

Our Responsibility to Change the World

The Mathematics and Philosophy of Chaos

Emily Sheetz

Advisors Dr. Hannah Schell and Dr. Michael Sostarecz

Characteristics of Chaos

- Sensitive dependence
 - Determinism
 - Nonlinearity
-
- Uncertainty
 - Patterns

Logistic Equation

$$x_{new} = \lambda * x_{old} * (1 - x_{old})$$

Select x_0 and λ and iterate:

$$x_1 = \lambda * x_0 * (1 - x_0)$$

$$x_2 = \lambda * x_1 * (1 - x_1)$$

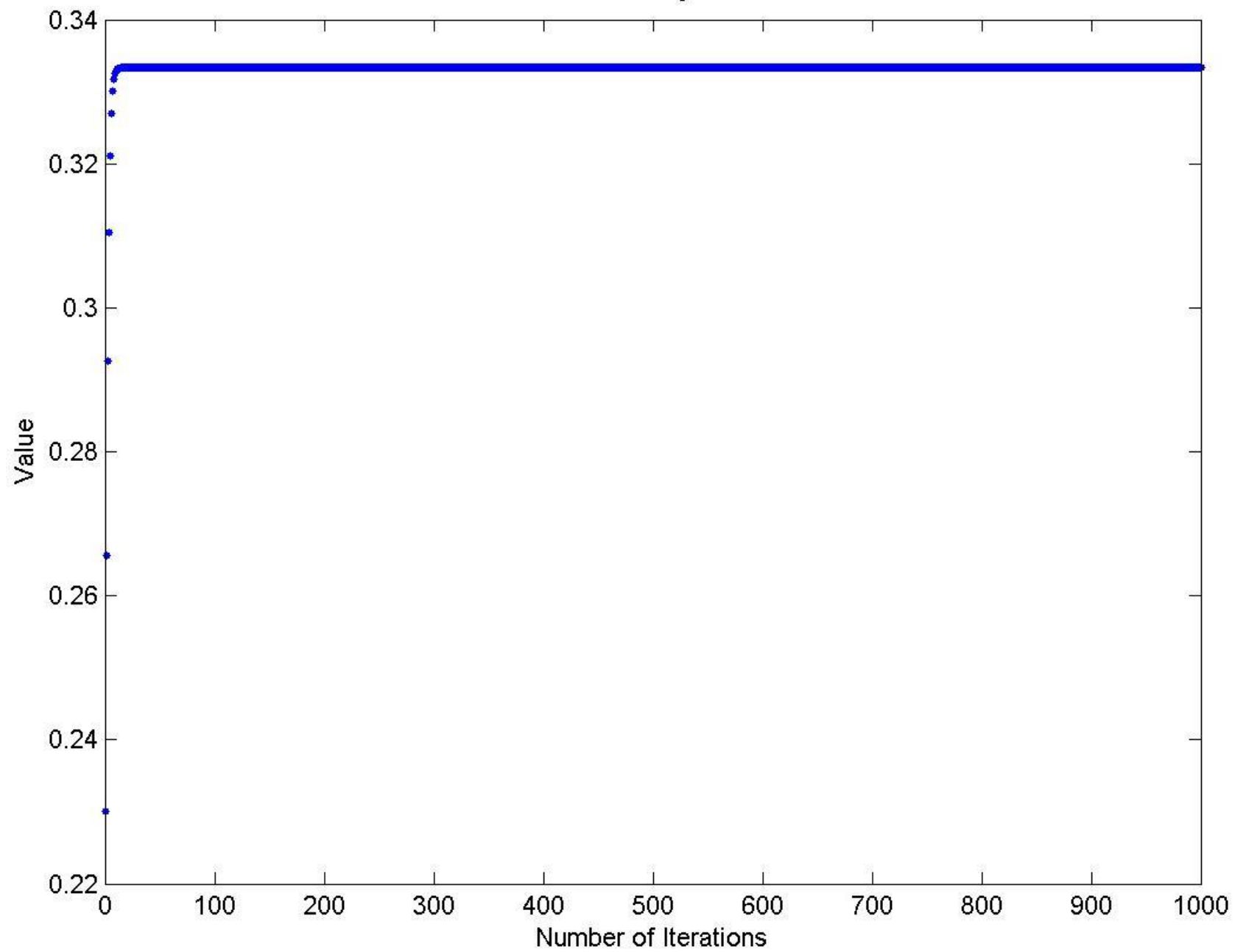
$$x_3 = \lambda * x_2 * (1 - x_2)$$

Logistic Equation

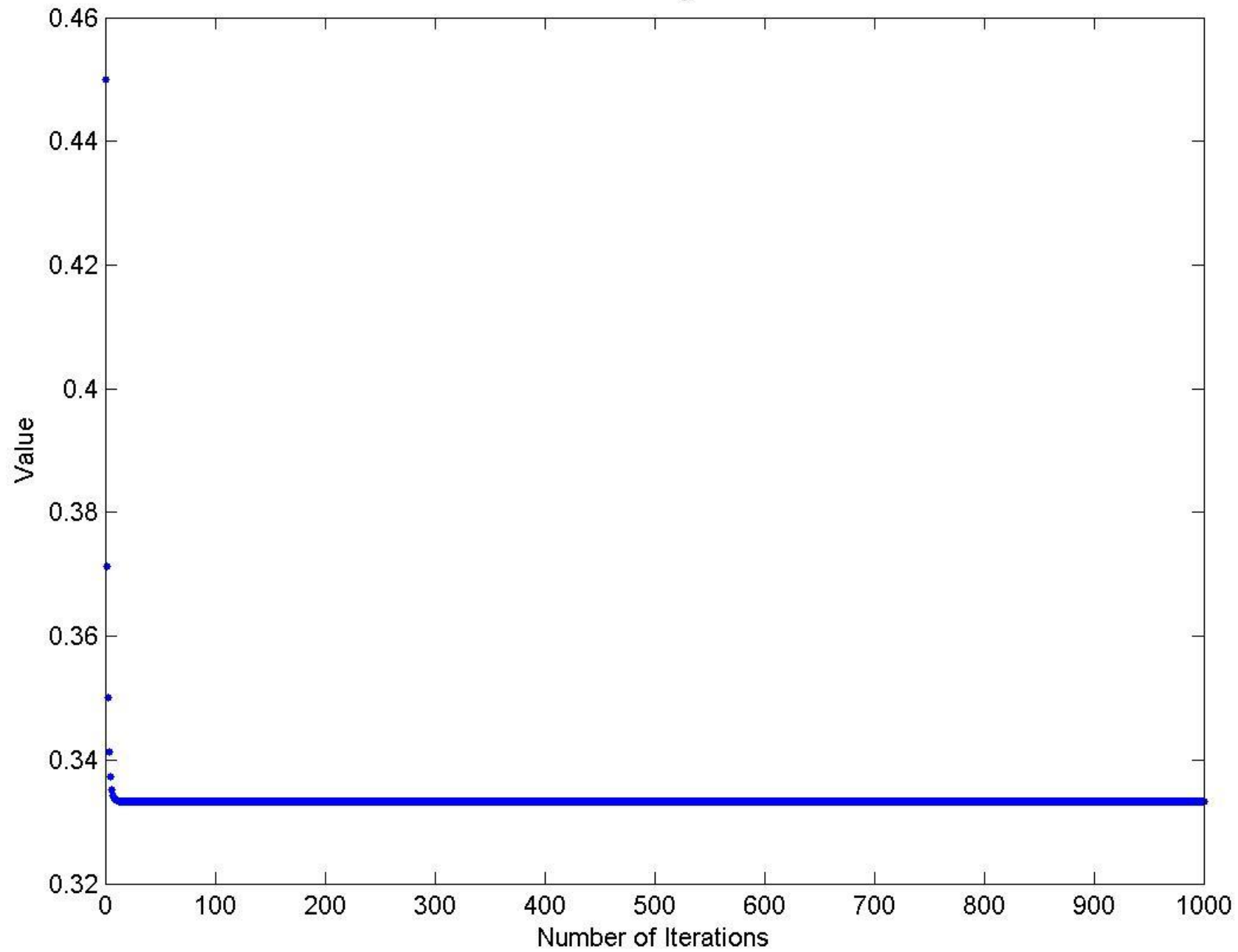
$$x_{new} = \lambda * x_{old} * (1 - x_{old})$$

- Nonlinear
- Deterministic
- Long term behavior of the system with different parameters

