1.1.2 Change and Bifurcations

Bookmark this page

Wes just gave the following definition of bifurcation:

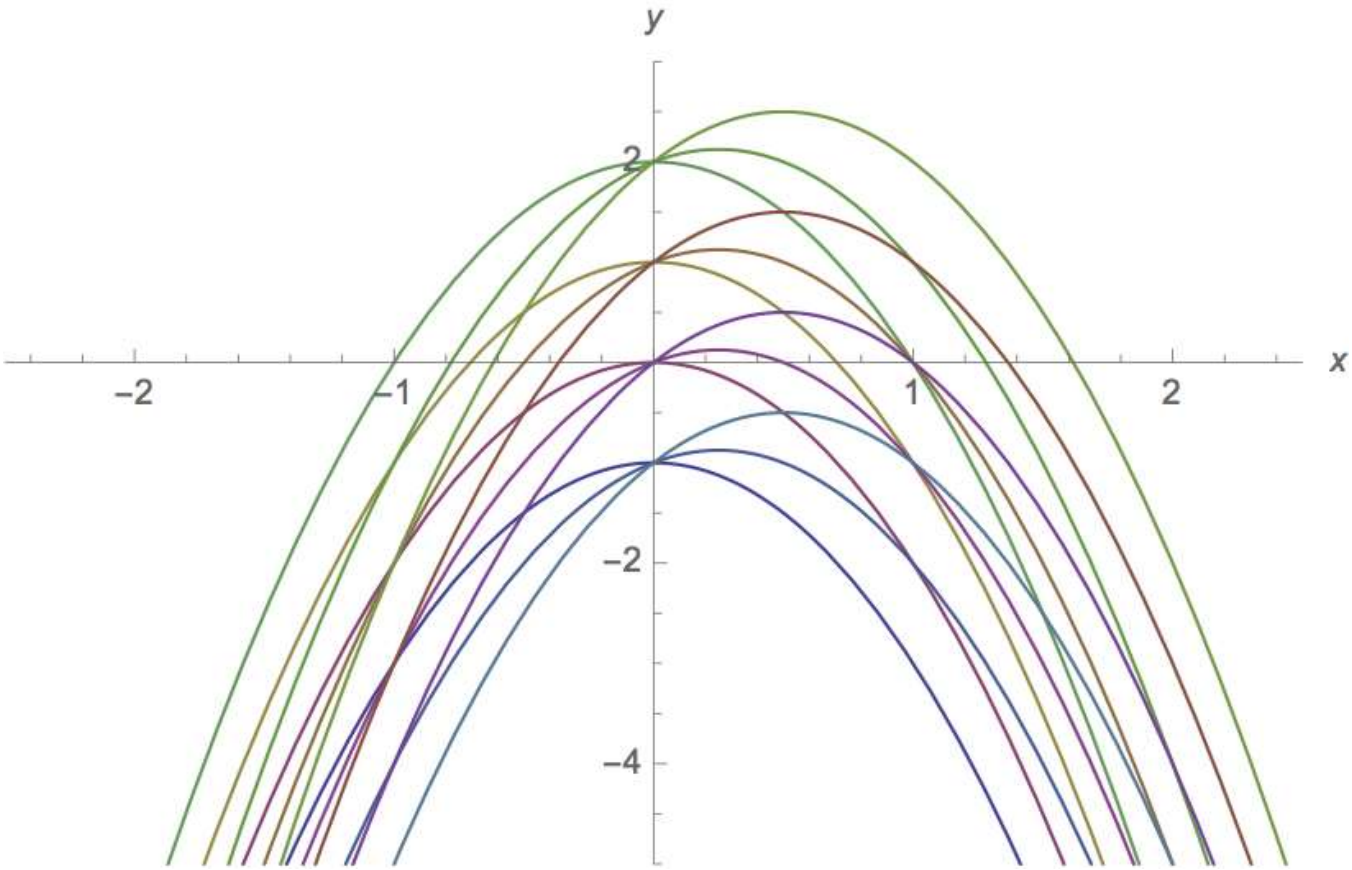
> **Bifurcation:** *a major change in the expected qualitative dynamical behavior of a system in response to changing a parameter.*

Let's try to make sense of this starting with parameters.

Parameters

You may recall the discussion of parameters in the Item Response Theory section. A **parameter** is a quantity that influences the behavior of a system or object and can vary from situation to situation, but is viewed as fixed within a given situation. In item response theory, the value of the parameter b was fixed for a given problem, and was related to that problem's level of difficulty.

In the equation of a parabola, $y = ax^2 + bx + c$ with $a \neq 0$, the quantities $a, b,$ and c are parameters - they are fixed for each particular parabola and affect its location in the plane, how 'wide' it is and so on. By changing the values of these parameters, we can describe many different parabolas.



View Larger Image
Image Description

Sudden Major Changes

When you used interactive tools to study the effects of parameters on the Item Response Theory curve, the shape of the graph generally changed smoothly in response to your adjustments.

In this section, we will study situations in which a small adjustment of a parameter results in a major change in the a **dynamical system** (roughly, a system where something changes with time). Bifurcations are characterized by *dramatic* changes in response to a small adjustment of a parameter.

In the section on Population Dynamics, we explored a dynamical system involving predator and prey fish populations over time. We looked at the qualitative behavior of the predatory-prey system to predict that populations of predator and prey fish would vary cyclically over time. When we introduced a parameter representing fishing, however, we

found that increasing the level of fishing beyond $e = 0.5$ was predicted to lead to extinction of the marlin population. This is an example of a sudden major change in the system in response to a small change in parameter.

Learn About Verified Certificates

English