Math 141 Honors Project #1
Due Date: Monday, October 5
Information Sheet

In this project, you will act as mathematical consultants to a fictitious manufacturing company. Your goal is to solve the simulated problem described in the attached letter. Your work will be evaluated on the correctness of the mathematics, the clarity of the writing, and the overall presentation.

You should hand in a typed report in the form of a standard business letter responding to the company. I expect that most reports will be approximately 3–5 pages, but it is acceptable to use more or less space if necessary. **All reports are due at the beginning of class on Monday, October 5.**

You will work together in groups of three or four students (check your e-mail for the names of your collaborators). You are responsible for contacting the other members of your group and deciding how to collaborate. All members of the group will receive the same grade on the project (out of 50 points).

You and your group are encouraged to meet with Prof. Martin well in advance of the due date to discuss your ideas and progress (as well as matters such as technical writing style). *You must not consult anybody outside the class, or use any outside resources not specifically allowed in the project description.*

The following checklist will be used to grade your assignment. Please use it as a guide while preparing your report.

Content (25 points)

Does the report:

1. Solve the problem that was originally asked?
2. Construct an accurate mathematical model of the problem?
3. Apply correct and appropriate mathematical techniques to find a solution?
4. Explain all symbols, terminology and notation used?

Clarity (20 points)

Does the report:

5. Give a clear and well-organized explanation of how the model was constructed?
6. Give a clear and well-organized explanation of how the answer was found?
7. Give acknowledgement where it is due, including appropriate citations?

Presentation (5 points)

Does the report:

8. Use correct spelling, grammar and punctuation?
9. Label any figures, drawings or tables appropriately?
10. Look neat?

Braddock Plastics Ltd.
2900 Fahrenheit Road
New Lawrence, CO 80202

September 16, 2009

Dear Consultants:

We are a manufacturing firm that produces plastics and other industrial materials. Our patented production process consists essentially of heating raw materials to a very high temperature in an enclosed chamber, turning them into a sort of "soup" (in the trade lingo). The soup is then enriched with small amounts of certain additives (e.g., stabilizers, colorants, or foaming agents), depending on what finished material is desired. These additives have to be introduced when the temperature of the soup is within a narrow range. For example, Additive A has a *target temperature* (TT) of 300°C and an *allowed temperature error* (ATE) of 20°C; that is, it must be added to the soup when it is between 280°C and 320°C. If it is added at a temperature outside this range, the final product will be inferior or even unusable, so it is imperative for quality control purposes that each additive be introduced to the soup at the right time. Our most common additives, and their TT and ATE values, are listed in Table 1.

What makes the process tricky is that it is very difficult to measure the temperature of the soup. Therefore, instead of trying to keep track of its temperature throughout the production process, we would like to estimate a formula for the temperature T (in degrees Celsius) at any given time m (in minutes after the start of the process). For this purpose, we have, at substantial expense, taken several measurements of the temperature of the soup at specified times (see Table 2). The walls of the reaction chamber are maintained at a constant temperature of 1000°C, and we always start with the same amount of raw materials at room temperature (20°C).

We request your considered professional advice on the following points.

First, one of my assistants has reviewed the data in Table 2 and has suggested the formula $T = 60\sqrt{m} - 200$. We would appreciate your candid evaluation of the suitability of this formula for our purposes. If you are able to suggest a more accurate formula, by all means do so.

Second, we would like to know the appropriate time interval during which each additive in Table 1 should be added to the soup. Please note that Table 1 is not exhaustive; there are many other possible additives that can be used. Therefore, while we are most interested in the additives listed in Table 1, it would be more useful to have an answer that encompasses other ATE values for the TT's listed in the table. Actually, it would be even better if you can provide an answer that allows for all possible values of both TT and ATE.

We would like to have your finished report of approximately 3–5 pages no later than Monday, October 5 at 10:00 AM. To assist you, we have assigned our mathematical advisor (none other than your fine instructor) to answer any questions your group may have in the course of your investigation and to assist you in preparing your report. We encourage you to take advantage of his services well in advance of the deadline.

Sincerely,

Ed Small
Chief Engineer

Table 1: TT and ATE values for some common additives

Additive	Target temperature (TT) (°C)	Allowed temperature error (ATE) (°C)
A	800	50
B	800	15
C	800	10
D	800	5
E	680	15
F	525	15
G	525	10
H	525	5

(The actual names of the additives are trade secrets, and have been omitted on the advice of our attorneys.)

Table 2: Temperature of the soup during the production process

Time (min)	Temperature (°C)
50	230
100	405
150	545
200	650
250	730
300	800