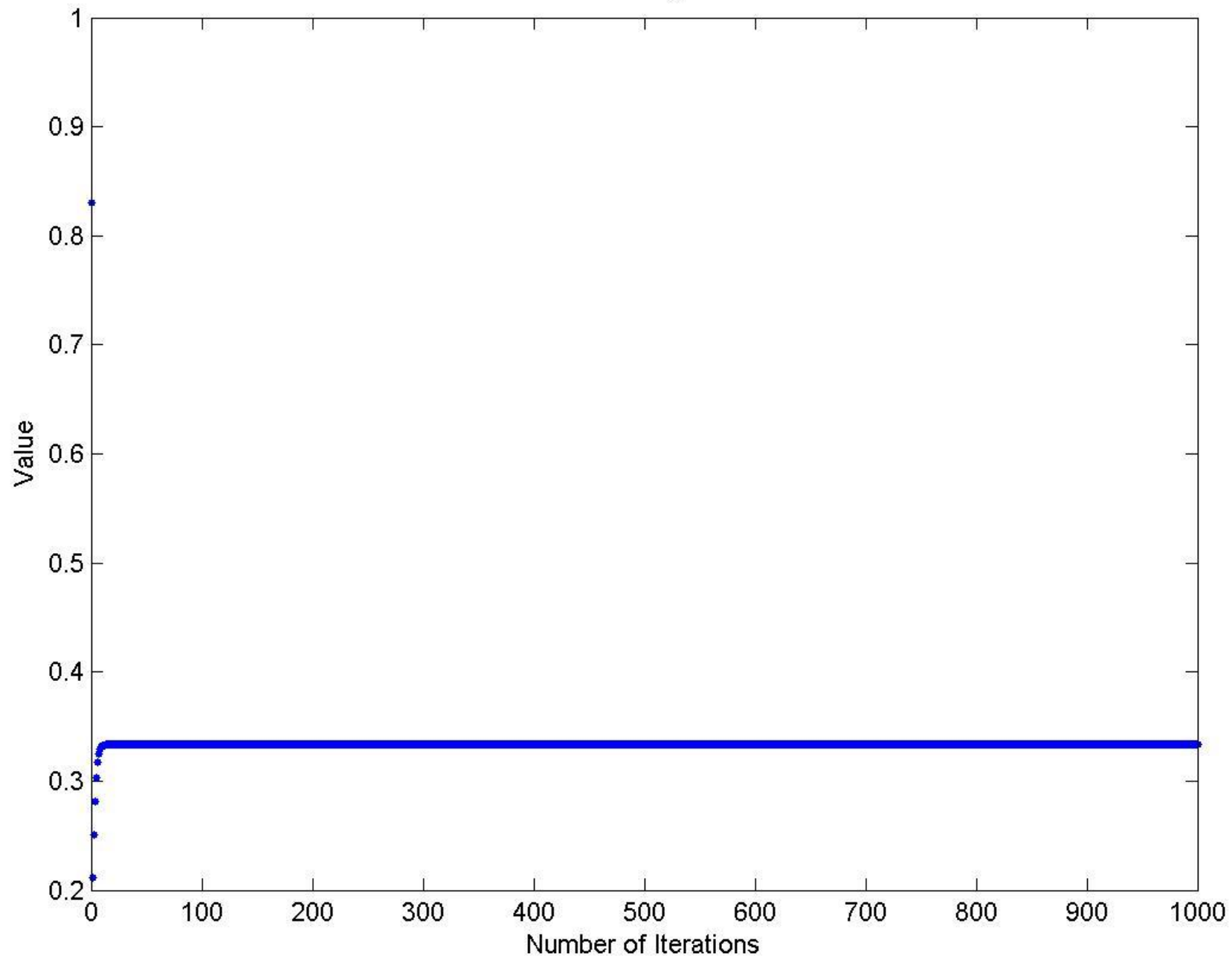
Logistic Equation, $x_0=0.23$, $\lambda=1.50$



