Introduction to Complexity (Fall 2016) 2.10 Take Unit 2 Test » Unit 2 Test

Instructions 1

You may use any course materials, websites, Netlogo models, calculators, etc. for this test. Just don't ask another person for the an share your answers with other people.

Question 2

Aristotle and Newton differed in their beliefs in the following way:

- A. Aristotle believed that the earth revolved around the sun, whereas Newton believed that the sun revolved around the earth.
- . B. Aristotle believed that objects set in motion will stay in motion, whereas Newton believed that objects set in motion would slow down and eventually stop
- C. Aristotle believed that there were two separate sets of laws, one for behavior in the "heavens" and one for behavior on earth. Newton believed that the san applied to both.
- D. Aristotle believed that the planets move in perfect circles about a non-moving sun, whereas Newton showed that they move in ellipses.

Question 3

Pierre Simon Laplace believed that:

- A. The existence of sensitive dependence on initial conditions makes perfect prediction impossible.
- B. If we had perfect knowledge of the positions of all elements of the universe and all forces acting on them, perfect prediction would be possible in principl
- C. Newton's laws are imperfect, which makes perfect prediction impossible.

Question 4

According to Henri Poincaré:

- A. Perfect prediction is impossible for any phenomenon in nature.
- B. If we had perfect knowledge of the positions of all elements of the universe and all forces acting on them, perfect prediction would be possible in principl
- C. In some systems, sensitive dependence on initial conditions might make perfect prediction impossible in practice, due to errors or imprecision in measur conditions.
- D. Newton's laws are imperfect, which makes perfect prediction impossible.

Question 5

Suppose a population grows without limit, according to the formula

 $n_{t+1} = birthrate * n_t$

If birthrate = 4 and the initial (year 0) population $n_0 = 1$, which is the correct formula for the population at year t (i.e., n_t)?

- \circ A. $n_t = 4t$
- \circ B. $n_t = 4t^2$
- \circ C. $n_t = t^4$
- \circ D. $n_t = 4^t$
- E. $n_t = 4 * 2^t$

Question 6

Recall that the logistic model is:

$$n_{t+1} = [birthrate - death-rate] * [n_t - (n_t^2/k)]$$

where k is the maximum population (or carrying-capacity).

Suppose that birthrate = 4, death-rate = 0, k = 20, and the initial population n_0 = 20.

Using this model, what is n_{12} ?

- 。 A. 20
- 。 B. 21
- 。 C. 1
- 。 D. 0
- 。 E. 4

Question 7

For the logistic model (given in the question above), let birthrate = 5, death-rate = 0, k = 100 and $n_0 = 20$. What is the fixed-point of the these values?

- 。 A. 50
- 。B. 80
- 。 C: 20
- 。 D. 100
- 。 E. 0

Question 8

Recall that the logistic map is:

$$x_{t+1} = R (x_t - x_t^2)$$

where x = current-population / carrying-capacity and R = birthrate - deathrate.

Let R = 1.6. What is the fixed-point attractor for this value of R, starting from any

x0 (assuming x0 is greater than 0 and less than 1)?

- 。 A. 0.375
- 。 B. 0.450
- 。 C. 0.2
- 。 D. 0.355
- 。 E. 0.575

Question 9

For the logistic map, let R = 3.2. What kind of attractor does this yield?

- · A. Fixed point attractor
- B. Period 2 attractor
- o C. Period 4 attractor
- D. Period 8 attractor
- E. Chaotic attractor

Question 10

Which of the following can you conclude from the logistic map bifurcation diagram?

- A. When R is between 2.4 and 3.0, the logistic map has a fixed point that increases as R increases.
- B. When R is between 3.0 and 3.4, the logistic map has a period-2 attractor in which, as R increases, the two values in the attractor get closer together.
- C. The onset of chaos for the logistic map is between 3.4 and 3.5.

Question 11

A system exhibits deterministic chaos if:

- \circ $\,$ $\,$ A. Chaos occurs for only some values of x_0
- B. If two initial conditions are very close, their trajectories under the system will also be close.
- · C. The system is deterministic, but its behavior can be impossible to predict with perfect accuracy.

Question 12

Which of these best describes what Feigenbaum's constant measures?

- A. The distance between bifurcations in the logistic map as Rincreases
- B. The rate at which the distance between bifurcations in the logistic map decreases as Rincreases
- $\circ~$ C. The increase in the periods of attractors in the logistic map increases as R increases