Math. 362-02
Fall, 2015
R. B. Kearfott

Third Exam

Thursday, November 12, 2015

This exam is closed book, but you may use calculators. The exam should be done on your own paper. Make sure your name is on all pages. Show all work, and show it in a logical and organized manner: You will be graded on what you show, in addition to your answer. Each entire problem is worth 16 points, and 4 points are free. You may leave when you finish, and you may keep this sheet with the questions.

1. Find the unit vector that is in the same direction as $(1, 3, -\sqrt{6})$.
2. Find the norm of the orthogonal projection of $u = (1, 2, 3)$ onto $a = (3, 0, -4)$.
3. If u and a are as in Problem 2, find vectors v and w such that $u = v + w$, v is in the direction of a, and w is orthogonal to a.
4. Find a vector equation for the line between $(1, 2, 3)$ and $(4, 5, 6)$.
5. Find a basis of the null space for $A = \begin{bmatrix} 4 & -2 & 6 \\ -2 & 1 & -3 \end{bmatrix}$.
6. Consider the equation $x^2 + \sqrt{3}xy = 1$.
   (a) Compute a transition matrix P, with
   $$\begin{bmatrix} x \\ y \end{bmatrix} = P \begin{bmatrix} x' \\ y' \end{bmatrix},$$
   such that the equation written in terms of x' and y' has no $x'y'$ term.
   (b) Write down the equation in the new coordinate system.
   (c) Check your work.