

# Chaos Theory

Frank Hernández

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# Abstract

I would like to delve into fully understanding and explaining Edward Lorenz's Chaos Theory, using the different parts of Chaos Theory (Butterfly Effect, system of non-linear differential equations, etc.). Using these, we can look at the other applications of Chaos Theory: computer science, earthquake detection, meteorology, physics, etc.

**Definition:** a special topic of mathematics that deals with complex systems whose behavior is highly sensitive to slight changes in conditions, so that small alterations can give rise to strikingly great consequences.

**Definition:** The Butterfly effect is the theory that a small change within a system can vastly alter the final result. The name for this came from Edward Lorenz, who used the example of a butterfly flapping its' wings in Brazil can cause a series of events in a complex system that can lead to a hurricane due to the initial conditions in a complex weather system.

Using the Butterfly Effect, we can demonstrate how one minuscule change in the initial conditions can predict a difference large difference in the system of differential equations. Similarly, we can imagine the same principle in real life situations such as a large weather system, tectonic activity, etc. We can imagine that one tiny change in the initial condition would mean the difference between a nice day in California, or a huge earthquake in Los Angeles.

**Definition:** Chaos Theory, defined by Edward Lorenz, measures complex systems. These systems are so complex, that we can only hope to understand them through the use of computers because there are far too many elements that move within the system. While Chaos Theory was first used with weather models, we find it everywhere in nature. Fractals and Chaos Theory are used in weather detection, earthquake detection, bridge building, antennae, etc. My goal is to focus on a more specific topic with Chaos Theory and the Butterfly Effect using Ordinary Differential Equations in the Fall of 2016. I would like to further investigate about the discovery of the Lorenz Attractor, which is how Lorenz discovered the Butterfly Effect as well as the Chaos Theory.