Math 1311
Homework 9 (Section 5.1- Section 5.2)

Record your answers to all the problems in the EMCF titled **" Homework 9"** .

1. Suppose a renewable population grows logistically according to $N = \frac{794}{1+13e^{-0.02t}}$. According to the theory of maximum sustainable yield, what is the optimum harvesting level?
   a) 794
   b) 397
   c) 1588
   d) 795

2. If the optimum yield level is 800 and the initial population is 400, find the value of b associated with the logistic formula $N = \frac{K}{1+be^{-rt}}$.
   a) 5
   b) 4
   c) 3
   d) 7

3. Suppose a new magazine initially sells 600 copies per month. Research indicates that a vigorous advertising campaign could increase sales by 40% each month if our market were unlimited. But research also indicates that magazine sales in our area are unlikely to exceed 2400 per month. Make a logistic model of projected magazine sales.
   a) $N = \frac{600}{1+3e^{-0.336t}}$
   b) $N = \frac{2400}{1+3e^{-0.336t}}$
   c) $N = \frac{40}{1+3e^{-0.336t}}$
   d) $N = \frac{2400}{1+40e^{-0.336t}}$

4. The following table is adapted from a paramecium culture experiment conducted by Gause in 1934. The data show the paramecium population N as a function of time t in days. Use regression to find a logistic model for this population using a graphing calculator. Round the r value to three decimal places and the other parameters to two decimal places.

t	N
2	24
3	35
5	95
6	193
8	350
9	428
10	520
11	580

a) $N = \dfrac{83.54}{1+680.87e^{-0.558t}}$

b) $N = \dfrac{681.87}{1+83.54e^{-0.558t}}$

c) $N = \dfrac{680.87}{1+83.54e^{-0.558t}}$

d) $N = \dfrac{83.54}{1+0.558e^{-0.558t}}$

5. Studies to fit a logistic model to a particular species of the fish population have yielded $N = \dfrac{146}{1+2.8e^{-3.21t}}$, where t is measured in years and N is measured in thousands of tons of fish. At what time was the population growing the most rapidly? Round your answer to two decimal places.

a) $t = 0.54$ year
b) $t = 0.02$ year
c) $t = 0.32$ years
d) $t = 0.16$ year

6. The following table shows world population N, in billions, in the given year. According to the logistic model $N = \frac{10.90}{1 + 2.23e^{-0.030t}}$, when will world population reach 90% of carrying capacity?

Year	N
1965	3.38
1970	3.72
1975	4.15
1980	4.48
1985	4.87
1990	5.38
1995	5.72
1999	6.05

a) 2064
b) 2069
c) 2066
d) 2094

7. Let $f(x) = cx^{3.50}$. Suppose that $f(y)$ is 2 times as large as $f(z)$. How do y and z compare?

a) $y = 1.22z$
b) $y = 7z$
c) $y = 0.09z$
d) $y = 1.87z$

8. Let $f(x) = cx^{2.97}$ and suppose that $f(5) = 7$. Find the value of c.

a) 17.02
b) 64.71
c) 0.06
d) 4.07

9. On wet roads, under certain conditions the front tires of a car will *hydroplane*, or run along the surface of the water. The critical speed V at which hydroplaning occurs is a function of p, the tire inflation pressure. Suppose the following table shows hypothetical data for p, in pounds per square inch, and V, in miles per hour.
Find a formula that models V as a power function of p. Round parameters to the nearest hundredth.

