The textbook of the future

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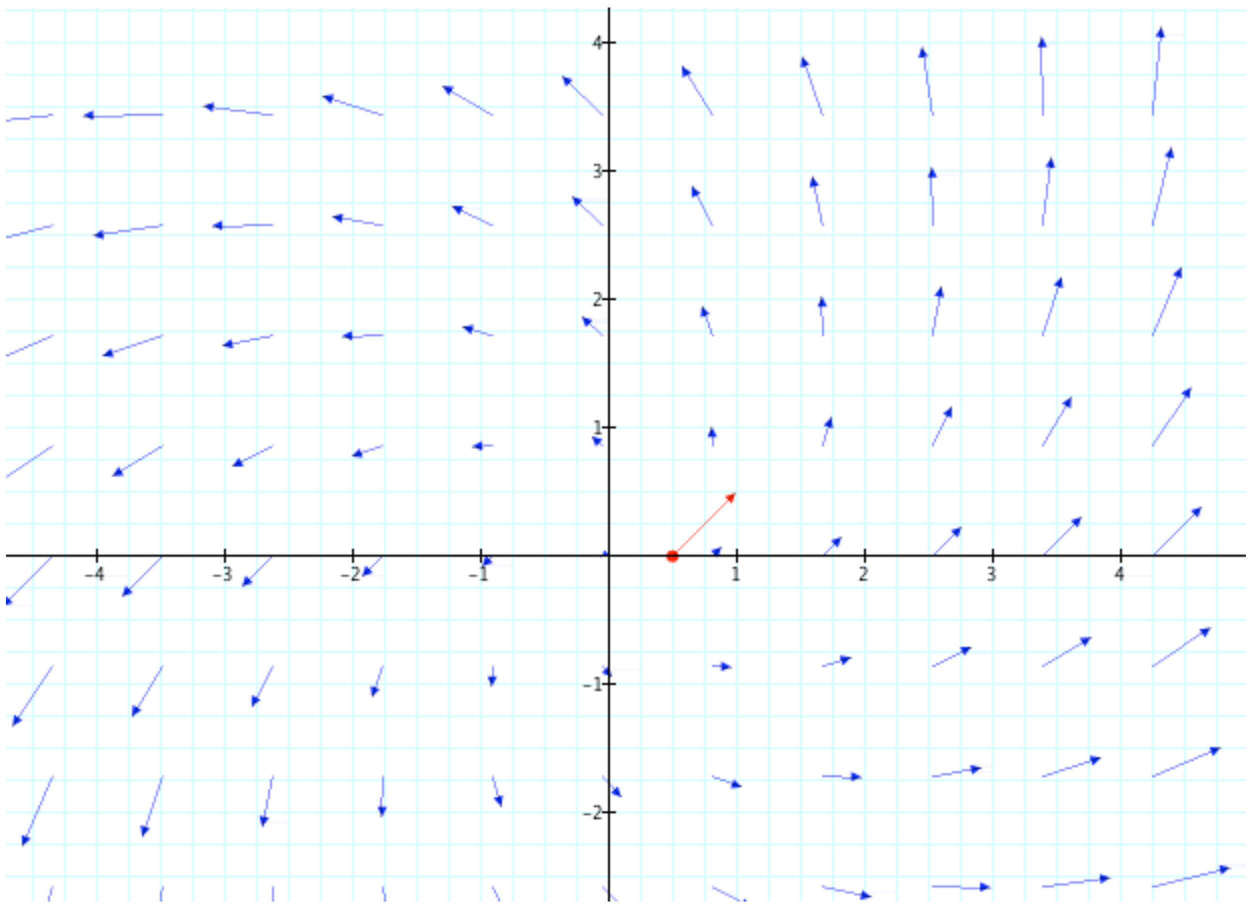
Accessibility

