Math 206 Project 2
Initial Due Date Sunday 27 July 2014 at 6:00pm

Covers:

This project covers up through Chapter 14 of the tutorial.

What to Submit:

For this project you will need to create and submit a single script m-file called `project2.m` (all lower case!) which is marked up for publishing. This file should do all of the things requested in the problems below in the order specified. The answers should be placed into variables as specified. The marking up should be done in the following way:

Each command should be within its own section (use `%%`) and be preceded by a brief description (use `%`) describing what that particular command does in your own words using full sentences. Use bullets, numbered lines, boldface and italics in a way which helps your descriptions and makes your published m-file easier to read.

Grading Method:

Grading for this course is via an automated grading system which checks both that your answers are correct and that you used the correct method of obtaining them. This is why it is important to assign your answers to the correct variable names and use the methods specified. The plots and marking up (marking up is worth 9 points) will be checked by hand. Once the grading is done, a text file will be uploaded to ELMS containing the results.

If there are any unexpected errors then the project will automatically earn a grade of 0 so make sure you run your m-file through Matlab and check the output before submitting! Be very careful about making sure that any necessary symbolic variables are defined in your code. The assumption should be that we will run your m-file through a clear matlab process.

Final Warning:

When you test your script m-file, type the following in Matlab:

```
>> clear all
>> project2
```

This will make sure that you've cleared out any residual defined variables and it will make sure that your code is not going to error. You have been warned!

The Problems:

1. Declare all symbolic variables and functions you will need for the project. [4 pt]
2. Use `fzero` to approximate a root of $x - 3\cos x$ near $x = 1.5$. Assign the answer to `p2`. [4 pt]
3. The population of bacteria in a culture at time t is given by the function $\frac{1000}{1+e^{-0.1t}}$. Find the rate of growth of the population at $t = 15$. Assign the answer to `p3`. [5 pts]
4. Find the approximate concavity measurement (second derivative) of the function $\sin\left(\frac{x^2-1}{2x-3}\right)$ at $x = 2$. Assign the answer to `p4`. [5 pts]
5. Evaluate $\int x^3 \cos x \; dx$ with `int`. Assign the answer to `p5`. [5 pts]
6. Use `int` to evaluate the integral whose result is the area under the function $y = -x^2 + 5x - 1$. How you find the interval of integration is up to you and is not part of this assignment but the interval should be exact. Assign the answer to `p6`. [5 pts]
7. If a population has mean 0 and standard deviation 1 and is normally distributed then the probability that a randomly chosen value is between 0.11 and 1.3 is given by $\int_{0.11}^{1.3} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2} dx$. Use `integral` to approximate this value. Assign the answer to `p7`.
   Note: You don't need to know anything about probability to do this problem. just integrate. [5 pts]
8. Solve the initial value problem $\frac{dy}{dt} + y = t^2$ with $y(2) = 5$ using the first method shown in the tuturial. Assign the answer to `p8`. [5 pts]
9. Logistic population growth (exponential but eventually limited) is modeled by a function which satisfies the differential equation $y' = ky(L - y)$ where k is the growth rate and L is the limit. Use `dsolve` wrapped in `subs` and using the second method in the tutorial (symbolic function - make sure you've done a `syms` for this) to find the population after 10 years if an initial population of $y(0) = 70$ has growth rate $k = 0.00022$ and limit of $L = 3000$. Assign the answer to `p9`. [10 pts]
10. (a) Declare the function $f(x) = \frac{x}{\sqrt{2x+7}}$ symbolically. Use this declaration for all of the following: [2 pts]
    (b) Evaluate $f(-2)$. Assign the answer to `p10b`. [2 pts]
    (c) Evaluate $f'(-2)$. Assign the answer to `p10c`. [5 pts]
    (d) Evaluate $\int_1^3 xf(x) \; dx$. Assign the answer to `p10d`. [5 pts]
11. (a) Declare the function $g(x) = \sqrt[3]{x^3 + 1}$ with a function handle. Use this declaration for all of the following: [2 pts]
    (b) Evaluate $g(2)$. Assign the answer to `p11b`. [2 pts]
    (c) Evaluate $\left(\frac{g(x)}{x}\right)''(5)$. Note the 5 is plugged in here! Assign the answer to `p11c`. [5 pts]
    (d) Use `integral` to approximate $\int_0^2 x^2 g(x) \; dx$. Assign the answer to `p11d`. [5 pts]
12. Plot $y = x^3 - 8x + 3$ using `ezplot`. [5 pts]
13. First execute the `figure` statement and then plot the solution to the initial value problem $4u''(t) + \frac{1}{3}u(t) = 0$ with $u(0) = 3$ and $u'(0) = -1$ using `ezplot` wrapped around `dsolve` wrapped around the differential equation. You can solve apply `dsolve` either way. [10 pts]