Note to students: This packet is a required supplement for students enrolled in Math 100: Core Competency in Mathematics. Students are expected to obtain this document and bring it with them to class.

Students may obtain this document by:
• Purchasing this packet at the bookstore
• Downloading and printing a copy of the packet by going to the website: http://www.wiu.edu/math/stu-org/math%20100%20supp.pdf
General Functions (Chapter 0 and 1)
For questions 1-4, use each graph to answer the related questions. Make sure to pay attention to the numbers on the x and y axes (the window).

1. a. Is this a function? ___________
   b. What is its domain? __________
   c. What is its range? ____________
   d. What is its y-intercept? _________
   e. What is its x-intercept(s) ___________
   f. Determine y
      When x is 3: ______________
   g. Determine x
      When y is -3: _____________

2. a. Is this a function? ___________
   b. What is its domain? __________
   c. What is its range? ____________
   d. What is its y-intercept? _________
   e. What is its x-intercept(s) ___________
   f. Determine y
      When x is 15: ______________
   g. Determine x
      when y is 40: _____________

3. a. Is this a function? ___________
   b. What is its domain? __________
   c. What is its range? ____________
   d. What is its y-intercept? _________
   e. What is its x-intercept(s) ___________
   f. Determine y
      When x is 4: ______________
   g. Determine x
      When y is 0: _____________

4. a. Is this a function? ___________
   b. What is its domain? __________
   c. What is its range? ____________
   d. What is its y-intercept? _________
   e. What is its x-intercept(s) ___________
   f. Determine y
      When x is 2: ______________
   g. Determine y
      When x is -2: _____________
5. The graph shown is a graph of the function H(x). Use it to answer the following questions:

- The domain of H(x): __________
- The range of H(x): __________
- What is the highest point(s) H(x): _________
- What is the y-intercept of H(x): _________
- What are the x-intercepts of H(x): _________
- Determine H(-2) = _________
- Determine H(0) = ________
- Determine x so that H(x) = -600: ___________

(hint: Which inputs result in an output of -600? )

6. Use the equation \( B(x) = 8 - 2x^2 \) to answer the following questions:

- Fill in the table:

<table>
<thead>
<tr>
<th>X</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>B(x)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Sketch a graph of B(x) and label your window:

- What is the domain of B(x):
- What is the range of B(x):
- What is the y-intercept of B(x): ______________
- What are the x-intercepts of B(x): ______________

Selected answers for problems 1-6: 1b. all reals 1c. \( y \geq -4 \) 1e. (2,0) and (-2, 0) 1f. about 4 2a. yes 2c. all y’s greater than or equal to -90 2d. (30,0) and (-30,0) 2g. about 35 and -35 3b. \( x \geq 0 \) 3d and 3e: (0,0) 3f. about 4 and -4 4a. yes 4c: all values greater than or equal to 0 4g. no such input 5a. all reals 5b. all reals less than or equal to 200 or \( y \leq 200 \) 5d. (0, -400) 5h. "about" x = -9 and x = 6 6. d. \( y \leq 8 \) 6f. (-2, 0) and (2,0)
Graphing Functions Homework

For each function given in problems 7-14, fill in the table, sketch a graph (always label your window), and answer the related sub-questions. Remember, use your table values to help determine a good window for your graph.

7. \( f(x) = 2x^2 - 18 \)

| X  | f(x)   | a. y-intercept: \( \) and x-intercept(s): \( \)  
|----|--------|-----------------------------------------------
| -3 |        |                                               
| -2 |        |                                               
| -1 |        | b. \( f(8) = \) \( \) and \( f(-8) = \) \( \) 
| 0  |        |                                               
| 1  |        | c. Domain: \( \) 
| 2  |        | d. Range: \( \) 
| 3  |        | 

8. \( g(x) = -2x^2 - 18 \)

| X  | g(x)   | a. y-intercept: \( \) and x-intercept(s): \( \)  
|----|--------|-----------------------------------------------
| -3 |        |                                               
| -2 |        | b. \( g(8) = \) \( \) and \( g(-8) = \) \( \) 
| -1 |        | c. Domain: \( \) 
| 0  |        | d. Range: \( \) 
| 1  |        | 
| 2  |        | 
| 3  |        | 

9. \( h(x) = 3x + 12 \)

| X  | h(x)   | a. y-intercept: \( \) and x-intercept(s): \( \)  
|----|--------|-----------------------------------------------
| -3 |        | b. \( h(4) = \) \( \) and \( f(-4) = \) \( \) 
| -2 |        | c. Range: \( \) 
| -1 |        | d. Is h(x) linear? \( \) 
| 0  |        | 
| 1  |        | 
| 2  |        | 
| 3  |        | 

10. \( k(x) = 3x^2 + 12 \)

| X  | f(x)   | a. y-intercept: \( \) and x-intercept(s): \( \)  
|----|--------|-----------------------------------------------
| -3 |        | b. \( k(6) = \) \( \) and \( k(-6) = \) \( \) 
| -2 |        | c. Range: \( \) 
| -1 |        | 
| 0  |        | 
| 1  |        | 
| 2  |        | 
| 3  |        | 