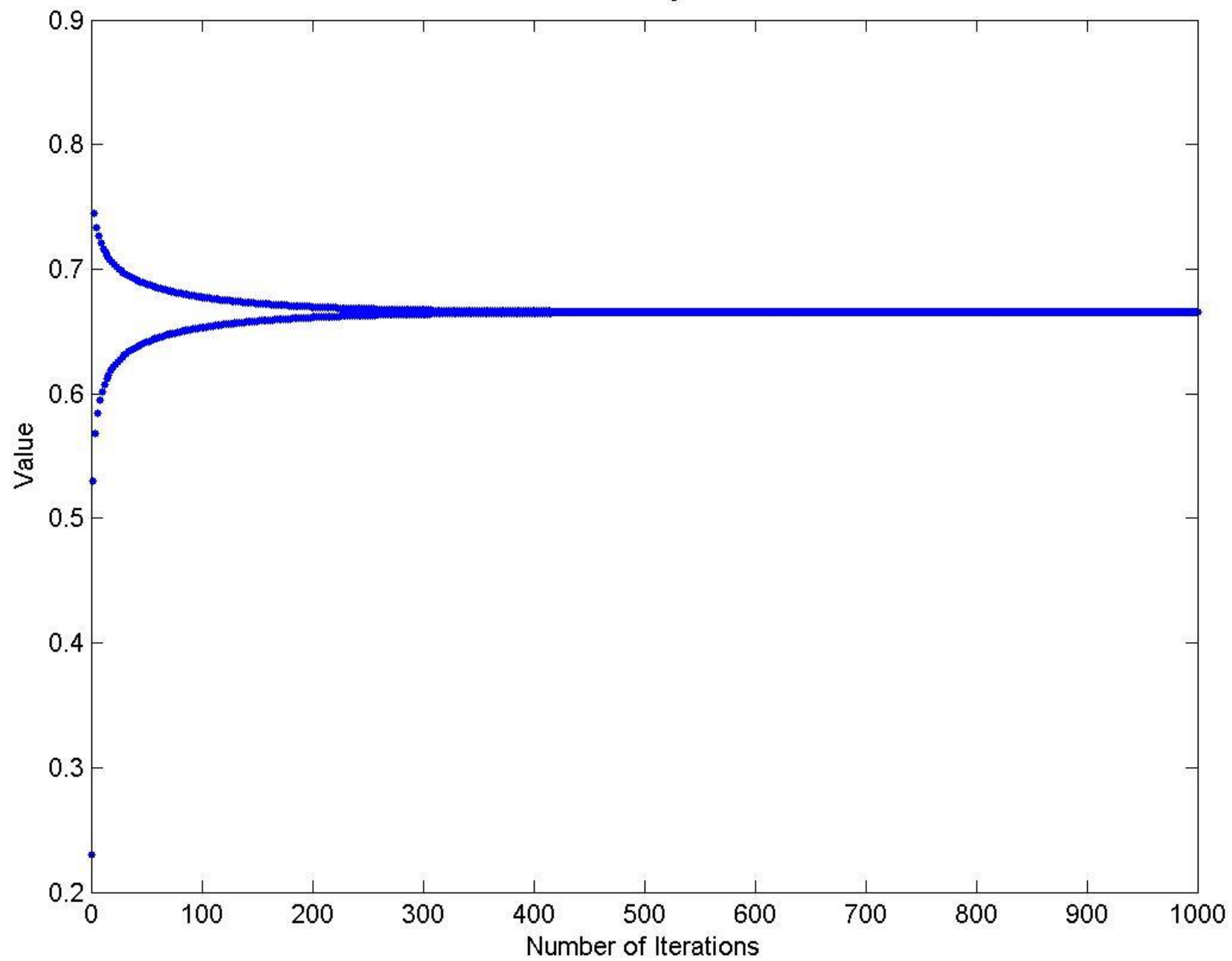
Logistic Equation, $x_0=0.45$, $\lambda=1.50$



