Calculus: a brief history essay

Throughout history, mathematics has been part of our everyday lives. Calculus in particular has been used extensively whether from a simple computation of areas and shapes to a complex computation of complicated differential equations. It has been used by many people in computing a draft of building plans, determining an economical computation problem that involves differential numbers, determining stress levels of a certain objects, determining rates of change in objects, or in determining an input that will balances a system.

Calculus remained as indispensable tool in analyzing and determining these tasks as well as it remains a good practice in using to prove or disprove theoretical concepts on computations. The development of calculus can be divided into three areas namely Integral Calculus, Differential Calculus, and Modern Calculus and the developments of these areas were intertwined with each other. Integral Calculus Integral Calculus can be first credited to Greek as the first ones to use infinitesimal numbers. The Greeks was the first to consider the division of objects into an infinite number of cross-sections.

Also the Greeks, particularly the names of Antiphon and Eudoxus were the first ones to use the method of exhaustion, which made it possible to compute the area and volume of regions and solids by breaking them up into an infinite number of recognizable shapes. A Greek mathematician from Syracuse named Archimedes, extend this method to calculate the area under the arc of a parabola using summation of an infinite series which in turn leads to the accurate approximation of Pi(?)(A History of the Calculus: URL CITED).

Among his other contributions is determining the area of a circle which he proved to be equal to ? ultiplied by the square of the radius of the circle (A History of the Calculus: URL CITED). During the third century, Chinese mathematicians Liu Hui and Haidao Suanjing published Nine Chapters and Sea Island Mathematical Manual respectively, which dealt with using the Pythagorean Theorem which is then used to measure the size of things. Indian mathematicians also have some contributions on the area of calculus. Aryabhata made an important step in the development of integral calculus as he was the first to write the sum of the cubes at around 500 AD (Katz, 1995, 63-174).

At around 1000 AD, an Iraqi mathematician by the name of Ibn al-Haytham, derive the formula for the sum of the fourth powers. He then in turn developed a method for determining the general formula for the sum of any integral powers (Katz, 1995, 63-174). Fermat was the first person known to have evaluated the integral of general power functions in the 17th Century. He was able to reduce this evaluation to the sum of geometric series and the resulting formula was helpful for the development of calculus to Newton and Leibniz.

The discovery of infinitesimal calculus is often credited with Newton and Leibniz. On the 11th of November 1675, integral calculus was used for the first time by Leibniz in finding the area under the function y = x. Also, Leibniz introduced the integral sign ? representing an elongated S which comes from the Latin word summa. In 1854, Bernhard Riemann defines the integral that does not require continuity. In his lecture in 1854, he introduces his

Riemannian geometry as well his theory on higher dimensions which in turn paved the way for Einstein's general relativity.

Differential calculus Archimedes was also the first to find the tangent to a curve, other than a circle, using a method similar to differential calculus. This discovery was due to his study in spiral whereas he separated a point's motion into two components namely – radial motion and circular motion components (Boyer, 1991, p127). Aryabhata too has a contribution in the development of differential calculus. He expressed an astronomical problem using the form of a basic differential equation using a notion of infinitesimal numbers (Joseph, 2000, 298 – 300).

In 12th century, this equation led Bhaskara II in the 12th century to develop the concept of a derivative representing infinitesimal change. He described an early form of " Rolle's theorem" (Joseph, 2000, 298 – 300). Also, during the 12th century, Sharaf al-Din al-Tusi, a Persian mathematician was the first to discover the derivative of cubic polynomials which becomes an important result in differential calculus (Berggren, 1990, 304 – 309). The 16th and 17th centuries seems to be the culmination of the ideas of the European mathematicians.

Pierre de Fermat discovers a method of finding the greatest and the smallest ordinates of curved lines, analogous to that of what is studied in differential calculus. Fermat also developed a method for determining maxima, minima, and tangents to various curves that was equivalent to differentiation. He also made contribution on the part of calculus that laid the foundation of Isaac Barrow's study on tangent curves. Barrow's lectures contain some new ways of determining the areas and tangents of curves geometrically. European mathematicians including Barrow, Blaise Pascal, and John Wallis discussed the idea of a derivative.

Also John Wallis was given credit for introducing the symbol ? for infinity. In 1653, Pascal described a tabular presentation of binomial coefficients which is now called the Pascal’s triangle. In 1691, after the invention of the modern calculus, Michael Rolle gives the first proof of the Rolle’s Theorem. Also after the invention of the modern calculus, Augustin Louis Cauchy stated the mean value theorem in its modern form. Leibniz also had a contribution in the field of differential calculus as he suggests the notation of d, from the Latin word differentia, to represent differentials.

