Math 302: Problem Set 3

Due: September 24, 2009

Email me your m-files and results as attachments in ONE email with each m-file having the format `firstname_lastname_prob.m`. Be sure to comment your code so I can follow it.

1. (25 points) Create a script called `invest.m` that solves the following. The value V of an initial investment P in a savings account paying an annual interest rate r is given by

$$V = P\left(1 + \frac{r}{m}\right)^{mt},$$

where m is the number of times the interest is compounded in a year and t is the number of years. If the interest is compounded continuously, the value is given by

$$V = Pe^{rt}$$

Consider an investment of $\$5,000$ for 15 years at an annual interest rate of 7.5%. Show the difference in the value of the account when the interest is compounded annually, quarterly, and continuously by constructing a plot that shows the value of the investment as a function of time (years) for each compounding method. Plot the three cases in the same plot, use a different line type for each plot, label the axes, create a legend, and add a title to the plot.
Grading: 5 points for each case, 5 points for labeling the axes, title, and legend, 5 points for commenting

2. (40 points) Create a script called `projectile.m` that solves the following. If a projectile is fired with an initial velocity of v_0 meters per second at an angle α above the horizontal and air resistance is assumed to be negligible, then its position after t seconds is given by the parametric equations

$$x = (v_0 \cos\alpha)t \quad y = (v_0 \sin\alpha)t - \frac{1}{2}gt^2$$

where g is the acceleration due to gravity (9.8 m/s^2).

   (a) If a gun is fired with $\alpha = 30°$ and $v_0 = 500$ m/s, when will the bullet hit the ground? How far from the gun will it hit the ground? What is the maximum height reached by the bullet? Calculate these showing all work and graph the position of the bullet to check and demonstrate your answers. Be sure to put your answers in the header of the m-file in commented form.

   (b) Using `subplot`, graph the path of the bullet for 4 values of α (with appropriate titles!) demonstrating how your answers to part (a) may change.

Grading: 5 points for calculating when the bullet will hit the ground, 5 points for distance from the gun, 5 points for the max height reached, 5 points for graph of part a, 10 points for graph of part b, 5 points for description of how graph changes, 5 points for commenting.

3. (15 points) Create a script called `collide.m` that solves the following.Given paths of two particles traveling in space, it would be important to know whether the particles collide or if the curves intersect. For the two particles traveling along the space curves given by

$$\mathbf{r}_1(t) =< t^2, 7t - 12, t^2 > \quad \mathbf{r}_2(t) =< 4t - 3, t^2, 5t - 6 >$$

where t is time in seconds, with $t \geq 0$, graph the space curves to see if they intersect, then comment (showing work) whether they actually collide.
Grading: 5 points for graph, 5 points for work, 5 points for commenting

4. (20 points) Create a script called `sinefun.m` that solves the following. Graph the function using `mesh` and `surf`.

$$f(x, y) = \sin\left(\frac{2\pi x}{60}\right) \sin\left(\frac{3\pi y}{60}\right)$$

in the domain $x \in [0, 100]$ and $y \in [0, 100]$. Graph the plots side-by-side. In the comments section, explain which of the graphs you prefer and why.
Grading: 5 points for mesh, 5 points for surf, 5 points for explanation, 5 points for commenting