Feedback — Quiz 9: Sections 19-20

You submitted this quiz on **Sat 17 Nov 2012 7:29 PM PST**. You got a score of **10.00** out of **10.00**.

Section 19 deals with Replicator Dynamics. Be ready to answer both conceptual and mathematical questions on this topic, as well as questions about Fisher's Fundamental Theorem.

Section 20 is all about crowd wisdom and predictions. Questions 6 through 9 deal with the specifics of the Diversity Prediction Theorem, so make sure you have a good grasp of that. And then there's a fun one about predictive models at the end.

Good luck, and enjoy!

Question 1

What does Replicator Dynamics accomplish? Please select only one answer.

Your Answer		Score	Explanation
It helps to explain the role of variation in evolution.	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

Replicator Dynamics specifically explains the role of variation in evolution.

The other options are beyond the scope of the model and are not derived directly or explicitly from the model.

[See 19.1, "Replicator Dynamics"]

Question 2

What are the two mechanisms by which replication occurs in the Replicator Dynamics model?

Your Answer		Score	Explanation
1. Agents do what a lot of other agents are doing; 2. Agents do what has the best payoff.	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

Remember, agents replicate according to the strategy that seems to have the best payoff and that many of the other agents are using.

[See 19.2, "Replicator Equation"]

Question 3

Imagine there are three groups of dinosaurs trying to adapt to a fast-changing environment. At $time = 0$, each dinosaur has a stated, numeric fitness level, and there is an equal proportion of dinosaurs with each fitness level in each group:

Group 1: (4,6,7)

Group 2: (1,5,9)

Group 3: (4,4,5)

Which group will increase in fitness the most from $time = 0$ to $time = 1$? By how much will this group increase in fitness?

Note: By equal proportion, this means that for instance, in Group 1, $\frac{1}{3}$ of dinosaurs have fitness=4, $\frac{1}{3}$ have a fitness of 6, and $\frac{1}{3}$ have a fitness of 7.

Your Answer		Score	Explanation
Group 2, by $\frac{32}{75}$ or about 42%.	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

According to Fisher's Fundamental Theorem, Group 2 will increase in fitness the most because it has the greatest variance.

Since Group 2 makes the most sense, we'll start there and use replicator dynamics to check our answer:

Average fitness at $time = 0$ is $\frac{1+5+9}{3} = 5$.

Weight (fitness = 1): $\frac{1}{3} * 1 = \frac{1}{3}$.

Weight (fitness = 5): $\frac{1}{3} * 5 = \frac{5}{3}$.

Weight (fitness = 9): $\frac{1}{3} * 9 = \frac{9}{3}$.

So the sum of these weights is $\frac{1}{3} + \frac{5}{3} + \frac{9}{3} = \frac{15}{3}$.

Next, use the replicator equation to find proportions at $time = 1$:

Proportion (fitness = 1): $\frac{^1/_3}{^15/_3} = \frac{1}{15}$.

Proportion (fitness = 5): $\frac{^5/_3}{^15/_3} = \frac{5}{15}$.

Proportion (fitness = 9): $\frac{^9/_3}{^15/_3} = \frac{9}{15}$.

Finally, find the new average fitness for the group by multiplying fitnesses by proportions:

$(1 * \frac{1}{15}) + (5 * \frac{5}{15}) + (9 * \frac{9}{15}) = 7\,\frac{2}{15}$ or $7.1\overline{3}$.

Test this result against the two possible answers:

Did average fitness increase by 33%?

$5 * 1.33 = 6.65$. No.

How about by ~ 42%?

$5 * 1.42 = 7.1$. Yes, our fitness increased by about 42%. (Exactly $42.\overline{6}$%).
[See 19.3, "Fisher's Theorem"]

Question 4

Which of the following are fundamental components of Fisher's Fundamental Theorem? You can pick more than one.

Your Answer		Score	Explanation
☐ Cooperation Games	✓	0.17	
☐ Prisoner's Dilemma	✓	0.17	
☑ Replicator Dynamics	✓	0.17	
☐ Markov Processes	✓	0.17	
☑ Rugged Landscapes	✓	0.17	
☑ There is no cardinal	✓	0.17	
Total		1.00 / 1.00	

Question Explanation

As stated in lecture, the three fundamental models used to think about Fisher's Fundamental Theorem are:

There is no cardinal (i.e. there is variation within populations/species),

Rugged landscapes exist (i.e. there may be local optima which make finding the global optima difficult),

And replicator dynamics (evolution can occur through weighing (1) the rational observation of the actual payoff to being a certain type, and (2) the number of people of that type).

