Course > Section... > 1.2 Co... > 1.2.4 Q...

1.2.4 Quiz: Using the graph of dP/dt versus P

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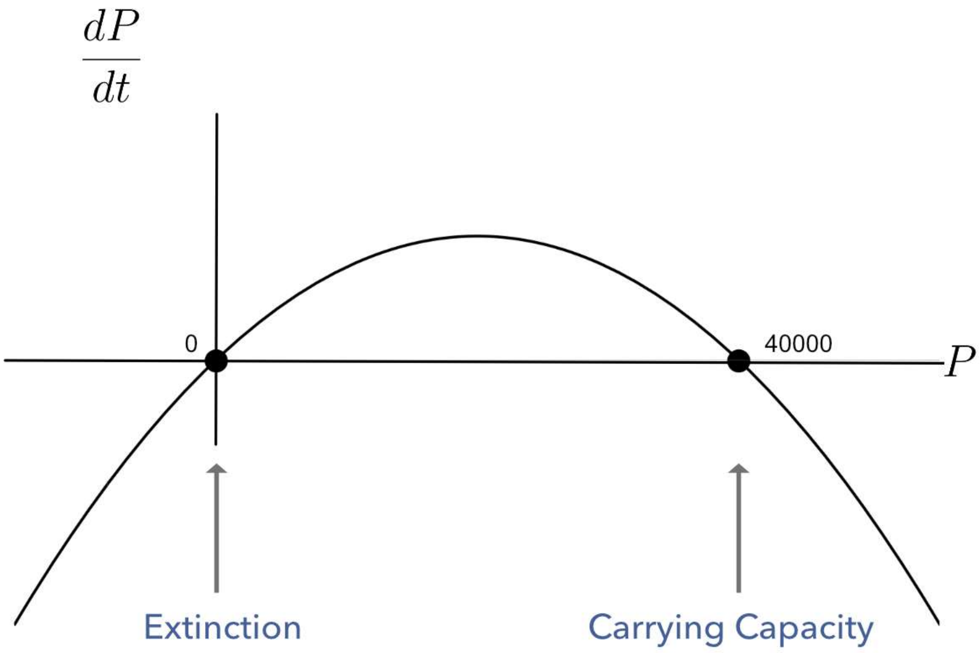

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Image Description

Question 1

2/2 points (graded)

Wes showed how to use the graph of $\frac{dP}{dt}$ versus P to see whether the population will be increasing or decreasing for a given population level.

When the population is between 0 and $40,000$, the graph of $\frac{dP}{dt}$ is above the horizontal axis.

A. This means $\frac{dP}{dt}$ is

● positive ✓

○ negative

○ zero

○ none of above

○ We cannot tell from this graph.

B. This means the population is

● increasing ✓

○ decreasing

○ constant

○ zero

○ none of above

○ We cannot tell from this graph.

Explanation

When the population is between 0 and $40,000$, the graph of $\frac{dP}{dt}$ is above the horizontal axis, so $\frac{dP}{dt} > 0$ and thus $P(t)$, the population size, is increasing.

Submit You have used 1 of 4 attempts

Answers are displayed within the problem

Question 2

1/1 point (graded)

At what population level is the population increasing fastest? Why?

○ When P = 10,000

○ When P = 20,000 ✓

○ When P = 30,000

○ When P = 40,000

● When P = 50,000

○ None of the above.

Explanation

At $P = 20,000$, the graph of $\frac{dP}{dt}$ has a maximum (this is the x-coordinate of the vertex of the parabola $y = \frac{1}{10}P(1 - \frac{P}{40000})$). Thus the derivative is greatest at $P = 20,000$, and the population is increasing fastest here.

Note: This means there will be an inflection point in the graph of P versus t, as P goes from concave up ($\frac{dP}{dt}$ increasing) to concave down ($\frac{dP}{dt}$ decreasing). The graph of $P(t)$ will look qualitatively like the graph of the function in the Item Response Theory section, and in fact, the solution to the differential equation is a logistic function.

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Question 3

1/1 point (graded)

Wes used arrows on the horizontal axis of the graph of $\frac{dP}{dt}$ versus P to represent intervals of P-values for which the population P is increasing or decreasing. An arrow to the left means for population levels in this interval, P is decreasing. An arrow to the right means P is increasing.

Try this on your own: Ask yourself for which P-values the derivative is positive. Then draw arrows on the horizontal axis to the right, to indicate that P is increasing. Do the same for where the derivative is negative.

Once you are done, compare your graph with the graphs below. Which is the correct one?

