

Euler's Method ; Spread of
Infectious Disease
Math 102 Section 107

Krishanu Sankar

November 20, 2017

$$y' = 0.1(y - 4)$$

Q1. What's the slope of the solution at $t = 0$, given that $y_0 = 6$?

$$y' = 0.1(y - 4)$$

Q1. What's the slope of the solution at $t = 0$, given that $y_0 = 6$?

A. $0.1(y - 4)$

B. 0.2

C. $y'(0)$

D. -0.4

$$y' = 0.1(y - 4)$$

Q1. What's the slope of the solution at $t = 0$, given that $y_0 = 6$?

A. $0.1(y - 4)$

B. 0.2

C. $y'(0)$

D. -0.4

Answer: B. A and C are both correct, but you can simplify further!

$$y' = 0.1(y - 4)$$

What's the value of the approximation y_2 ?

- A. $y_2 = 4 + 2e^{0.1}$
- B. $y_2 = y_1 + (\Delta t) \cdot y_1'$
- C. $y_2 = 6.1 + (0.5)(0.21)$
- D. $y_2 = 6.1 + 2e^{0.1}$

$$y' = 0.1(y - 4)$$

What's the value of the approximation y_2 ?

- A. $y_2 = 4 + 2e^{0.1}$
- B. $y_2 = y_1 + (\Delta t) \cdot y_1'$
- C. $y_2 = 6.1 + (0.5)(0.21)$
- D. $y_2 = 6.1 + 2e^{0.1}$

Answer: C. A is the *exact value*. Note answer B, as it is the general formula one uses for Euler's method. (In our example, $\Delta t = 0.5$.)

$$y' = 0.1(y - 4)$$

What's the value of the approximation y_2 ?

- A. $y_2 = 4 + 2e^{0.1}$
- B. $y_2 = y_1 + (\Delta t) \cdot y_1'$
- C. $y_2 = 6.1 + (0.5)(0.21)$
- D. $y_2 = 6.1 + 2e^{0.1}$

Answer: C. A is the *exact value*. Note answer B, as it is the general formula one uses for Euler's method. (In our example, $\Delta t = 0.5$.)

$$y' = 0.1(y - 4)$$

Q3. In this case, does Euler's method give us an over-approximation, or an under-approximation to the exact answer?

$$y' = 0.1(y - 4)$$

Q3. In this case, does Euler's method give us an over-approximation, or an under-approximation to the exact answer?

- A. Over-approximation
- B. Under-approximation

$$y' = 0.1(y - 4)$$

Q3. In this case, does Euler's method give us an over-approximation, or an under-approximation to the exact answer?

A. Over-approximation

B. Under-approximation

Answer: It is an under-approximation, because the actual solution is *concave up*.

$$y'' = 0.1y' = 0.01(y - 4)$$

$$\text{Rate of infection} = aI(N - I)$$

Q4. Suppose that people *recover* at a rate proportional to the number of infected.

$$\text{Rate of infection} = aI(N - I)$$

Q4. Suppose that people *recover* at a rate proportional to the number of infected.

A. $\frac{dI}{dt} = aI(N - I) + bI$

B. $\frac{dI}{dt} = aI(N - I) - bI$

C. $\frac{dI}{dt} = bI$

D. $\frac{dI}{dt} = \frac{a}{b}I(N - I)$

where $b > 0$ is a positive constant.

$$\text{Rate of infection} = aI(N - I)$$

Q4. Suppose that people *recover* at a rate proportional to the number of infected.

A. $\frac{dI}{dt} = aI(N - I) + bI$

B. $\frac{dI}{dt} = aI(N - I) - bI$

C. $\frac{dI}{dt} = bI$

D. $\frac{dI}{dt} = \frac{a}{b}I(N - I)$

where $b > 0$ is a positive constant. Answer: B. The fact that people are recovering *decreases* the number of infected.

$$\frac{dI}{dt} = aI(N - I) - bI$$

Q4. Which constant relates to the *probability of transmission*?

A. a

B. b

C. N

$$\frac{dI}{dt} = aI(N - I) - bI$$

Q4. Which constant relates to the *probability of transmission*?

A. a

B. b

C. N

$$\frac{dI}{dt} = aI(N - I) - bI$$

Q4. Which constant relates to the *probability of transmission*?

A. a

B. b

C. N

$$\frac{dI}{dt} = aI(N - I) - bI$$

Q4. Which constant relates to *how long a person is contagious?*

A. a

B. b

C. N

$$\frac{dI}{dt} = aI(N - I) - bI$$

Q4. Which constant relates to *how long a person is contagious?*

A. a

B. b

C. N

$$\frac{dI}{dt} = aI(N - I) - bI$$

Q4. Which constant relates to *how long a person is contagious?*

A. a

B. b

C. N