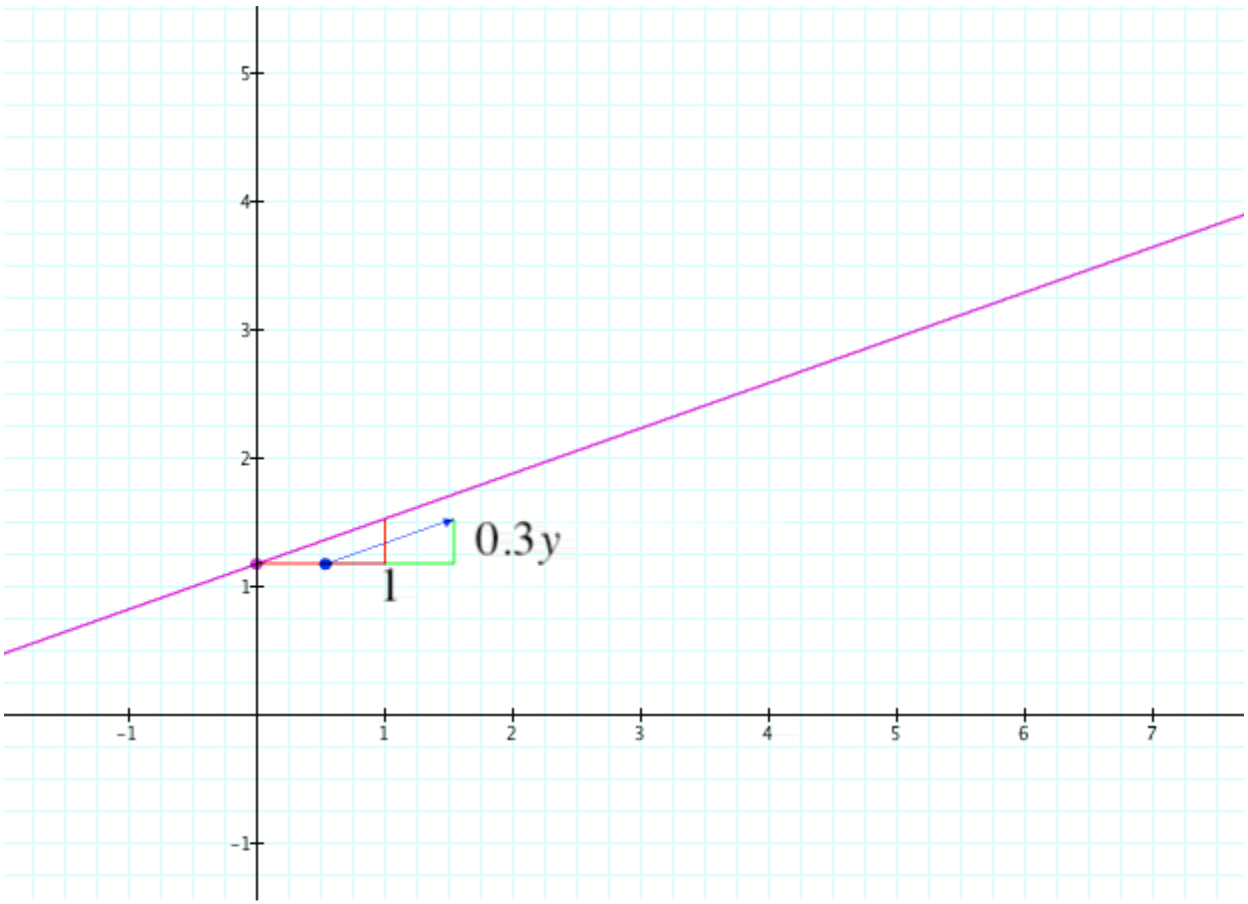
An e-text is more than a pdf

- Interactive
- Adaptable
- Non-linear

Phase plane



Exponential Growth



How many examples do you need?

Second-Order Linear Homogeneous Equations

Additional Examples

Solve the initial value problem

$$\frac{d^2y}{dx^2} + 16\frac{dy}{dx} + 100y = 0$$
$$y(0) = 4$$
$$y'(0) = -3$$

This is a second-order linear constant-coefficient initial value problem. First we find the general solution.

Step 1: Write the equation in operator form.

$$(D^2 + 16D + 100)y = 0$$

Step 2: Find the roots. We use the quadratic formula to compute the roots, $-8 \pm 6i$

Step 3: Write the general solution.

$$y(x) = c_1 \exp(-8x)\cos(6x) + c_2 \exp(-8x)\sin(6x)$$

Now that we have the general solution, we plug in our initial values to find the solution to the initial value problem. First we compute, $y'(x) = -8c_1 \exp(-8x)\cos(6x) - 6c_1 \exp(-8x)\sin(6x) - 8c_2 \exp(-8x)\sin(6x) + 6c_2 \exp(-8x)\cos(6x)$. Then we plug in $x = 0$ to get the following equations.

How many examples do you need?

Second-Order Linear Homogeneous Equations

Additional Examples

Solve the initial value problem

$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} = 0$$
$$y(0) = 5$$
$$y'(0) = 0$$

This is a second-order linear constant-coefficient initial value problem. First we find the general solution.

