1.1.5 Quiz: Parameters, Variables and Bifurcations

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Question 1

1/1 point (graded)

In the example of the Lorenz weather model, we're examining the behavior of a fluid trapped between two thin plates. Recall that a bifurcation is a dramatic change in the behavior of the system in response to a small change in parameter.

What is this system? Recall we consider time as the independent variable. Some of the dependent variables of interest might be the temperature of the fluid, or the fluid's density or position – these relate to whether the fluid will experience no motion, convective rolling or turbulence.

The parameter is ΔT, the temperature difference between the two plates. For a specific temperature difference ΔT we consider what happens to those dependent variables over time.

Imagine we start with $\Delta T = 0$, so the two plates are the same temperature. As the parameter ΔT increases, what types of bifurcations can occur in the behavior of the fluid? Choose all that apply.

- [ ] No motion to turbulence
- [x] No motion to convective rolling ✔
- [x] Convective rolling to turbulence (chaos) ✔
- [ ] Turbulence (chaos) to convective rolling

- [ ] None of the above.

✔

Explanation
Choices B and C. There are two bifurcations: one is the switch from no motion to convective rolling, one is the switch from convective rolling to turbulence (chaos).

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Answers are displayed within the problem

Question 2

1/1 point (graded)
Suppose $\Delta T > 0$ and the fluid is experiencing convective rolling. As the parameter ΔT decreases, what type of bifurcations can occur as the plates approach the same temperature?

- [ ] Turbulence to no motion
- [x] Convective rolling to no motion ✔
- [ ] Convective rolling to turbulence (chaos)
- [ ] None of the above.

Explanation
Choice B. Note: Bifurcations can happen for an increase or decrease in parameter. Here we're decreasing the parameter to zero which would result in no motion.

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Question 3

5/5 points (graded)

Let's consider the fishing example. There are several different values which might be varied in this example. Can you match each to its role in the scenario that Wes described?

A. Time	independent variable ▼ ✔ **Answer:** independent variable
B. Population of Fish	dependent variable ▼ ✔ **Answer:** dependent variable
C. Carrying Capacity of the Lake	this quantity is not varied in the scenario ▼ ✔ **Answer:** this quantity is not varied in the scenario
D. Temperature of the Lake	this quantity is not varied in the scenario ▼ ✔ **Answer:** this quantity is not varied in the scenario
E. Fishing Rate	parameter ▼ ✔ **Answer:** parameter

Time is the independent variable. The dependent variable is the population of fish. The parameter is the fishing rate.

We fix a particular fishing rate, and consider what happens to the population of fish over time. We then compare that what happens with a different parameter value, for example, a larger fishing rate.

(Note: The fishing rate may also change with time, which would add another complication to this model. In the examples of this module, however, we'll always consider the parameters fixed for each situation and consider time the independent variable.)

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