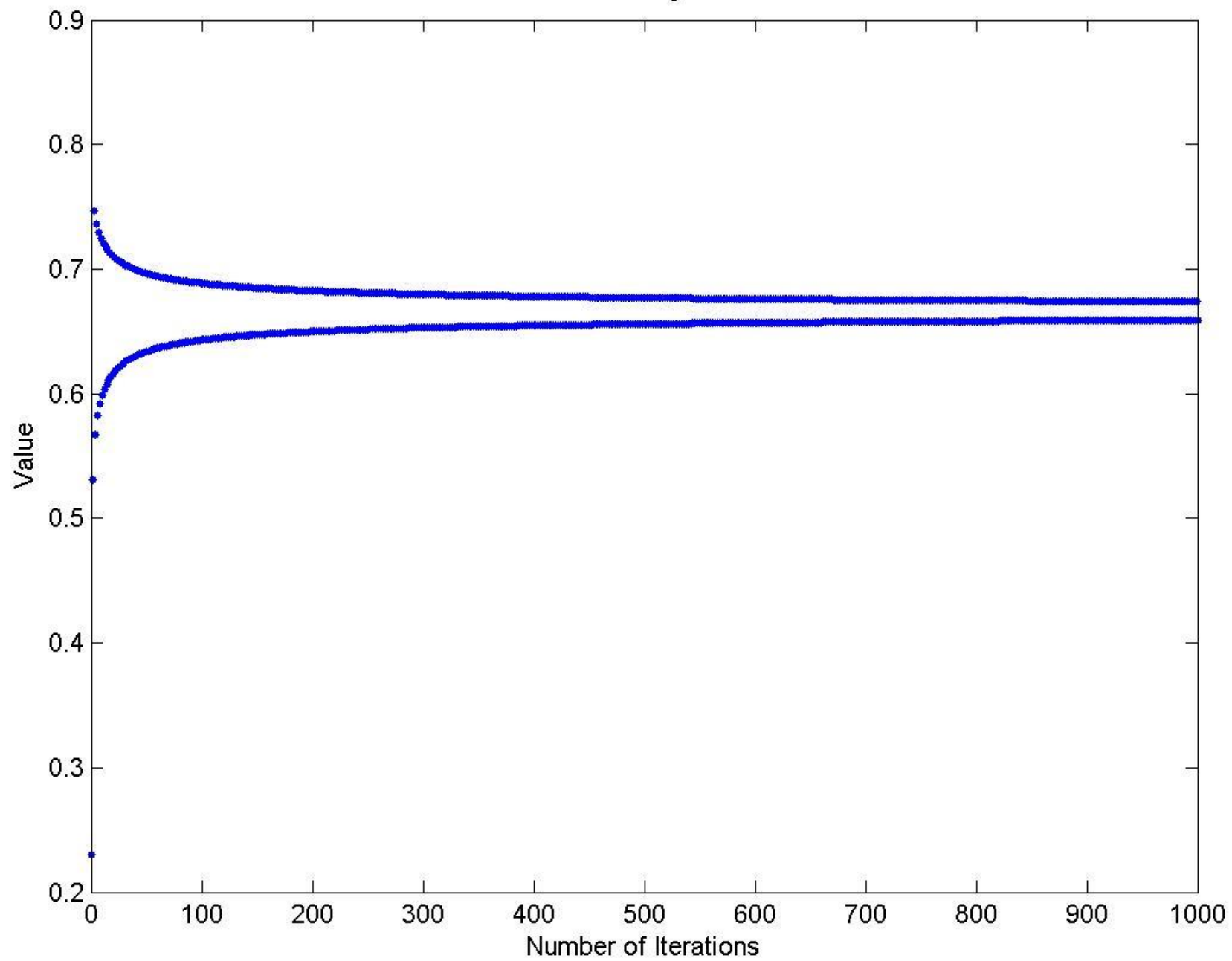
Logistic Equation, $x_0=0.83$, $\lambda=1.50$



