastened with a staple. You must also submit an electronic version of your report to your instructor via email. Use Microsoft Word or other suitable word processor. Equations will be typed, using for example the Microsoft Equation Editor built into Word. Graphs that include proper axis labels can be carefully hand-drawn on the report pages OR made using Microsoft Excel, or similar, and electronically inserted into your document. On the front page, team member's names will be clearly visible.

The report will be self-contained, i.e. the reader will not need prior knowledge or understanding of the problem to understand your report. Your calculations and conclusions will be explained in detail, as befits a professional report on a topic of public interest. Your audience consists primarily of non-mathematician police officials, and quite possibly the Middleburg public as well, since this study will be made public in Middleburg. Relatively few of your readers will be fluent in the mathematical concepts used; explain accordingly. Your explanation and presentation are as important as the mathematics, but of course your mathematical analysis must be sound, complete, and correct. It should go without saying that your grammar, punctuation, and spelling will be flawless.

Group evaluation: Your group turns in one report and everyone in the group gets the same grade. To provide some accountability, however, every group member is required to submit to their instructor an informal group evaluation. Handwritten, typed, or email are OK. The evaluation should include (just!) a few sentences about how well the group worked together. The evaluation **must include** your estimate of the share of the project work that you feel each group member did, expressed as a percentage (e.g. 33%/33%/33% or 40%/30%/30%, etc.). **These percentages must add to 100%.** These evaluations will be held in confidence, and used at the end of the semester, if necessary, to adjust final grades.

A word to the wise: This project counts for about 5% of your final grade. Please make sure that your report's qualities of completeness, clarity, and correctness reflect your best abilities. Please carefully read *all* the instructions and resources provided.