

Due on Monday, Aug 31, 2009

1. Read Chapter 1 of the text.
2. Download the statistical package R to your computer from www.r-project.org
3. Read chapters 1 through 5 of “An Introduction to R” (the pdf file is in the Help menu of your downloaded copy). It’s pretty dry; you may want to skim some of the sections. The “R reference manual,” also in the Help menu, tells how to use all the R functions and is a useful resource.
4. Try the commands in the R linear algebra tutorial. Look at the results of the calculations that are made in assignment statements. Note the roundoff errors in some of the calculations! (Do not hand anything in for this problem.)
5. Express the following systems of equations in matrix form as $\mathbf{Ax} = \mathbf{b}$. What is the rank of A for each case? Find the solution set for \mathbf{x} by row-reducing the augmented matrix. Also use R to check your results. (Advanced R users: try writing an R function that transforms a matrix to row reduced echelon form.)

(a)

$$\begin{aligned}x_1 + 5x_2 + 2x_3 &= 5 \\4x_1 - 1x_2 + 3x_3 &= -8 \\6x_1 - 2x_2 + x_3 &= 0\end{aligned}$$

(b)

$$\begin{aligned}3x_1 - 5x_2 + 6x_3 + x_4 &= 7 \\4x_1 + 2x_3 - 3x_4 &= 5 \\x_2 - 3x_3 + 7x_4 &= 0\end{aligned}$$

6. Write the quadratic polynomial

$$5x^2 + 3y^2 + z^2 + 4xy + 2xz - 2yz$$

in the form

$$\begin{bmatrix} x & y & z \end{bmatrix} \mathbf{A} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

where the matrix \mathbf{A} is symmetric.

7. Exhibit a set of matrices $\mathbf{A}, \mathbf{B}, \mathbf{C}$ such that

$$\text{tr}(\mathbf{ABC}) \neq \text{tr}(\mathbf{CBA}).$$

8. Let

$$\mathcal{V} = \left\{ \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_k \end{pmatrix} : x_1, x_2, \dots, x_k \in \mathfrak{R} \right\}$$

and let $k \geq 3$. Which of the following sets of vectors

$$\mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_k \end{pmatrix}$$

are subspaces of \mathcal{V} ?

- (a) All \mathbf{x} such that $x_1 \geq 0$
 - (b) All \mathbf{x} such that $x_1 + 3x_2 = x_3$
 - (c) All \mathbf{x} such that $x_2 = x_1^2$
 - (d) All \mathbf{x} such that $x_1x_2 = 0$
 - (e) All \mathbf{x} such that x_2 is rational.
9. Do problems 1.5, 1.22, 1.25 (also write down what the column space, row space, and null space are by providing bases for them) in the book.

Suggested additional problems (DO NOT HAND IN): 1.2, 1.4, 1.7, 1.9, 1.12, 1.14, 1.15, 1.16 (use R!), 1.18, 1.21, 1.23, 1.27.