Portfolio

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Purpose

Throughout this course, you will work through a few prompts and collect them together in a course portfolio. These prompts represent key topics in this course. As you progress through the course, you will add to this portfolio and also have an opportunity to go back and edit any previous responses. By the end of the term, you will have a portfolio of work that demonstrates your understanding of this course.

Drafts

Each week, you will submit a draft of a portfolio prompt. Each draft may be submitted as many times as you like. Each draft will receive written feedback to help you edit your next submission. When a submission is polished, the feedback of "great!" will be written at the top of the page. Unless an issue is a minor fix, you will need to rewrite the submission, addressing all of the feedback you received. When submitting a draft,

- Write "Prompt #" at the top of the page, along with your name.
- Write out the entire instructions of the prompt before responding.
- Show all work, and write a sentence to justify anything that is unclear.
- Work vertically – do not write $a = b = c = d$ in a horizontal manner.
- At the end, respond to the prompt with a complete sentence.
- Any new prompt will begin on a new page.
- Any portfolio prompt with a "great!" on it should be saved to submit at the end of the term.

Full Portfolio

This portfolio will be worth 100 points at the end of the term. When you submit your portfolio, create a Cover Sheet. It should say "Portfolio" along with your name. Then include all of the portfolio prompts, in order, and staple your work in the top-left corner.

Prompts

Prompt 1

A stick of butter found to be 37°F is removed from the refrigerator and set on the counter in the 70°F kitchen. If the butter is found to be 46°F after 5 minutes, how long should we expect to wait until the butter reaches 68°F? Begin by writing a differential equation to model the change in temperature of the butter over time, then solve the IVP. Show all work that justifies your conclusion.

Prompt 2

The differential equation $x' + x\cos t = \cos t$ is both linear and separable.

1. Use separation of variables to find a general solution of the differential equation.
2. Use an integrating factor to find a general solution of the differential equation.

Prompt 3

Solve the IVP $\frac{d^2Q}{dt^2} + 6\frac{dQ}{dt} = -5Q, Q(0) = 2, Q'(0) = -1$.

Prompt 4

Consider a mass-spring system that has a 3 kg mass attached to a spring (which is attached to a wall) and a dashpot. Suppose that the spring gives a spring constant of $k = 75$.

1. Find the b-value (representing the resistance provided by the dashpot) that will produce a critically-damped system.
2. Suppose that the dashpot provides a resistance given by $b = 18$ and that this system has a forcing function of $3te^{2t}$. Find a formula for the position of the mass at time t.

Prompt 5

A field contains C chicken eggs and S snakes. On any given week, the changing population of eggs and snakes is modeled by

$$\frac{dC}{dt} = 20C - 14CS$$
$$\frac{dS}{dt} = -2S + 4CS$$

1. If $x = C$ and $y = S$, find the x-nullclines and the y-nullclines.
2. Find the equilibrium solutions for this system.
3. Using full sentences and units, describe what the equilibrium solutions represent in terms of numbers of eggs and snakes.

Prompt 6

Solve the IVP below.

$$\mathbf{x}' = \begin{bmatrix} 2 & 3 \\ -6 & -4 \end{bmatrix} \mathbf{x} \qquad , \qquad \mathbf{x}(0) = \begin{bmatrix} 0 \\ -2 \end{bmatrix}$$

Prompt 7

Find and classify the equlibria of the system below. Show all work to justify your conclusion.

$$\frac{dx}{dt} = 2x\left(1 - \frac{x}{2}\right) - xy$$
$$\frac{dy}{dt} = 4y\left(1 - \frac{y}{4}\right) - 4xy$$

Prompt 8