Descartes' Mathematical Contributions

Descartes was the first mathematician to use the notation where the letters at the beginning of the alphabet represent data and the letters at the end of the alphabet to represent variables or unknowns.[i] This has been adopted as the modern standard

Descartes' understanding of algebra was deep. He stated that the number of distinct roots of an equation is equal to the degree of the equation. Descartes was willing to consider negative (he called them false roots) and imaginary roots. He developed a rule for determining the number of positive and negative roots in an equation. The Rule of Descartes as it is known states "An equation can have as many true [positive] roots as it contains changes of sign, from + to – or from – to +; and as many false [negative] roots as the number of times two + signs or two – signs are found in succession."[ii]

Analytic Geometry

Descartes' greatest contribution to mathematics was developing analytic geometry. The most basic definition of analytic geometry is applying algebra to geometry. Descartes established analytic geometry as "a way of visualizing algebraic formulas".[iii] He developed the coordinate system as a "device to locate points on a plane".[iv] The coordinate system includes two perpendicular lines. These lines are called axes. The vertical axis is designated as y axis while the horizontal axis is designated as the x axis. The intersection point of the two axes is called the origin or point zero. The position of any point on the plane can be located by locating how far perpendicularly from each axis the point lays. The position of the point in the coordinate system is specified by its two coordinates x and y. This is written as (x,y). The coordinate system is also known as the Cartesian coordinate system. The adjective Cartesian comes from Latin version of Rene Descartes' name

The coordinate system was developed to locate points on a plane but it evolved into what we call analytic geometry. The fundamental principle of analytic geometry can be described as *"all pairs of values satisfying the equation are coordinates of points on a curve; and, conversely, all points on this curve have coordinates which satisfy the given equation."*[v] Analytic geometry allows us to graphically express the relationship between two variables that are functionally related to each other. The coordinate system has been described as the "a kind of acid test of the validity of a physical law or theorem"[vi] As result analytic geometry has been applied to wide variety of areas including physics, chemistry, economics, astronomy, and sociology. E. T. Bell describes Descartes as having "renovate[d] a whole department of human thought."[vii] Mathematics was being used as a tool in other disciplines as result of analytic geometry.

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[i] Roger Cooke, *The History of Mathematics: A Brief Course,* (Toronto: John Wiley & Sons, Inc., 1997), 327.
[ii] Cooke, 328.
[iii] Lloyd Motz and Jefferson Hane Weaver, *The Story of Mathematics,* (New York: Plenum Press, 1993), p. 106.
[iv] Motz, 106.

[v] Carl B. Boyer, “Analytic Geometry: The Discovery of Fermat and Descartes ”, in *From Five Fingers to Infinity: A Journey through the History of Mathematics,* ed. Frank J. Swetz, (Peru, Illnois: Open Court Publishing Company, 1994), 460.
[vi] Motz, 106.
[vii] Bell, 52.