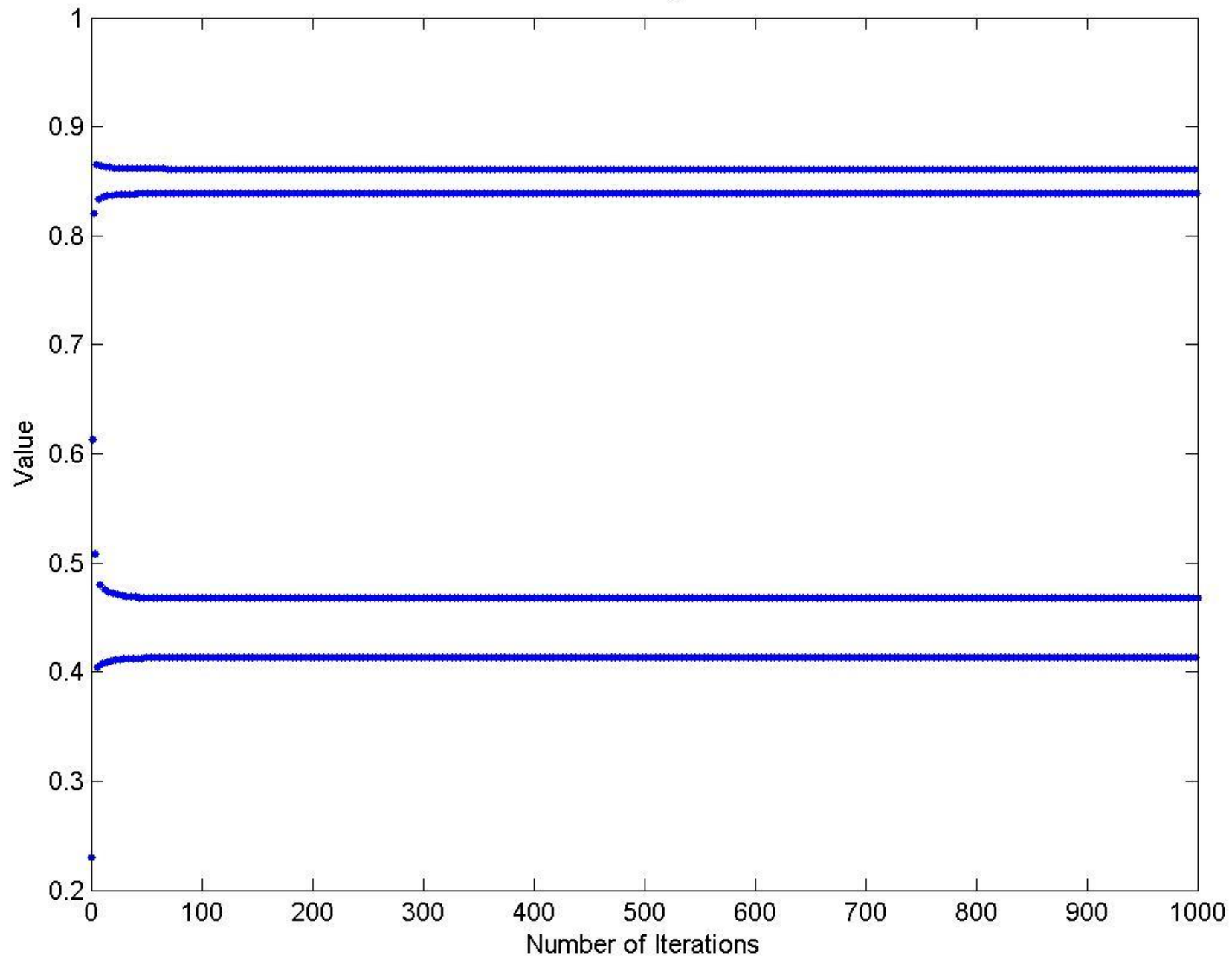
Logistic Equation, $x_0=0.23$, $\lambda=2.99$



