

## 8.3 Empirical Models

### *Mathematica* Quick Review Questions

*Introduction to Computational Science: Modeling and Simulation for the Sciences*

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This file contains system-dependent Quick Review Questions and answers in *Mathematica* for Module 8.3 on "Empirical Models." Complete all code development in *Mathematica*.

### Linear Empirical Model

**Quick Review Question 1** List the expressions that are linear combinations of  $u$  and  $v$ .

- A.  $5u - 18v$       B.  $-18v + 5u$       C.  $7u$   
D.  $15uv$       E.  $u/5 + v/3$       F.  $5/u + 3/v$

**Quick Review Question 2** Give the command in an appropriate software system to return the equation in  $x$  for the least-squares line that fits the list of points,  $lst$ , and passes through the origin.

### Non-Linear One-Term Model

**Quick Review Question 3** Suppose  $xLst$  and  $yLst$  are lists of  $x$  and  $y$  values, respectively.

- a. Suppose we wish to assign to  $pts$  the list of ordered pairs of corresponding  $x$  and  $y$  values but not to display the result. Give name of the function to generate a list of ordered pairs with values from  $xLst$  and  $yLst$ .
- b. Select the symbols that surround the argument(s) of this function.  
A.  $()$       B.  $\{\}$       C.  $[]$       D.  $\langle \rangle$   
E.  $" "$       F.  $' '$       G. nothing
- c. Select the symbols that surround the pair  $xLst, yLst$  to return a list of the list of  $x$  values followed by the list of  $y$  values.  
A.  $()$       B.  $\{\}$       C.  $[]$       D.  $\langle \rangle$   
E.  $" "$       F.  $' '$       G. nothing
- d. Select the symbol so that the result of the command to obtain the list of ordered pairs is not displayed.  
A.  $.$       B.  $,$       C.  $;$       D.  $?$   
E.  $!$       F.  $:$       G. nothing
- e. Give the entire command to assign to  $pts$  the list of points with  $x$ -values from  $xLst$  and  $y$ -values from  $yLst$ .
- f. Suppose instead of constructing a list of ordered pairs from lists  $xLst$  and  $yLst$ , we wish to read the data from *DanWoodEM.dat*, where each line contains an  $x$

and then a  $y$ -value. Give the command to read this data and to assign to *pts* the list of data points.

- g. Give the name of the function to plot these points.
- h. Give the command to produce a plot similar to that of Figure 8.3.5. Assign the graphics to variable *lp*.
- i. Give the command to display a line from the first point, (1.309, 2.138), to the last, (1.68, 5.66). Assign the graphics to variable *lne*.
- j. Give the command to display *lp* from Part h and *lne* from Part i on the same graph.

### Solving for $y$ in a One-Term Model

**Quick Review Question 4** Suppose *xLst* and *yLst* are lists of  $x$  and  $y$  values, respectively. Give the command in an appropriate software system to assign to *pts* the list of ordered pairs of corresponding  $x$  and  $y$  values but not to display the result.

**Quick Review Question 5** Give the command in an appropriate software system to generate the plot in Figure 8.3.13, where *pts* is the list of ordered pairs for the data and the points are larger.

### Answers to Quick Review Question

1. The following are linear combinations of  $u$  and  $v$ :
  - A.  $5u - 18v = (5)u + (-18)v$
  - B.  $-18v + 5u = (-18)v + (5)u$
  - C.  $7u = (7)u + (0)v$
  - D.  $u/5 + v/3 = (1/5)u + (1/3)v$
2. Because a line through the origin has the form  $y = mx$ , the command is any of the following:
 

```
Fit[lst, {x}, x]
Fit[lst, {0, x}, x]
Fit[lst, {x, 0}, x]
```
3.
  - a. *Transpose*
  - b. C. `[]`
  - c. B. `{ }`
  - d. C. `;`
  - e. `pts = Transpose[{xLst, yLst}];`
  - f. `pts = ReadList["DanWoodEM.dat", {Number, Number}]`
  - g. *ListPlot*
  - h. `lp = ListPlot[pts, AxesLabel -> {"x", "y"}, PlotStyle -> {PointSize[.03]}];`
  - i. `lne = Show[Graphics[Line[{{1.309, 2.138}, {1.68, 5.66}}]]];`
  - j. `Show[lp, lne];`

4. `pts = Transpose[{xLst, yLst}];`
5. `lp = ListPlot[pts,  
PlotStyle -> {PointSize[.03]}];`