

## Due Date

The due date for this lab is Monday, February 10, at the beginning of lecture. Late submissions will not be accepted. You must submit the lab in person. Emailed copies will not be accepted.

You are encouraged to discuss this assignment with other students and with the instructors, but the work you hand in should be your own.

## Getting Help

For helpful background material, see the web page

<http://sites.math.rutgers.edu/courses/251/Maple/Lab1/Vectors.html>

For this lab, the data you will be given will consist of coordinates for three points,  $p$ ,  $q$ , and  $r$ , in  $\mathbb{R}^3$ . Then  $\vec{pq}$  will denote the vector directed *from*  $p$  *to*  $q$  and  $\vec{pr}$  will denote the vector directed *from*  $p$  *to*  $r$ . The vector  $\vec{v}$  will be  $\vec{pq} \times \vec{pr}$ , the cross product (vector product) of the two vectors.  $T$  will be the triangle in  $\mathbb{R}^3$  whose vertices are  $p$ ,  $q$ , and  $r$ .

## INSTRUCTIONS

- **Use Maple, Matlab, or Mathematica to**
  - compute the two vectors  $\vec{pq}$  and  $\vec{pr}$  and compute the angle between these vectors in two different ways,
  - Draw the triangle  $T$  formed by  $p$ ,  $q$ , and  $r$ , as well as the vectors  $\vec{pq} \times \vec{pr}$  starting from  $p$ , showing several pictures to illustrate the relationship between  $\vec{v}$  and this triangle, and
  - Find the equation of the plane containing  $p$ ,  $q$ , and  $r$ .
- **Your code should consist of the following:**
  - Storing the three points  $p$ ,  $q$ , and  $r$ . As a general rule, you should always be storing your inputs and using variables instead of just carrying numbers from one step to the next. This will make the underlying process more clear for you (and help you with exams later on).
  - Compute the vectors  $\vec{pq}$  and  $\vec{pr}$ , and finding the angle between these vectors in two ways, one using the dot product and a second using the cross product.
  - Compute  $\vec{v} = \vec{pq} \times \vec{pr}$  and describe **in words** how  $\vec{v}$  relates to the vectors  $\vec{pq}$  and  $\vec{pr}$ . You can include this in a comment within the code.
  - Two plots (Figure 1 and Figure 2) that draw the triangle  $T$  made up of points  $p$ ,  $q$ , and  $r$ , and a line segment coming from  $p$  in the direction of  $\vec{v}$  to illustrate your result from the previous part. You want to have a different viewing angle for the two plots so that they show different views of the image.
  - A calculation of the equation of the plane containing  $p$ ,  $q$ , and  $r$ . You need to display the equation in all three forms; one vector and two scalar forms. (You can do this in a comment, if needed be.)

- **Hand in a printout of your work. In this printout:**

- Label all pages with your name and section number. Also, please *staple together* all the pages you hand in.
- *Clean up your submission by removing the instructions that had errors.*

- **Include in the work that you hand in:**

- A printout of all Maple, Matlab, or Mathematica instructions that you have used. Identify clearly in your printout the components of the vectors  $\vec{pq}$ ,  $\vec{pr}$ , and  $\vec{v}$ . (These identifications can be inserted by hand on your printout.)
- A printout of a picture of the three vectors and the triangle  $T$ . The picture should include labeled axes and should show the geometry of the situation well. Label the points  $p$ ,  $q$ , and  $r$  in your picture. Label the vector  $\vec{v}$  in your picture. Label the triangle  $T$  in your picture. (These labels can be inserted by hand on your printout.)