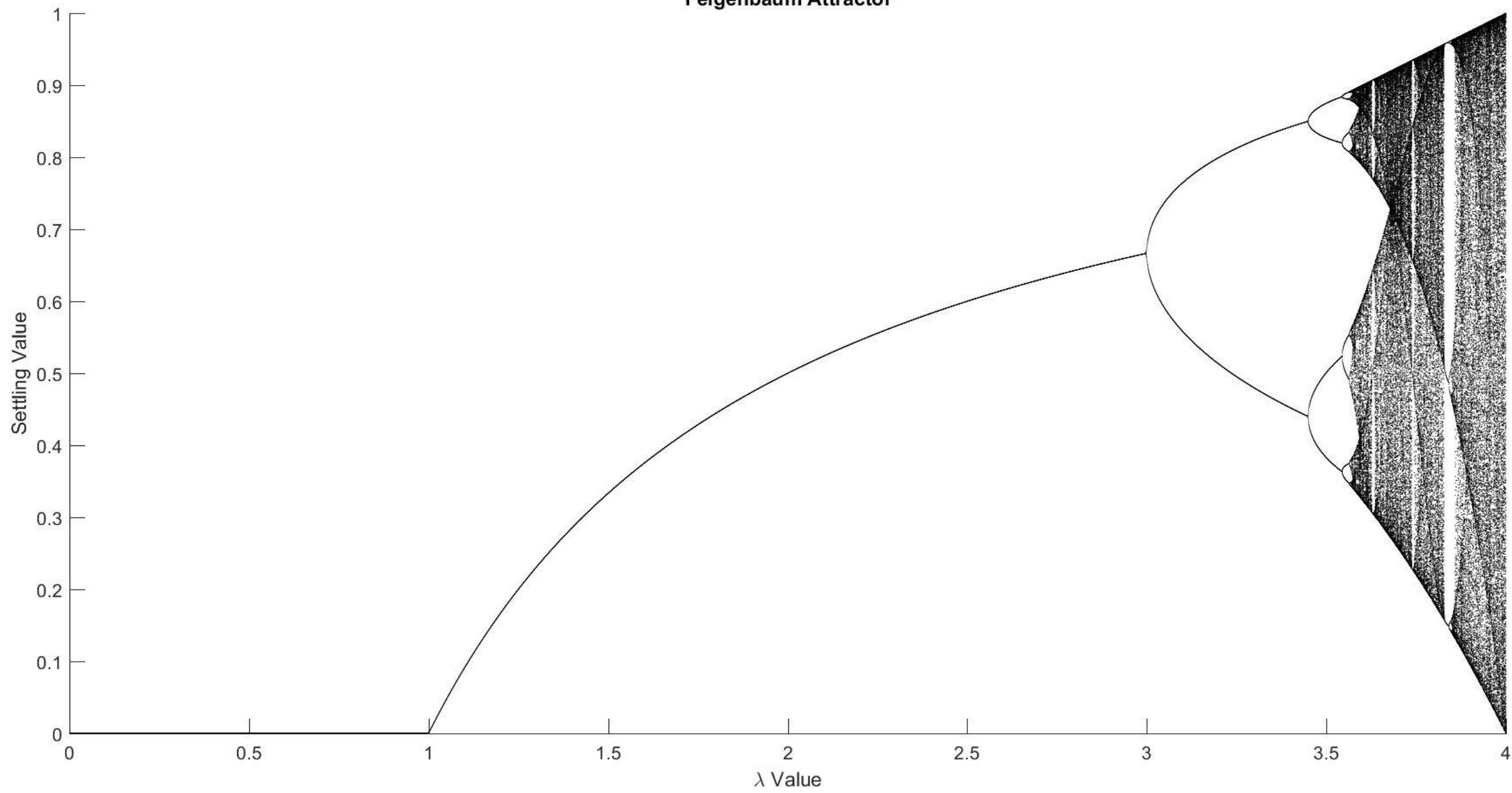
Logistic Equation, $x_0=0.23$, $\lambda=3.00$



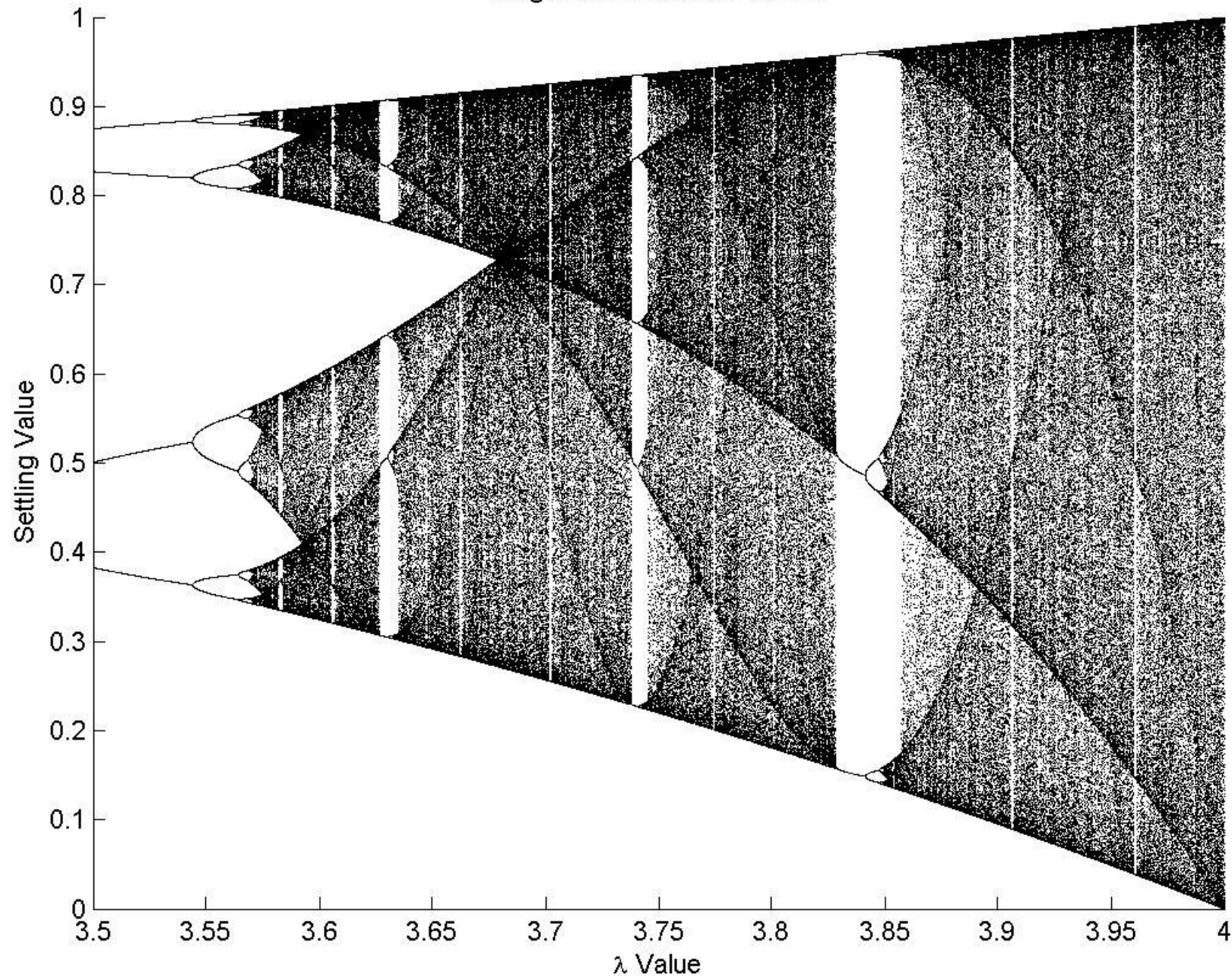
Logistic Equation, $x_0=0.23$, $\lambda=3.46$