Taylor’s Theorem and Taylor’s Series was introduced in 17th century by an English mathematician named Brook Taylor although the result was first discovered by James Gregory in 1671. In 1797, Joseph Louis Lagrange introduces the notations f’x and y’ for the derivatives of functions f(x) and y, respectively at Ecole Polytechnique. During the lecture, he also gives an algebraic proof of the Taylor’s Theorem. Louis F. A. Arbogast introduces the symbol D for the operation of differentiation in 1800.

His studies include concept of factorial and the formal algebraic manipulation of series that was investigated before by Lagrange and Laplace in the 1770s. In 1841, Carl Gustav Jacob Jacobi reintroduced the ? notation as a partial derivative notation which later becomes standard. Adrien-Marie Legendre originally introduced the notation in 1786, but immediately abandoned it. The l’Hopital’s Rule, also known as the l’Hospital’s Rule, was first discovered by Johann Bernoulli but since Guillaume Francois Antoine de L'Hopital had a contract with Bernoulli, de L'Hopital introduced the work of Bernoulli in his textbooks in calculus.

Modern calculus While Greek mathematicians contributed in the early contributions on the field of calculus, westerners had their way in improvising and discovering new method in calculus as well as giving birth to modern calculus in the late 17th century. By applying infinitesimal calculus to the tangent line problem, Rene Descartes provided the basis for the calculus of Newton and Leibniz that later resulted in the birth of the field of modern mathematics (Gullberg, 1997). The restricted geometrical version of the second fundamental theorem of calculus was been proven by James Gregory in the mid-17th century.

Archimedes' works on integral calculus was made obsolete when Isaac Newton published his studies. The invention of the modern calculus and the establishment of Pre-Modern calculus were often credited with two people – Newton and Leibniz, which made their own significant contributions to this field of mathematics. Their most important contributions were the development of the fundamental theorem of calculus. One of the contributors in the early modern calculus is Pierre-Simon Laplace who formulated Laplace's equation and invented the Laplace transform.

Among the influential mathematicians during the Post-Modern Calculus contributors were Carl Friedrich Gauss, Augustin Louis Cauchy, Johann Peter Gustav Lejeune Dirichlet, and Georg Friedrich Bernhard Riemann. Gauss can be considered as the greatest mathematician that ever lived (The Mactutor

History of Mathematics: URL CITED). One of the works of Gauss was proving the law of quadratic reciprocity, which shows a relationship between solvability of certain quadratic equations. In 1796, Gauss proved the triangular case of the Fermat polygonal number theorem.

Augustin Louis Cauchy, a profound French mathematician who formulates and proves the theorems of calculus rigorously. His contribution includes several theorems in complex analysis and the study of permutation groups. The modern formal definition that we still used today was credited to Dirichlet. Among his works focuses on number theory and analysis. German mathematician Bernhard Riemann introduces the theories of Riemannian geometry. His works also includes the theory in higher dimensions which is discussed at Gottingen in 1854.

Other contributor in the Post-Modern era of calculus is a French born mathematician Joseph Liouville. Liouville states that every bounded entire function must be constant which is known as Liouville’s theorem. His theorem was improved by Charles Emile Picard on his little theorem, which states that every entire function whose image omits at least two complex numbers must be constant. Another mathematician was a French mathematician Charles Hermite. His research includes studies on invariant theory, number theory, orthogonal polynomials, quadratic forms, algebra and elliptic functions.

Various mathematical concepts such as cubic Hermite splines, Hermite polynomials, Hermitian operators, and Hermite normal form were named after him. Among his other works in the fields of calculus were the proving of e, the base of natural logarithms, as a transcendental number which in turn were used by Ferdinand von Lindemann to prove that ? is transcendental. While working at Glasgow University, William Thomson, 1st Baron Kelvin, did some important work in the area of mathematical analysis of electricity and thermodynamics.

The discovery of calculus can be annotated to the works of mathematicians in the field of algebra and geometry. Calculus as a branch of mathematics was been founded from early Greek philosophers and mathematician in the name of Euclid and Archimedes to the names of Cauchy and Lagrange as well as some Asian mathematicians. It is by far, the most prestigious by-product of time since the principles of a simple lever up to the principles behind computer systems. Many people had contributed to this field and that their contributions remain significantly visible to our everyday lives.

Some of their works were extensively used in building construction, for example, and in the development of sophisticated systems that allows complex systems. Without the discoveries of these great mathematicians, the ease in handling mathematical equations will be troublesome for us. It is true that mathematics exist as a guided and organized principle, it is also a tool in discovering things in the world we move. Calculus as a tool is powerful enough to represent things that revolve around us. Without calculus, this world we move is immeasurable and that we will have a hard time to quantify things in our own way.