Feedback — Quiz 3: Sections 7-8

You submitted this quiz on **Sat 17 Nov 2012 9:32 PM PST**. You got a score of **10.00** out of **10.00**.

Section 7 covered Tipping Points, and Section 8 covered Growth Models.

Be ready to do some calculations on R_0 from the disease models from our tipping point lecture, as well as some growth calculations from section 8.

If you have any trouble, you'll be able to check out the explanations after you take the quiz the first time. They might be a big help for those of you who want to try the quiz again, or for those of you who just solidify what you've already learned.

Good luck!

Question 1

Which of the following might be explained by a tipping point? (Hint: pick more than 1 answer)

Your Answer		Score	Explanation
☐ Last year there were 2 bunnies in a pen in my backyard. Now there are 40.	✔	0.25	
☑ New home sales plummet by 60%	✔	0.25	
☑ Power outages occur throughout the East Coast of the U.S.	✔	0.25	
☑ Residential Segregation	✔	0.25	
Total		1.00 / 1.00	

Question Explanation

New home sales rose consistently through the 90s and into the 2000s, then plummeted around '06 when the "bubble" burst. This is a tipping point.

Power grids are like checkerboards, in which power either percolates or does not; there may be a tipping point at which power cannot percolate.

Looking back to the Schelling model, we see there may be a tipping point at which neighborhoods become segregated.

The bunnies, however, are exponentially increasing, as is typical for animal populations. There is no tipping point there.

[See Lecture 7 on Tipping Points]

Question 2

In a building with 70 residents, a rumor spreads through a diffusion process. At what point is the rate of diffusion greater: when 15 people have heard, or when 50 people have heard? (Hint: you can solve this with only a small amount of math)

Your Answer		Score	Explanation
The rumor spreads faster when 50 people have heard.	✔	1.00	
Total		1.00 / 1.00	

Question Explanation

The best way to solve this question is to realize that you can ignore most of the terms in the diffusion equation because they will be equal in this context. You only need to look at W(N-W):

For W=15, W(N-W) = 15(55) = 825

For W=50, W(N-W) = 50(20) = 1,000

Since 1,000 > 825, we know that the rumor will spread more quickly when 50 residents have heard than when only 15 have heard. Recall, however, that at this point we are only part of the way toward calculating the real rates of diffusion; our results here - 825 and 1,000 - do not represent the rates of diffusion.

[See 7.3, "Contagion Models 1: Diffusion"]

Question 3

Imagine that a virus has an R_0 of 9. What is the minimum percentage of the population that should be vaccinated in order to prevent the spread of this virus? Give your answer to one decimal point (e.g., 50.5%).

You entered:

88.9

Your Answer		Score	Explanation
88.9	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

V is the percentage of people who must be vaccinated. V must be greater than or equal to $1 - \frac{1}{R_0}$.

Since $R_0 = 9$, V must be greater than or equal to $1 - \frac{1}{9} = \frac{8}{9} = 88.89$.

Remember, however, that networks, changes in contact, and other externalities will come into play in real life contexts.

[See 7.4, "Contagion Models 2: SIS"]

Question 4

In our disease model (SIS), R_0 must be less than 1 in order to ensure that the disease will not spread throughout the population. In this model, R_0 is an example of which type of tipping point?

Your Answer		Score	Explanation
Contextual Tipping Point	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

R_0 is a contextual tipping point. As R_0 exceeds 1, the probability of the disease spreading changes from 0 to 1. The definition of a contextual tipping point is "a change in the environment, x, by a tiny bit that has a huge effect on the end state." Remember the percolation model for forest fires? Both the percolation model and this circumstance are examples of contextual tipping points.

[See 7.5, "Classifying Tipping Points"]

Question 5

Imagine a situation in which there exist four possible outcomes: one with probability $\frac{1}{6}$, one with probability $\frac{1}{3}$, and two with probability $\frac{1}{4}$. Calculate the diversity index. (Please round your answer to the hundredths place, i.e. 5.55)

You entered:

3.79

Your Answer		Score	Explanation
3.79	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

First, square each of the probabilities:

$$(\frac{1}{6})^2 = \frac{1}{36}$$

$$(\frac{1}{3})^2 = \frac{1}{9}$$

$$2(\frac{1}{4})^2 = \frac{2}{16}$$

Next, we add each of these results together using a common denominator:

$$\frac{2}{72} + \frac{8}{72} + \frac{9}{72} = \frac{19}{72}$$

We then take the inverse of the above result, giving us $\frac{72}{19} = 3.79$

[See 7.6, "Measuring Tips"]

Question 6

Note: this question requires careful thinking.

If output equals $30\sqrt{K}$, the savings rate equals 20%, and equilibrium output equals 1200, what is the depreciation rate?

Your Answer		Score	Explanation
15%	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

If equilibrium output equals 1200, then the equilibrium level of capital equals 1600, because $30\sqrt{1600} = 1200$

Therefore, at $K = 1600$, investment must equal depreciation.

Let d denote the depreciation rate. Depreciation equals 1600d.

Investment equals 20% of 1200, which is 240.

Therefore, $d = 15$

[See 8.3, "Basic Growth Model"]

Question 7

A country has a production function such that output equals $40\sqrt{K}$ where K equals the amount of capital. If this country has 36 units of capital, what is its output?

You entered:

240

Your Answer		Score	Explanation
240	✓	1.00	

Total	1.00 / 1.00

Question Explanation

Output = $40\sqrt{36}$ = 240

[See 8.3, "Basic Growth Model"]

Question 8

If output equals $40\sqrt{K}$, the savings rate equals 10% and the depreciation rate is 20%, what is the long run equilibrium level of OUTPUT?

You entered:

800

Your Answer		Score	Explanation
800	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

Equilibrium capital, K, must be such that savings equals depreciation. Therefore, it must be that:

$(0.1) \cdot 40\sqrt{K} = 0.2K$

Now multiply both sides by 10:

$40\sqrt{K} = 2K$, or $20\sqrt{K} = K$

Then, divide both sides by the square root of K:

$20 = \sqrt{K}$

Therefore, $K = 400$, so total output equals 800.

[See 8.3, "Basic Growth Model"]

Question 9

A country has a production function of $100\sqrt{K}$, a savings rate of 10%, a depreciation rate of 10%, and current capital stock, K, of 10,000. Assuming no change in technology, what will be the growth rate for this country?

Your Answer		Score	Explanation
0%	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

Plug in for K:

Current output equals $100\sqrt{10,000} = 10,000.$

Next year, capital will increase by 1000 but depreciate by 1000 as well.

This means there will be no growth. In other words, growth rate = 0%

[See 8.3, "Basic Growth Model"]

Question 10

Imagine a country in which an innovation changes the output function from $10\sqrt{K}$ to $50\sqrt{K}$. Assuming that capital depreciates at 10% and the country saves 10%, by what factor does equilibrium output increase after the innovation?

Your Answer		Score	Explanation
It increases by a factor of 25.	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

First solve for initial equilibrium by setting investment equal to depreciation:

$(0.1) \cdot 10\sqrt{K} = 0.1K$. This reduces to $10\sqrt{K} = K$.

So $K = 100$ and output = 100.

After the innovation, the equilibrium is:

$(0.1) \cdot 50\sqrt{K} = 0.1K$. This reduces to $50\sqrt{K} = K$.

So $K = 2500$ and output = 2500.

Now find the factor by which output has increased:

$\frac{2500}{100} = 25$

After the innovation, equilibrium output increases by a factor of 25.

[See 8.4, "Solow Growth Model"]