[See 19.3, "Fisher's Theorem"]

Question 5

In which situation would you choose Six Sigma (the importance of reducing variation) over Fisher's Fundamental Theory (which encourages variance)?

Your Answer	Score	Explanation

☐ When the landscape is rugged but you have not yet found a global maximum.	✓	0.25
☐ When trying to cure cancer.	✓	0.25
☑ When you have found a global optima in either a single peaked landscape or a fixed but rugged landscape.	✓	0.25
☐ When the landscape is dancing.	✓	0.25
Total		1.00 / 1.00

Question Explanation

Remember, variance in Fisher's Fundamental Theorem is helpful for finding solutions that are otherwise difficult to find either because there are many local optima or because the landscape is changing and requires adaptation (like curing cancer).

Problems which are fixed landscapes and for which the best solution has largely been found, are better handled by trying to minimize variance around that solution. It is in these cases that we would want to use Six Sigma.

[See 19.4, "Variation or Six Sigma"]

Question 6

$Diversity\ Prediction\ Theorem$: If you have a large crowd using one biased model to make a prediction, what type of values (small or large) do you expect for each of the following: Crowd Error, Average Error, and Diversity?

Your Answer		Score	Explanation
◉ Crowd Error: Large; Average Error: Large; Diversity: Small	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

Biased populations tend to produce large crowd errors.

Crowd Error = Average Error - Diversity, so Average Error must be large, while Diversity must be small.

This makes sense, because if the population is biased, each individual is probably going to make substantial errors. And if they're all subject to the same bias, they will probably predict similar values (have little diversity).

[See 20.3, "Diversity Prediction Theorem"]

Question 7

$Diversity\ Prediction\ Theorem$: If crowd diversity decreases, what must happen to the average error in order to retain the same crowd error?

Your Answer		Score	Explanation
The average error must decrease as well.	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

Remember that Crowd Error = Average Error - Diversity.

So if diversity decreases, but we want the result (crowd error) to remain the same, then the average error must decrease along with the diversity.

If the average error does not decrease, on the other hand, but diversity still does, then the crowd error would increase.

[See 20.3, "Diversity Prediction Theorem"]

Question 8

There are three predictions: 45, 25, 56. The actual value is 39. What is the average diversity?

Your Answer		Score	Explanation
164.67	✓	1.00	

Total	1.00 / 1.00

Question Explanation

Step 1: Calculate the average prediction:

$\frac{45+25+56}{3} = 42$

Step 2: Subtract the average prediction from each prediction, and then square each term:

$(45-42)^2 = 9$; $(25-42)^2 = 289$; $(56-42)^2 = 196$;

Step 3: Take the average of these terms: $\frac{9+289+196}{3} = 164.67$

[See 20.3, "Diversity Prediction Theorem"]

Question 9

In the Diversity Prediction Theorem, where might diversity come from? You may select more than one answer.

Your Answer		Score	Explanation
☑ Different functional forms of the model.	✔	0.25	
☑ Different categories.	✔	0.25	
☑ Different perspectives.	✔	0.25	
☑ Different models.	✔	0.25	
Total		1.00 / 1.00	

Question Explanation

All of the answers can help to increase the diversity of the crowd (i.e. the average squared distance of each individual's prediction from the average prediction of the crowd).

[See 20.3, "Diversity Prediction Theorem"]

Question 10

In a job interview, you are asked to predict the number of ping pong balls that can fit into a yellow school bus. Which type of predictive model are you better off using?

Your Answer		Score	Explanation
Linear Model	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

The better response is a linear model.

To predict the number of ping pong ball on a school bus, you might want to divide the bus into sections. Imagine one row, and try to figure out how many balls might fit into that row; then multiply by your prediction of how many rows are on the bus. Alternatively, predict how many balls would fit into one cubic foot; then predict the total cubic footage of the bus, and multiply. This is linear prediction - breaking the problem into parts so as to make manageable predictions, then adding these predictions together.

The categorical approach would be to think of something similar in size to a school bus, and predict how many ping pong balls fit into that. Then use the analogy to predict how many balls fit in the school bus. But unless you know how many ping pong balls fit in various vehicles or containers - we're assuming most of you don't - this isn't a very good model.

[See 20.2, "Linear"]