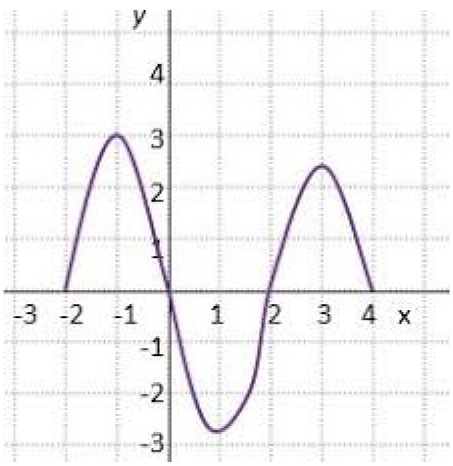
MTH 122, Fall 2019

Practice exercises for Exam 1

1. Consider the function shown in the graph below.
   For what values of the independent variable does it increase?
   For what values of the independent variable does it decrease?
   For what values of the independent variable is it concave up?
   For what values of the independent variable is it concave down?
   For what values of the independent variable it has a local maximum?
   For what values of the independent variable it has a local minimum?



2. Stella trims her hair to the level of her chin on Monday every 6th week. Sketch a possible graph of the length of her hair as a function of time. Is this a periodic process? Why?

3. Suppose you throw a ball upward, with an initial velocity of 50 feet per second, from the roof of a 160-foot-high building.
   a. Sketch a possible graph of the height of the ball as a function of time.

   Suppose that the height of the ball as a function of time is given by $H(t) = 160 + 50t - 16t^2$.
   b. Find the height of the ball after three seconds.
   c. What does H(0) represent?
   d. When will the ball be 10 feet above the ground?
   e. When will it hit the ground?
   f. What is the range and the domain of H(t)?

Section 1.3

7. The accompanying table shows the number of households, in millions, with cable television in various years.

Year	1977	1980	1983	1986	1988	1990	1992	1994	1996	1998	2000	2002	2004
Number	12.1	17.7	34.1	42.2	48.6	54.9	57.2	60.5	64.7	67.0	68.5	73.5	73.9

Source: 2006 *World Almanac and Book of Facts*

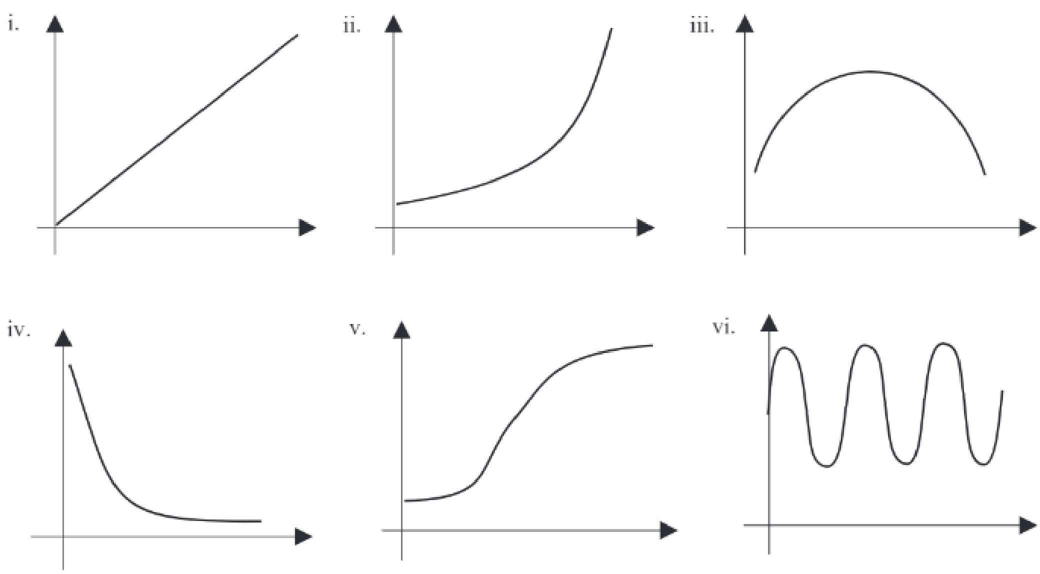
a. Decide which is the independent variable and which is the dependent variable.
b. Decide what would be appropriate scales for the two variables for a scatterplot.
c. State precisely which letters you will use for the two variables and state what each variable you use stands for.
d. Draw the associated scatterplot.
e. Raise some predictive questions in this context that could be answered when we have a formula relating the two variables.

