8.3 Empirical Models

R Quick Review Questions

Introduction to Computational Science:
Modeling and Simulation for the Sciences, 2ⁿᵈ Edition
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This file contains system-dependent Quick Review Questions and answers in R for Module 8.3 on "Empirical Models." Complete all code development in R.

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   Consider the set of points pts = {(0.2, 0.1), (0.4, 0.3), (0.3, 0.3), (0.3, 0.6)}.
a.   Assign to $xLst$ a vector of the x-coordinates.
b.   Assign to $yLst$ a vector of the y-coordinates. Combine the two vectors into a data frame called *data*.
c.   Give the command to return the model for the least-squares line that best fits the set of points.
d.   Assign to x a sequence of numbers from 0 to 0.6 varying by 0.1, and do not display the result.
e.   Assign to *lineValues* the corresponding list of y-values for the line of Part c.
f.   Graph the line.

Non-Linear One-Term Model

Quick Review Question 3   Suppose *pts* is a data frame of points, where the first column contains the x-coordinates and the second column contains the corresponding y-coordinates.
a.   Give the command to obtain the first column of *pts* and assign it to a variable called $xLst$.
b.   Give the command to obtain the second column of *pts* and assign it to a variable called $yLst$.

      c.   Suppose instead of constructing *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.

      d.   Give the name of the function to plot these points.

      e.   Give the commands to produce a plot similar to that of Figure 8.3.5, including the labels. (Hint: some of these graphics commands are in the EmpiricalModels.R file.)

      f.   Give the command to display a line from the first point, (1.309, 2.138), to the last, (1.68, 5.66).

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.   **a.**
```
xLst = c(0.2, 0.4, 0.3, 0.3)
```
      b.
```
yLst = c(0.1, 0.3, 0.3, 0.6)
data = data.frame(xLst=xLst, yLst=yLst)
```
      c.
```
bestline = lm(yLst ~ xLst, data=data)
```
      d.
```
x = seq(0,.6,.1)
```
      e.
```
lineValues = bestline$coefficients %*% rbind(1, x)
```
      f.
```
plot(x, lineValues, type="l")
```

3.   **a.**
```
xLst = pts[,1]
```
      b.
```
yLst = pts[,2]
```
      c.
```
pts = read.table("DanWoodEM.dat")
```
      d.   *plot*

      e.
```
plot(xLst, yLst, pch=19, color="black", xlab="x", ylab="y")
```
      f.
```
segments(1.309, 2.138, 1.68, 5.66)
```

4.
```
pts = cbind(xLst, yLst)
```

5.
```
plot(pts)
```