MATH 142
Group Project: The Velodrome
by Professor Mark Janeba

Due Friday, February 10 by 5pm

Goals:

1. Gaining experience in group work.
2. Gaining experience in writing mathematically technical reports with precision.
3. Practice with Riemann sums and integration of tabular data.

Background:

In the year 2016, as Salem prepares to host the Olympics, Frank and Mark have a test-race on their bicycles on the new Willamette velodrome. As they ride on the velodrome, cycle-computers attached to their bicycles' handlebars record their velocities. The velocities are recorded every 0.2 seconds beginning at the point 350 feet before the finish line; the data is displayed in the attached table. Just as recording begins they are side-by-side. Frank and Mark continue riding for a brief period after the finish line.

Your Mission:

Give a complete report of the events of the race, in essay form. Show how you reached your conclusions by showing the calculations you made. Include the following specifics, but remember to make the entire report hold together in the form of an essay.

Specifics: Plot graphs of the velocity functions of the two cyclists on the same set of axes. What qualitative information is evident from these functions? For example, when is Frank riding faster than Mark? When is Mark riding faster than Frank? You might discuss the apparent race strategies of Frank and Mark, explaining how you make inferences from the graphs.

Using the best estimates you can, create a table of the distance functions of the two cyclists and then plot the graphs of the distance functions of the two riders on the same set of axes. What qualitative information about the cyclists is evident from these functions? For example, when are the two riding side by side? When is Mark ahead of Frank on the track? When is Frank ahead of Mark?

Your report should also address the following questions: Who won the race? How far did each cyclist ride during the 11 seconds that data were recorded, and what are the maximum possible errors in that calculation? Can these errors affect your decision about who won the race?

Assignment notes:

Your project must be typed, although the graphs may be drawn by hand. A spreadsheet program may be of assistance in this project, both for calculations and for graphing the tables. See me if no one in your group knows how to use a spreadsheet. The final report must be in the form of an essay that is easy to read and that explains all statements in a clear and unambiguous manner. It must not be of the form "question... answer, question... answer," etc. For repetitive calculations, present two or three of each type of calculation in the report to indicate the manner in which they were made. Please make sure that the reader is able to tell exactly where every single number came from. The reader should be able to use your report to tell how to re-calculate every number, in order to check your figures. Assume that the reader is another Calculus II student not working on this project. Remember to integrate the presentation of calculations and conclusions - that is, putting all the calculations at the end in an appendix is not acceptable.

A preliminary report is due at the beginning of class, Friday, February 3. The preliminary report will be a fairly formal report that addresses several of the project questions and outlines how your group will approach the remaining questions.

Your final project report is due at 5 p.m. Friday, February 10, at my office in Ford 213.

Data

Variables: t is elapsed time from beginning of data recording, in seconds; V_m and V_f are Mark and Frank's velocities, in mph, respectively. The numbers are rounded to one decimal place.

t	V_m	V_f	t	V_m	V_f
0.0	7.2	10.6	5.6	25.1	23.6
0.2	7.8	10.9	5.8	26.0	24.9
0.4	8.2	10.9	6.0	26.9	26.2
0.6	9.2	11.9	6.2	27.9	27.5
0.8	10.2	11.9	6.4	28.8	28.8
1.0	11.9	11.9	6.6	29.7	30.1
1.2	11.9	11.9	6.8	30.7	31.4
1.4	11.9	11.9	7.0	31.6	32.7
1.6	11.9	11.9	7.2	32.6	34.0
1.8	11.9	11.9	7.4	32.7	34.0
2.0	11.9	11.9	7.6	33.1	34.0
2.2	11.9	11.9	7.8	33.1	34.0
2.4	11.9	11.9	8.0	33.4	34.1
2.6	11.9	11.9	8.2	33.4	35.1
2.8	11.9	11.9	8.4	33.4	36.1
3.0	12.9	11.9	8.6	33.4	36.5
3.2	13.8	11.9	8.8	33.4	36.8
3.4	14.7	11.9	9.0	33.4	36.8
3.6	15.7	11.9	9.2	34.1	36.8
3.8	16.6	11.9	9.4	35.5	36.8
4.0	17.6	13.2	9.6	36.0	36.8
4.2	18.5	14.5	9.8	36.0	36.8
4.4	19.4	15.8	10.0	36.0	36.8
4.6	20.4	17.1	10.2	36.0	36.8
4.8	21.3	18.4	10.4	36.0	36.8
5.0	22.2	19.7	10.6	36.0	36.8
5.2	23.2	21.0	10.8	36.0	36.8
5.4	24.1	22.3	11.0	36.0	36.8

[Hint: you can copy and paste the data from the electronic copy of the project on our course website. In Excel, you can use Data− >Text to Columns to convert the data to separate columns.]