Math 32, Optional extra credit projects

Do at most <u>two</u> of the following six projects. They are worth an extra 3% each added to your overall grade, making a total of 6% if you do two. If you want to hand in any of these projects, I must receive them by Monday, December 11.

Useful references:

- Wikipedia
- MacTutor: `http://www-history.mcs.st-and.ac.uk/`
- Calculus by James Stewart (8th Edition)

You may use other sources. Make sure you cite any sources you use. Anything you write must be in your own words and not just copied from somewhere (or someone) else.

Project 1. The History of Calculus. Read the history of calculus at MacTutor

`www-history.mcs.st-and.ac.uk/HistTopics/The_rise_of_calculus.html`

and on Wikipedia. Give an account of this history in your own words and paying special attention to the contributions of Archimedes, Barrow, Newton and Leibniz as well as their early applications. Write about three pages.

Project 2. Applications. Read through sections 8.3, 8.4, 8.5 of the Calculus text where applications of calculus to physics, engineering, biology, economics and probability are given. Summarize some of these applications in your own words, giving mathematical examples. Write about three pages.

Project 3. The History of Logarithms and e. Read the history of logarithms at MacTutor

`www-history.mcs.st-andrews.ac.uk/Biographies/Napier.html`

and on Wikipedia. Give an account of this history in your own words and paying special attention to the contributions of Napier, Oughtred and Euler as well as their early applications. Starting with a number N, Napier's original logarithm was the solution L to the equation

$$N = 10^7(1 - 10^{-7})^L.$$

Can you explain why L is approximately $-10^7 \ln(N/10^7)$ in our modern notation? Write about three pages.

Project 4. Two integrals. In this project we first look at the integral

$$\int x^n \ln x \, dx.$$

Start by computing this integral when $n = 0, 1$ and 2. Show that this integral can be computed when n is any real number. Why does the case of $n = -1$ have to be done differently?

Secondly, look at the integral

$$\int x^n e^x \, dx.$$

Compute it for $n = 0, 1$ and 2. Do you see a pattern? What will this integral be for any positive integer n?

Project 5. The History of Trigonometry. Read the history of trigonometry at MacTutor

`www-history.mcs.st-and.ac.uk/HistTopics/Trigonometric_functions.html`

and on Wikipedia. Give an account of this history in your own words. For example, instead of our modern trigonometric functions like sine and cosine, everything was expressed in terms of chords - what were they? The half angle formula we use

$$\sin^2(\theta) = \frac{1}{2}(1 - \cos(2\theta))$$

is due to Ptolemy. Who was he and what was he doing? Write about three pages.

Project 6. Kepler's Laws Read about Kepler's Laws at MacTutor

`www-history.mcs.st-and.ac.uk/HistTopics/Orbits.html`

and on Wikipedia. Give an account of these laws in your own words and paying special attention to the contributions of Brahe, Kepler, Newton and Halley. Newton's proof of Kepler's Laws from his own laws of force and gravitation was one of the first great achievements of calculus. Write about three pages.