Feigenbaum Attractor



Feigenbaum Attractor Zoom



Feigenbaum Attractor

- Nonlinear, deterministic system
- Unpredictable, chaotic behavior
- Feedback
- Bifurcation points
- Patterns emerge from chaos

Incompatibilism vs. Compatibilism

- Incompatibilism: free will is incompatible with determinism
 - Libertarianism
 - Determinism
- Compatibilism: free will and determinism are compatible

Libertarianism

- Indeterminist free will
- Extra-factor strategies:
 - Mind-body dualism
 - Noumenal selves
 - Agent-causation

Determinism

- Free will is an illusion
- Actions are determined by unconscious brain activity
- Consider criminals: not responsible for actions
- Importance of political and social freedom
- Importance of choices and actions
- Opportunity to effect change

Compatibilism

- Alternate definition of free will
 - Unconstrained
 - Not incompatibilist “deep” free will
- Consequences of determinism
 - No constraint, coercion, or control
 - Events are not inevitable
 - Our actions are not automatic or mechanical

Evaluation of Perspectives for Project

- Libertarianism
 - Extra-factor strategies are difficult to defend
- Determinism
 - Well defended, effects contextualized in everyday life
 - But concerned with incompatibilist “deep” free will
- Compatibilism
 - Determinism agrees with scientific findings
 - Practical definition of free will

Chaos and Free Will

- The World as a Chaotic System
 - Deterministic
 - Sensitively dependent
 - Nonlinear
- Effect of Actions
 - Feedback, bifurcation points
 - Change on some scale
 - Unpredictable consequences
- Responsibility
 - Compatibilist perspective: we have free will
 - Alternate definition of free will with respect to responsibility
 - We are responsible for our choices

Responsibility to Change the World

We must be willing to make the most of our free will and take responsibility for our actions in order to make the most worthwhile contribution to the chaotic system of the world.

Selected Bibliography

Gleick, James. *Chaos: Making a New Science*. Penguin Books, 1987.

Hall, Nina, ed. *Exploring Chaos: A Guide to the New Science of Disorder*. WW Norton & Company, 1994.

Harris, Sam. *Free Will*. Simon and Schuster, 2012.

Kane, Robert. *A Contemporary Introduction to Free Will*. Oxford University Press, 2005.

Stewart, Ian. "Portraits of Chaos." Hall, 44-58.

Vivaldi, Franco. "An Experiment with Mathematics." Hall, 33-43.

Questions?

Thank you:

- Dr. Marsha Dopheide
- Dr. Hannah Schell
- Dr. Michael Sostarecz