Section 2.1

1. Which of the following relationships are functions and which are not? Explain your reasoning. For those that are functions, identify which of the two quantities depends on the other. Again, explain your reasoning.

a. The number of miles driven in a car versus the number of gallons of gas used.
b. The speed of a four-legged animal and its weight.
c. The major league baseball player who has a certain number of home runs at the end of the season.
d. The student who has a specific score on the SAT test in a particular year.
e. The amount of rain that falls on any particular day of the year in Seattle.
f. The day of the year on which given amounts of snow, in inches, fall in Buffalo.

2. Match each of the functions (a)–(f) with a corresponding graph (i)–(vi) and then label the axes appropriately. Explain your reasoning.



a. The population of a country as a function of time.
b. The path of a thrown football as a function of time.
c. The distance driven at a constant speed as a function of time.
d. The daily high temperature in a city as a function of time over several years.
e. The number of cases of a disease as a function of time.
f. The percentage of families owning DVD players as a function of time.

Section 2.2

5. Sketch the graph of a single smooth curve that is first decreasing and concave up, then increasing and concave up, and finally increasing and concave down. Mark all turning points and inflection points on your curve.

11. The number of cell phone subscribers grew slowly when cell phones were first introduced and then increased dramatically as more people appreciated their value. Eventually, the number of new subscribers began to slow as most individuals already owned a cell phone. Sketch the graph of cell phone subscribers as a function of time. Mark the location of the inflection point.

17. Ana trims her fingernails every Saturday morning. Sketch a possible graph of the length of her nails as a function of time. Is this a periodic process?

Section 2.3

1. Which of the following relationships are functions and which are not? For those that are not functions, explain why not. For those that are functions, identify the independent and dependent variables and give a reasonable domain.
   a. The cost of first-class postage on January first of each year since 1900.
   b. The weight of letters you can mail with $n = 1, 2, 3, \ldots$ first class mail postage stamps.
   c. The time of sunrise associated with each day of the year.
   d. The time of high tide associated with each day of the year.
   e. The high temperature associated with each day of the year.
   f. The closing price of a share of General Electric stock each trading day on the stock exchange.
   g. The area of a rectangle whose base is b.
   h. The area of an equilateral triangle whose base is b.
   i. The height of a bungee jumper t seconds after leaping off a bridge.
   j. The time it takes the bungee jumper to reach a height H above the ground.
   k. The number of baseball players who have n home runs in a full season.
   l. The height of liquid in a 55-gallon tank h hours after a leak develops.
   m. The daily cost to a family of heating their home versus the average temperature that day.
2. The balance B, in thousands of dollars, in a CD account at a bank is a function of time t, in years, since you opened the account, so $B = f(t)$.
   a. What does $f(4) = 2$ tell you? What are appropriate units?
   b. Is f an increasing or decreasing function of t?
   c. Discuss the concavity of f.

8. When a cup of hot coffee is left to cool on the table where the air temperature is 70°F, the change ΔT in the temperature T of the coffee is proportional to the difference between the temperature of the coffee and room temperature. Write a formula for ΔT as a function of T.

Section 2.4

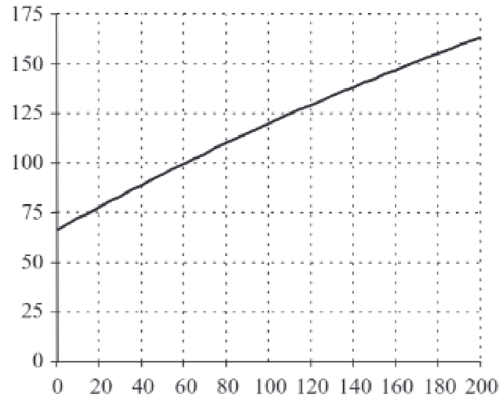
7. A turkey is put into an oven to heat. The accompanying graph shows the relationship between the temperature T, in °C, of the turkey and the time t in minutes since it went into the oven.

a. Which axis represents the temperature T and which the time t?

b. What was the temperature of the turkey when it first went into the oven?

c. Estimate the temperature of the turkey after 20 minutes.

d. Estimate how long it takes for the turkey to reach 150°.