Image Description for All Graphs

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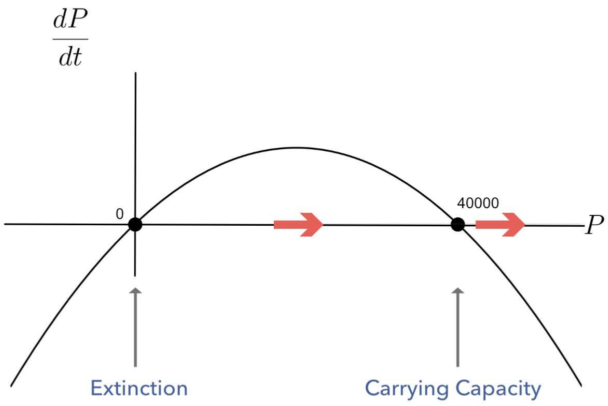

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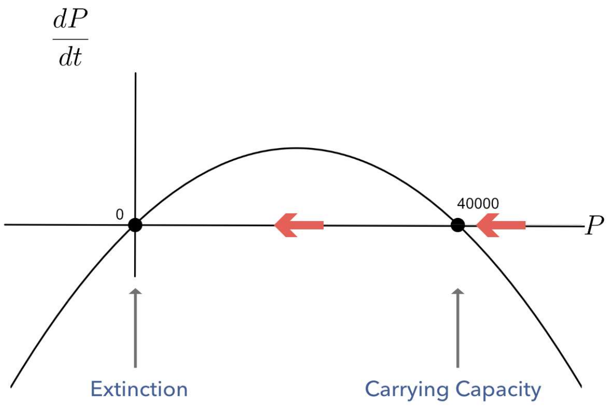

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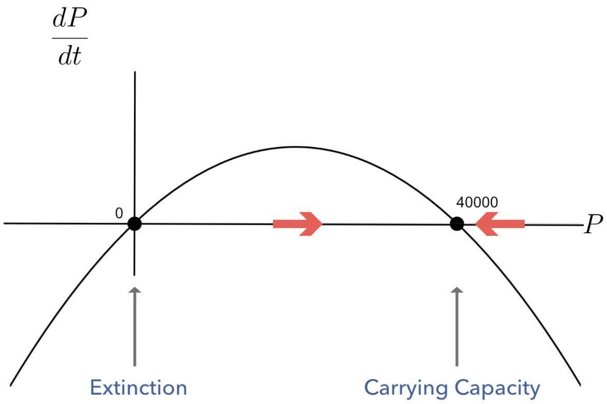

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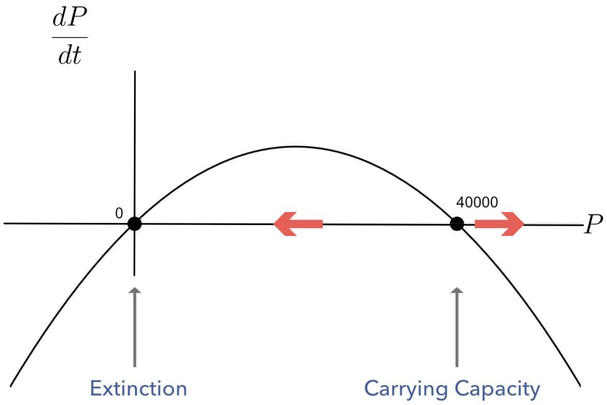

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Explanation

When $0 < P < 40,000$, the graph is above the axis because dP/dt is positive, so P is increasing. We draw an arrow to the right – in the direction of increasing P – along this portion of the P axis.

When $P > 40,000$, the graph of dP/dt is below the axis because $dP/dt < 0$. P is decreasing. We put an arrow to the left on this part of the P axis to indicate that P is decreasing here.

For $P < 0$ the model doesn't make biological sense. We ignore this part of the graph.

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You have used 1 of 2 attempts

ℹ Answers are displayed within the problem

Question 4

1/1 point (graded)

Recall we can classify equilibrium solutions as stable, unstable or semi-stable (see previous section). The solution $P(t) = 40,000$ represents a:

● stable solution. ✓

○ unstable solution.

○ semistable solution.

○ generic function. This is not an equilibrium solution.

Explanation

Recall the red arrows on the graph indicate when P is increasing or decreasing. For $P = 40,000$, we look at the value of $\frac{dP}{dt}$ for values near $40,000$ (slightly less and slightly more). This tells us how the population P is changing.

According to the model, populations below $40,000$ increase toward $P = 40,000$ and populations above $40,000$ decrease toward $P = 40,000$. Therefore, $P = 40,000$ is a stable equilibrium point.

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You have used 1 of 2 attempts

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