

Math 1311

**Homework 4 (Section 2.4 & Section 2.6)**

Record your answers to all the problems in the EMCF titled “**Homework 4**”.

1. Solve using the crossing-graphs method:  $12^x + 3x = 9^x + 3$ . Round your answer to two decimal places.
- a) 0.68
  - b) 0.98
  - c) 1.28
  - d) 0.33

2. Find the positive solution using the crossing-graphs method:  $4x^3 - 7x = 4 - 2x^2$ . Round your answer to two decimal places.
- a) 1.55
  - b) 2.35
  - c) 1.95
  - d) 1.35

3. A breeding group of foxes is introduced into a protected area, and the population growth follows a logistic pattern. After  $t$  years the population of foxes is given by

$$N = \frac{39.68}{0.30 + 0.88^t} \text{ foxes.}$$

When will the fox population reach 78 individuals? Round your answer to two decimal places.

- a) after 14.26 years
  - b) after 16.01 years
  - c) after 19.85 years
  - d) after 12.26 years
4. The temperature  $C$  of a fresh cup of coffee  $t$  minutes after it is poured is given by  $C = 55e^{-0.09t} + 82$  degrees Fahrenheit. The coffee is cool enough to drink when its temperature is 93.91 degrees. When will the coffee be cool enough to drink?
- a) 13 seconds after it is poured
  - b) 27 seconds after it is poured
  - c) 23 seconds after it is poured
  - d) 17 seconds after it is poured

5. The temperature  $C$  of a fresh cup of coffee  $t$  minutes after it is poured is given by  $C = 125e^{-0.05t} + 77$  degrees Fahrenheit. What is the temperature of the coffee in the pot? (Note: We are assuming that the coffee pot is being kept hot and is the same temperature as the cup of coffee when it was poured.)
- 202 degrees Fahrenheit
  - 279 degrees Fahrenheit
  - 164 degrees Fahrenheit
  - 83 degrees Fahrenheit

6. The temperature  $C$  of a fresh cup of coffee  $t$  minutes after it is poured is given by  $C = 128e^{-0.03t} + 67$  degrees Fahrenheit. What is the temperature in the room where you are drinking the coffee? (Hint: If the coffee is left to cool a long time, it will reach room temperature.) Round your answer to the nearest unit.
- 61 degrees Fahrenheit
  - 68 degrees Fahrenheit
  - 67 degrees Fahrenheit
  - 70 degrees Fahrenheit

7. You are hosting a convention for a charitable organization. You pay a rental fee of \$29,500 for the convention center, plus you pay the caterer \$16 for each person who attends the convention. Suppose you just want to break even. Use a formula to express the amount you should charge per ticket as a function of the number of people attending. Be sure to explain the meaning of the letters you choose and the units.

- $T(n) = \frac{29,500 + 16n}{n}$  dollars, where  $T(n)$  is the amount charged per person, and  $n$  is the number of people attending the convention.
- $T(n) = \frac{29,500 + 16 + n}{n}$  dollars, where  $T(n)$  is the amount charged per person, and  $n$  is the number of people attending the convention.
- $T(n) = \frac{(29,500 + 16)n}{n}$  dollars, where  $T(n)$  is the amount charged per person, and  $n$  is the number of people attending the convention.
- $T(n) = \frac{(29,500 - 16)n}{n}$  dollars, where  $T(n)$  is the amount charged per person, and  $n$  is the number of people attending the convention.

8. A breeding group of foxes is introduced into a protected area, and the population growth follows a logistic pattern. After  $t$  years the population of foxes is given by  $N = \frac{47.5}{0.25 + 0.24t}$  foxes. How many foxes were introduced into the protected area?

- 18 foxes
- 27 foxes
- 38 foxes
- 47 foxes

9. Use the information from question 8. When will the fox population reach 150 individuals?
- a) 2.13 years                      b) 3.86 years                      c) 1.90 years                      d) 4.37 years

10. Section 2.4 Exercise 10b

- a) 20 mins                      b) 17.03 mins                      c) 25.09 mins                      d) 12.50 mins

11. Find the minimum value of  $3^x - 2x^2 + 9$  on the horizontal span of 0 to 10.

- a) 19.22  
b) -9.92  
c) -12.22  
d) 9.68

12. The weekly profit  $P$  for a widget producer is a function of the number  $n$  of widgets sold. The formula is

$$P = -4 + 5.3n - 0.6n^2.$$

Here  $P$  is measured in thousands of dollars,  $n$  is measured in thousands of widgets, and the formula is valid up to a level of 6 thousand widgets sold. At what sales level is the profit as large as possible? Round your answer to the nearest thousand.