Step 1: Write the equation in operator form.

$$(D^2 - 2D)y = 0$$

Step 2: Find the roots. The equation factors into *D*(D - 2)y = 0.$ So our roots are 0 and 2.

Step 3: Write the general solution.

$$y(x) = c_1 + c_2 \exp(2x)$$

Now that we have the general solution, we plug in our initial values to find the solution to the initial value problem. First we compute, $y'(x) = 2c_2 \exp(2x)$. Then we plug in $x = 0$ to get the following equations.

How many examples do you need?

Second-Order Linear Homogeneous Equations

Additional Examples

Solve the initial value problem

$$\frac{d^2y}{dx^2} + 9\,\frac{dy}{dx} = 0$$
$$y(0) = -6$$
$$y'(0) = 7$$

This is a second-order linear constant-coefficient initial value problem. First we find the general solution.

Step 1: Write the equation in operator form.

$$(D^2 + 9D)y = 0$$

Step 2: Find the roots. The equation factors into *D*(D + 9)y = 0.$ So our roots are 0 and -9.

Step 3: Write the general solution.

$$y(x) = c_1 + c_2 \exp(-9x)$$

Now that we have the general solution, we plug in our initial values to find the solution to the initial value problem. First we compute, $y'(x) = -9c_2 \exp(-9x)$. Then we plug in $x = 0$ to get the following equations.

Choose your own HW

Select the type of problem you would like to answer.

- ◉ **Agriculture**
- ○ **Business**
- ○ **Education**
- ○ **Social Science**

The total number of acres of farmland in the U.S. between 1990 and 2007 can be viewed in the Excel worksheet. Use the worksheet to graph the data provided. Then use techniques learned in Studio 4 to add a quadratic trendline (remember that a quadratic is a polynomial of degree 2), **rescaling the data so you are using x is years since 1990**. When creating the trendline, include the equation and the R^2 value on the chart.
Source: U.S. Department of Agriculture.

(a) Enter the equation found by creating the trendline.
(b) Does this function appear to be a good model of the data? Explain.
(c) According to the model, how much farmland will there be in the U.S. in 2010?

Choose your own HW

Select the type of problem you would like to answer.

- ○ **Agriculture**
- ◉ **Business**
- ○ **Education**
- ○ **Social Science**

Sony's yearly sales in billions of U.S. dollars are given in the Excel worksheet. Use the worksheet to graph the data provided. Then use techniques learned in Studio 4 to add a quadratic trendline (remember that a quadratic is a polynomial of degree 2), **rescaling so x is years since 1984**. When creating the trendline, include the equation and the R^2 value on the chart.
Source:http://www.sony.net/SonyInfo/IR/library/historical.html

(a) What is the equation of the trendline?
(b) Is this a reasonable equation? Explain.
(c) According to the model, what will Sony's total sales be in 2011?

Choose your own HW

Select the type of problem you would like to answer.

- ○ **Agriculture**
- ○ **Hollywood**
- ○ **Life Expectancy**
- ◉ **There's an App for that**

Apple introduced the iTunes App store in July 2008. Since then the number of apps available has increased. The Apps worksheet has the number of active Apps available by month for the first two years of the App store. Graph the data on an x-y scatter plot.

(a) Using what you learned in studio, add an *EXPONENTIAL* trendline with the equation and the R^2 value displayed on the graph. What is the exponential equation that best models the data?
(b) Using your model, predict the number of apps available in June 2011. Is this value reasonable?
(c) Create a second trendline, this time a *POWER* function. Make sure to display the equation and the R^2 value on the graph. Eneter the equation in the space provided. Does the exponential or the power function appear to be a better model of the data. Refer to the techniques in the studio to decide on which model, exponential or power, is better.

Non-linear

- Branching pathways
  - Core differential equations
  - Application modules
    - Biology, Physics, Mechanical Engineering, etc.
- Quick Reference - Wiki model
- Gamification

Data Mining

- Amazon.com model
  - Collect data on behavior
    - Scores, number of repeated visits, navigation patterns
  - Classify students
  - Provide different experiences to different classifications
    - Recommended pages, different sequences, customized content

The textbook of the future

- Portable
  - Accessible by computer, tablet, phone
- Interactive
  - Interactive diagrams, Student determined pathways, Infinite examples
- Adaptable
  - Data mining and differentiated instruction, Customized to student input
- Non-linear
  - Branching pathways, Reference structure