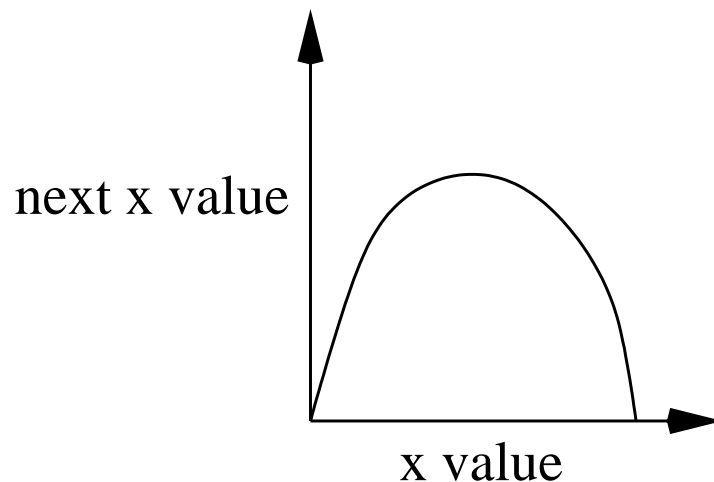


A very little bit about Time Series Analysis

- Given a time series, can we tell if it is chaotic (deterministic) or stochastic (produced by a non-deterministic process)? Yes
- The idea is to invert the procedure we used to generate orbits of the logistic function—use the orbits (i.e., the data) to generate the function!



- We used a function like this to determine x_{n+1} , the next x value, given x_n , the current x value.

Real Data

- Suppose we have some real data:

$$x_1 = 14$$

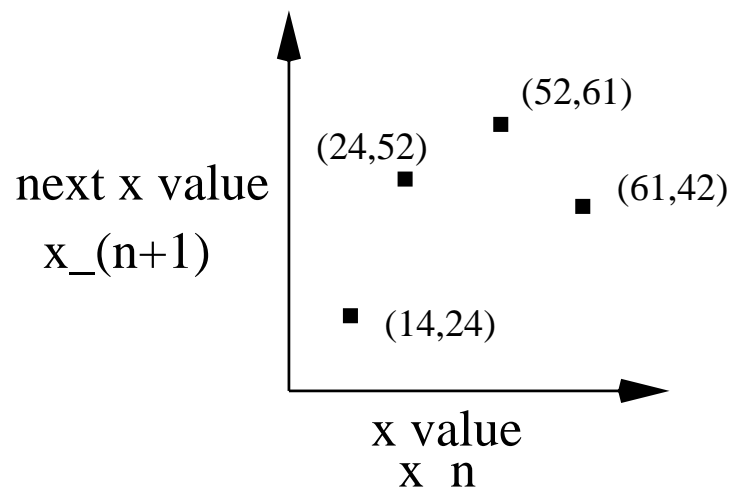
$$x_2 = 24$$

$$x_3 = 52$$

$$x_4 = 63$$

$$x_5 = 42$$

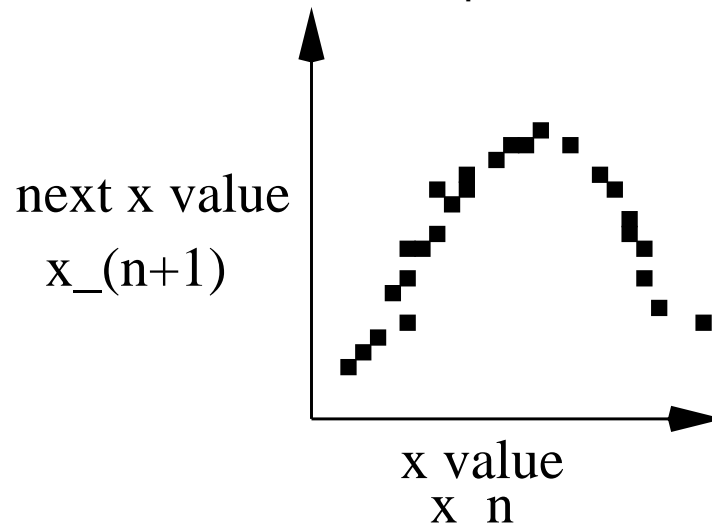
- Plot it as follows:



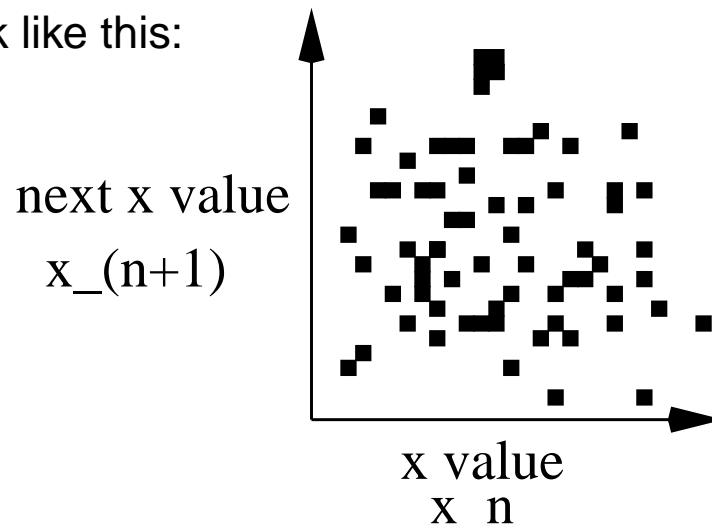
- The idea is that we're plotting x_{n+1} vs. x_n .
- Do this for lots and lots of data.

Determinism vs. Stochasticity

- If the data is deterministic, the plot will look like this:



- For a given x_n there is just one x_{n+1} .
- If the data is from a non-deterministic source, the plot will look like this:



- For a given x_n there can be many x_{n+1} 's.

Time Series Conclusion

- This sort of approach is a powerful and successful technique for analyzing experimental data.
- There's **much** more to it than this, however.
- For more, see, e.g.,
 - Kantz and Schreiber, *Nonlinear Time Series Analysis*. Cambridge. 1999.
 - Arbanel. *Analysis of Observed Chaotic Data*. Springer-Verlag. 1996.