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An Application of Geometry to Determinants

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I. Introduction

In this paper, Geometry has applications to many fields, including art, architecture, physics as well as to other branches of mathematics different subject areas of mathematics that exist, perhaps geometry has the most popular impact on our everyday lives. Everything around you has a shape, volume, surface, area, location and other physical properties. Geometry is all around us. Since origins, geometry has significantly impacted the ways people live. In this geometry section, we will learn many more applications of geometry that you can use of an everyday basis. Geometry's Origins, go back to approximately 3000 BC in ancient Egypt. Ancient Egyptians used an early stage of geometry in several ways, including the surveying of land, construction of pyramids and astronomy. Around 2900BC, ancient Egyptians begin using there knowledge to construct pyramids with four triangular faces and a square base.

II. Application

Given three points $A=(x_1,y_1)$,$B=(x_2,y_2)$and $C=(x_3,y_3)$ are not on the same line, find the equation of the circle going through these points?

Solution: If $P=(x, y)$ is an arbitrary point on the circle, then we can write

$a(x^2+y^2)+bx+cy+d=0$. Where a,b,c and d are constants.

Substituting the three points in the above equation gives the following homogeneous system in four equations and four variables a, b, c and d.

$a(x^2+y^2)+bx+cy+d=0$

$a(x_1^2+y_1^2)+bx_1+cy_1+d=0$

$a(x_2^2+y_2^2)+bx_2+cy_2+d=0$

$a(x_3^2+y_3^2)+bx_3+cy_3+d=0$

System however if (a,b,c,d) is a solution , so is $k(a,b,c,d)$ for any scalar k and so the has infinitely many solutions. So, the determinant.

$$\begin{vmatrix} x^2+y^2 & x & y & 1 \\ x_1^2+y_1^2 & x_1 & y_1 & 1 \\ x_2^2+y_2^2 & x_2 & y_2 & 1 \\ x_3^2+y_3^2 & x_3 & y_3 & 1 \end{vmatrix} = 0$$

For example, to find the equation of the circle going through the point$A(1,0)$, $B(-1,2)$ and $C(3,1)$

We write it as $$\begin{vmatrix} x^2+y^2 & x & y & 1 \\ 1 & 1 & 0 & 1 \\ 5 & -1 & 2 & 1 \\ 10 & 3 & 1 & 1 \end{vmatrix} = 0$$

Which gives after simplification

$6x^2+6y^2-14x-26y+8=0$

This can written as

$(x-7/6)^2+(y-13/6)^2=37/18$

This circle has $(7/6,13/6)$as center and $\sqrt{37/18}$ as radius

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