1. A raw turkey at room temperature of 70° F is placed into a 325° F oven to cook. The turkey is removed when its internal temperature reaches 190° F.

a. Sketch the graph of the temperature T of the turkey as a function of time t.

b. What are practical values for the domain and range of this function?

c. Describe the behavior (increasing/decreasing, concavity) for the graph.

Section 3.1 ***(For algebra skills do: 4, 12, 14, 21, 25, 31)***

11. Jason is typing his term paper for Econ 101. He types the body of the paper at the rate of 40 words per minute for 25 minutes, then takes a 5-minute break, and comes back to do the references at a rate of 15 words per minute for 12 minutes.

a. Sketch the graph of Jason's typing rate as a function of time.

b. Sketch the graph of the total number of words he types as a function of time.

c. Find the equation of each line segment you drew in part (b).

Exercising Your Algebra Skills

Solve each equation for the appropriate variable.

1.	$4x - 7 = 13$	**2.**	$3x + 8 = -7$
3.	$3x - 1 = -7$	**4.**	$8x + 7 = 15$
5.	$18y - 7 = 22$	**6.**	$5.4x - 7.2 = 0.8$
7.	$9 - 3z = 6$	**8.**	$5 - 4p = -7$
9.	$4.7q + 5.1 = 24.5$	**10.**	$-1.3w + 12.8 = 22.7$
11.	$4k + 7 = 9k - 8$	**12.**	$6z - 5 = 4z + 11$
13.	$3(2x - 5) = 4$	**14.**	$2(4 - 3w) = 7$
15.	$3.2(t - 1980) = 1700$	**16.**	$1.35(t - 75) = 8$

Find the slope and the horizontal and vertical intercepts of each line in Problems 17–32. (*Hint*: If the variables are x and y, then the y-intercept occurs when $x = 0$ and the x-intercept occurs when $y = 0$.)

17. $2x - 3y = 8$	**18.** $2x + 3y = 8$	**19.** $4x + 7y + 5 = 0$	**20.** $3y - 2x + 4 = 0$
21. $4x - 5y = 20$	**22.** $6x + 5y = 30$	**23.** $5x - 4y = 10$	**24.** $2x + 7y = 9$
25. $2u - 3v = 8$	**26.** $2u + 3v = 8$	**27.** $4u + 7v + 5 = 0$	**28.** $3u - 2v + 4 = 0$
29. $2s - 3t = 8$	**30.** $2s + 3t = 8$	**31.** $4s + 7t + 5 = 0$	**32.** $3s - 2t + 4 = 0$

Section 3.2

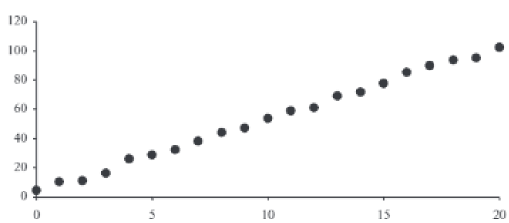
1. The U.S. imported 1.73 million gallons of wine in 2004, and 2.28 million gallons in 2007. Assume that the pattern of wine imports is a linear function of time.
   a. Find the equation for the linear function that can be used to model wine imports as a function of time. State explicitly what the independent variable represents.
   b. What is the practical significance of the slope of your line?
   c. Use your equation to predict the number of gallons of wine imported in 2012.
   d. Use your equation to predict when the U.S. will import 3 million gallons of wine.

4. The total movie attendance in the U.S. was 1.19 billion people in 1990 and 1.40 billion in 2007. Assume that the pattern in movie attendance is a linear function of time.
   a. Find the equation for the linear function that can be used to model movie attendance as a function of time. State explicitly what the independent variable represents.
   b. What is the practical significance of the slope of your line?
   c. Use your equation to predict movie attendance in 2015.
   d. Use your equation to predict when movie attendance will reach 1.50 billion people.

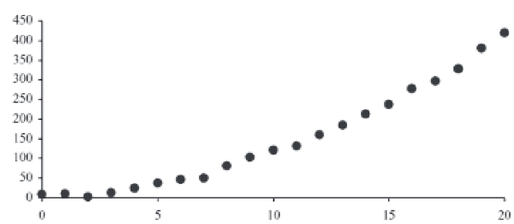
Section 3.3

1. The scatterplots for a variety of data sets are shown below. Which suggest a roughly linear pattern, which suggest a roughly non-linear pattern, and which apparently have no pattern? For those that seem to follow a linear pattern, use the black-thread method to draw what you think is the best line that captures that pattern.