- a) 14 thousand widgets per week  
b) 2 thousand widgets per week  
c) 4 thousand widgets per week  
d) 3 thousand widgets per week

13. F.E. Smith has studied population growth for the water flea. Let  $N$  denote the population size. In one experiment, suppose Smith found that  $G$ , the rate of growth per day in the population, can be modeled by  $G = \frac{0.32N(230-N)}{230+3.36N}$ . There are two values of  $N$  where  $G$  is zero.

Find these values of  $N$  and explain what is occurring at these population levels.

- a) At  $N=0$  and  $N=256$ , the growth rate is 5, that is, the size of the population is increasing.  
b) At  $N=0$  and  $N=248$ , the growth rate is 0, that is, the size of the population is not changing.  
c) At  $N=0$  and  $N=230$ , the growth rate is 0, that is, the size of the population is not changing.  
d) At  $N=0$  and  $N=233$ , the growth rate is 8, that is, the size of the population is increasing.

14. An important model for commercial fisheries is that of Beverton and Holt. It begins with the study of a single cohort of fish- that is, all the fish in the study are born at the same time. For a cohort of the North Sea plaice (a type of flatfish), the number  $N = N(t)$  of fish in the population is given by

$$N = 1000e^{-0.1t},$$

and the weight  $w = w(t)$  of each fish is given by

$$w = 6.32(1 - .93e^{-0.095t})^3.$$

Here  $w$  is measured in pounds and  $t$  in years. The variable  $t$  measures the so-called *recruitment age*, which we refer to simply as the *age*. The biomass  $B = B(t)$  of the fish cohort is defined to be the *total weight* of the cohort, so it is obtained by multiplying the population size by the weight of a fish. At what age is the size of the biomass maximized? Round your answer to the nearest year.

- a) 14 years old
- b) 26 years old
- c) 13 years old
- d) 4 years old

15. An important model for commercial fisheries is that of Beverton and Holt. It begins with the study of a single cohort of fish- that is, all the fish in the study are born at the same time. For a cohort of the North Sea plaice (a type of flatfish), the number  $N = N(t)$  of fish in the population is given by

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.Here  $w$  is measured in pounds and  $t$  in years. The variable  $t$  measures the so-called *recruitment age*, which we refer to simply as the *age*. The biomass  $B = B(t)$  of the fish cohort is defined to be the *total weight* of the cohort, so it is obtained by multiplying the population size by the weight of a fish. If a plaice weighs 4.21 pounds, how old is it? Round our answer to the nearest year.

- a) 13 years old
- b) 14 years old
- c) 21 years old
- d) 15 years old

16. Section 2.6 Exercise 2

- a) 1.84 mL/L; 1.28 hours
- b) 2.03 mL/L; 3.24 hours
- c) 1.03 mL/L; 5.03 hours
- d) 0.5 mL/L; 2.15 hours

17. Section 2.6 Exercise 4c

- a) 4833 widgets
- b) 5236 widgets
- c) 7563 widgets
- d) 3658 widgets

18. Section 2.6 Skill Building Exercise S-8

- a) local max  $(-5, 3)$  local min  $(5, -3)$
- b) local max  $(1, 4)$  local min  $(-1, -4)$
- c) local max  $(0, 4)$  local min  $(3, -4)$
- d) local max  $(-3, -5)$  local min  $(3, 5)$

19. Section 2.6 Skill Building Exercise S-24

- a) local max  $(0, -3)$  local min  $(10, 3)$
- b) local max  $(10, 106)$  local min  $(6, -102)$
- c) local max  $(5, 3)$  local min  $(10, -3)$
- d) local max  $(-4, 3)$  local min  $(7, -5)$

20. Section 2.6 Exercise 22c

- a) .39 grams
- b) .50 grams
- c) .45 grams
- d) .48 grams