

## MATH 444: MATHEMATICAL RESEARCH AND WRITING

A possible project.

Determinants have been studied for many years and there are many important results. Two with amusing proofs are the following. First, the number of spanning trees of a graph can be computed as a determinant (relating to Laplace matrix of the graph). Second, the product rule for matrices ( $\det(AB) = \det(A)\det(B)$ ) can be obtained using involutions with no need for the elementary matrices usually used for this purpose. A project would give some discussion of the definition(s) of determinant and their relevance. Other facts would include the ideas that for a matrix  $A$  formed of vectors  $\mathbf{v}_1, \mathbf{v}_2, \dots, \mathbf{v}_n$ , then  $|\det(A)|$  would be the volume of the paralloiped formed by the  $n$  vectors and the sign of  $\det(A)$  would have something to say about the orientation of the vectors particularly in  $\mathbf{R}^2$  and  $\mathbf{R}^3$ . There are other results/formulas such as the Cauchy-Binet formula that might deserve some coverage.

The project would be a small primer on determinants.