Tire inflation pressure p	Critical speed for hydroplaning V
25	52.5
30	57.4
35	62.0
40	66.2

a) $V = 35.89 \cdot p^{0.02}$
b) $V = -41.49 \cdot p^{67.11}$
c) $V = 29.82 \cdot p^{0.91}$
d) $V = 10.70 \cdot p^{0.49}$

10. A biologist has discovered that the weight of a certain fish is a power function of its length. He also knows that when the length of the fish is tripled, its weight increases by a factor of 5. What is the value of the power k? Round your answer to the nearest hundredth.
a) $k = 0.54$
b) $k = 1.46$
c) $k = 0.68$
d) $k = 4.55$

11. Model the following data with a power formula. You should be able to do this exercise quickly and easily without using a calculator.

x	1	2	3	4	5
y	1	$\frac{1}{8}$	$\frac{1}{27}$	$\frac{1}{64}$	$\frac{1}{125}$

a) x^{-3}
b) x^{-4}
c) x^{3}
d) x^{4}

12. *Binary stars* are pairs of stars that orbit each other. The *period* p of such a pair is the time, in years, required for a single orbit. The separation s between such a pair is measured in seconds of arc. The *parallax* angle a (also in seconds of arc) for any stellar object is the angle of its apparent movement as the Earth moves through one half of its orbit around the sun. Astronomers can calculate the total mass M of a binary system using

$$M = s^3 a^{-3} p^{-2}$$

Here M is the number of *solar masses.*

Assume the separation of a pair of stars is $s = 18.1$ seconds of arc, its parallax angle is $a = 0.77$ second of arc, and the period of the pair is 64.4 years. What would the mass be if the parallax angle were tripled but separation and period remained the same? Round your answer to the nearest hundredth.

a) 0.12 solar masses
b) 9.40 solar masses
c) 0.01 solar masses
d) 84.56 solar masses

13. When we add the notion of *carrying capacity* to the basic assumptions leading to the exponential model, then we get a different model. What is the name of this model?

a) Power Model

b) Logistic Model

c) Decomposition Model

d) Exponential Model

14. If the carrying capacity is 2300, the r value is 0.77 per year, and b=7, then find the formula for logistic growth.

a) $N = \frac{2300}{1+7e^{-0.77t}}$

b) $N = \frac{0.77}{1+2300e^{-7t}}$

c) $N = \frac{2300}{1+0.77e^{-7t}}$

d) $N = \frac{7}{1+0.77e^{2300t}}$

15. Section 5.1 Skill Building Exercise S-6

a) 9

b) 10

c) 11

d) 12

16. Section 5.1 Skill Building Exercise S-8

a) $K = 2400$

b) $K = 2500$

c) $K = 2600$

d) $K = 2700$

17. Section 5.1 Skill Building Exercise S-10

a) 60

b) 70

c) 80

d) 90

18. Section 5.1 Skill Building Exercise S-20

a) $N = \frac{26}{1+1800e^{-0.21t}}$

b) $N = \frac{1800}{26+e^{-0.21t}}$

c) $N = \frac{1800}{1+26e^{-0.21t}}$

d) $N = \frac{1}{1800+26e^{-0.21t}}$

19. It is a consequence of Newton's law of gravitation that near the surface of any planet, the distance D fallen by a rock in time t is given by $D = ct^2$. That is, distance fallen is proportional to the square of the time, no matter what planet one may be on. But the value of c depends on the mass of the planet. For Earth, if time is measured in seconds and distance in feet, the value of c is 16. Suppose a rock is falling near the surface of a planet. What is the comparison in distance fallen from 6 to 12 seconds into the drop?

a) The distance fallen in 12 seconds is 108.00 times the distance fallen in 6 seconds.
b) The distance fallen in 12 seconds is 4.00 times the distance fallen in 6 seconds.
c) The distance fallen in 12 seconds is 2.00 times the distance fallen in 6 seconds.
d) The distance fallen in 12 seconds is 1.41 times the distance fallen in 6 seconds.

20. It is a consequence of Newton's law of gravitation that near the surface of any planet, the distance D fallen by a rock in time t is given by $D = ct^2$. That is, distance fallen is proportional to the square of the time, no matter what planet one may be on. But the value of c depends on the mass of the planet. For Earth, if time is measured in seconds and distance in feet, the value of c is 16. For objects falling near the surface of a specific planet, if time is measured in seconds and distance measured in feet, the value of c is 5.5. If a rock is dropped from 269.5 feet above the surface of the planet, how long will it take for the rock to strike the ground?

a) 4 seconds
b) 5 seconds
c) 3 seconds
d) 7 seconds