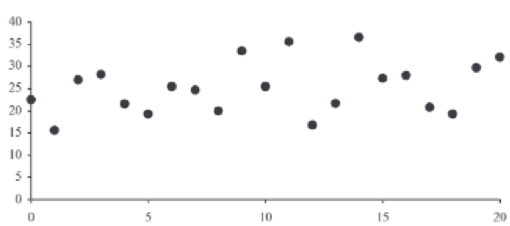
a.



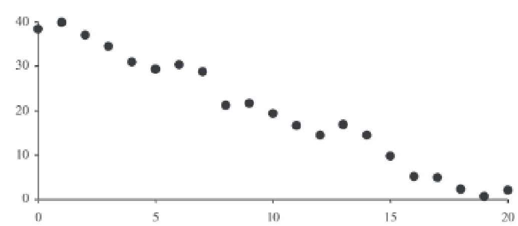
b.



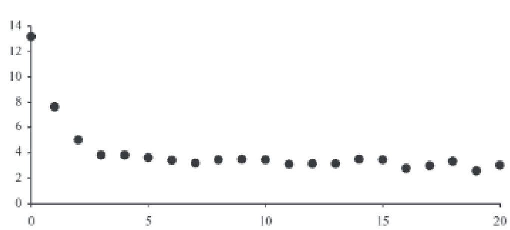
c.



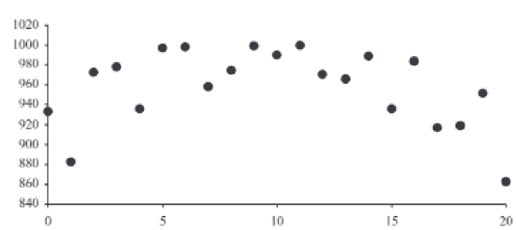
d.



e.



f.



3. The data in each of the following tables follow a linear pattern. For each set of data, carefully plot the points on graph paper. Estimate the slope and vertical intercept, and use these values to approximate the equation of the line.

a.

x	1	2	3	4
y	1.81	3.34	4.87	6.40

b.

x	1	2	3	4
y	1.08	0.69	0.30	−0.09

Section 3.4

7. The following table gives some measurements on the rate of chirping (in chirps per second) of the striped ground cricket as a function of the temperature.

T(°F)	89	72	93	84	81	75	70	82	69	83	80	83	81	84	76
Chirps	20	16	20	18	17	16	15	17	15	16	15	17	16	17	14

Source: Adapted from *The Songs of Insects* by George W. Pierce, Harvard University Press, 1948

a. Determine the equation of the line that best fits this set of data. How does it compare to the equation we estimated by eye in Example 5 of Section 3.3?
b. Does the value of the correlation coefficient indicate a high degree of correlation between chirp rate and air temperature?

14. In Example 4, we looked at data on the decrease in the number of cigarettes consumed on average, world-wide, from 1988 to 2002. The following table gives the corresponding data on the average number of cigarettes consumed, world-wide, from 1965 to 1981, where the pattern is clearly increasing.

1965	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
766	839	836	853	884	894	915	926	950	946	962	985	1,002

Source: Lester R. Brown, et al., *Vital Signs 2003: The Environmental Trends that are Shaping our Future*

a. Find the equation of the regression line that fits these data.
b. What does the slope of this line tell you?
c. What is the correlation coefficient for the regression line? Is there a significant level of correlation between the two variables?
d. World-wide cigarette use peaked in 1988. Use the regression equation to predict the number of cigarettes smoked per person in 1988.
e. Can you explain why the value predicted in part (c) is so different from the actual average of 1027 in 1988?
f. What might be some reasonable values for the domain and range of the regression function?

17. The following table gives estimates for the average temperature, in degrees Celsius, at the Earth's surface, worldwide, in different years.

Year	1880	1900	1920	1940	1960	1980	1999
Temperature	13.8	13.95	13.9	14.15	14.0	14.2	14.4

a. Find the equation of the line that best fits these data.
b. Assuming that the trend continues, predict the average surface temperature in 2020.