Math 100 problem supplement
11. \( m(x) = 3x^2 - 18x + 12 \)

<table>
<thead>
<tr>
<th>X</th>
<th>m(x)</th>
<th>a. y-intercept: _________</th>
</tr>
</thead>
<tbody>
<tr>
<td>-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. How many x-intercepts: ____________
c. \( m(10) = _____ \) and \( m(-10) = _____ \)
d. Range: _________________

12. \( n(x) = 3x^3 - 18x + 12 \)

<table>
<thead>
<tr>
<th>X</th>
<th>n(x)</th>
<th>a. y-intercept: _________</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. How many x-intercept(s): ____________
c. \( n(6) = _____ \) and \( n(-6) = _____ \)
d. Range: _________________

13. \( p(x) = .25x^2 - 36 \)

<table>
<thead>
<tr>
<th>X</th>
<th>p(x)</th>
<th>a. y-intercept: _________</th>
</tr>
</thead>
<tbody>
<tr>
<td>-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. x-intercept(s): ____________
c. \( p(10) = _____ \) and \( p(-10) = _____ \)
d. Range: _________________

14. \( q(x) = .05x^2 - 45 \)

<table>
<thead>
<tr>
<th>X</th>
<th>q(x)</th>
<th>a. y-intercept: _________</th>
</tr>
</thead>
<tbody>
<tr>
<td>-30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. x-intercept(s): ____________
c. \( q(15) = _____ \) and \( q(-15) = _____ \)
d. Range: _________________

Selected Answers: for problems 7-14:

7a. (0, -18) and (3,0), (-3,0)  7d. \( y \geq -18 \)
8a. (0, -18) and None  9b. 24 and 0  10a. (0,12) and (2,0); (-2,0)  11b. 2 x-ints.  11d. \( y \geq -15 \)
12a. (0,12)  12b. 3 x-ints. They are (-2.73, 0); (.73, 0); (2,0)  12d. All reals  13b. (12,0) and (-12,0)  14d. \( y \geq -45 \)
15. The table below is copied from this term's student schedule and lists the tuition and fees charges here at Western. Use it to answer the following questions.

a. Is the total charge a function of the number of hours taken? ____________

b. Is this a linear function? ________
   How do you know:

c. What would be the y-intercept of this function? ____________ Why does this make sense?

d. If someone asked how much it costs to attend WIU, you could answer about __________ per credit hour.

e. If your total tuition and fee bill was $2098.95, how many hours are you taking? __________
   Explain how you got your answer:

f. If your function was T(h) where h represented hours and T represented Total, determine T(17) = _______________ and explain what this means.

16. This table shows the approximate charge per tuition hour at WIU since 1997:

<table>
<thead>
<tr>
<th>Year</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge per hour (in dollars)</td>
<td>100</td>
<td>100</td>
<td>108</td>
<td>126</td>
<td>140</td>
</tr>
</tbody>
</table>

a. Sketch a graph of this information and label and mark your axes:

b. Is the charge a function of the year? ________________
   What is the input? ________________
   What is the output? ________________ and what is it measured in? ________________

c. Is this a linear function? ________________ Please explain:

d. Looking at the table, is the year a function of the amount charged? ________________ please explain.
17. Here is a chart found at Worldcom's website:


a. Does this chart represent a function? ____________  If so, describe the input:

and the output:

b. In what year did Worldcom's networth first reach 25 billion? ________

c. In what year did Worldcom's networth not increase? ______________

d. In what year did Worldcom's networth increase the most? ____________

e. If you were looking at this chart in 1999, does it indicate that Worldcom would be a good company to invest in?

f. Draw in what you believe the bars would look in the years 2000, 2001, and 2002:
Is there an x-intercept? __________ What would it mean?____________________

18. The graph below depicts the function f(x) where the x axis is from -10 to 10 by a scale of 1 and the y-axis is from -100 to 200 by a scale of 50. Use the graph to answer the following questions:

a. f(2) = __________ and f(-3) = __________

b. Find x so that f(x)=100
x = ___________________________

c. The y-intercept of this function is __________

d. This function has_______ x-intercepts and they appear to be _________________.

Math 100 problem supplement 6
19. In farming, the corn yield (in bushels per acre) of a certain field is a function of the amount of rainfall (in inches) received during the growing season. Draw a graph of what you think this function might look like:

20. Suppose the distance (in feet) that a model rocket can travel is a function of its booster power in kilowatts. The equation for this function is \( D(x) = 50\sqrt{x - 1} \)

   a. Use this equation to fill in the following table:

<table>
<thead>
<tr>
<th>Boosters</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (in feet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   b. Now use your table values to sketch a graph of this distance function. Make sure to label the increments on your grid:

   c. \( D(17) = \) ___________ which means……

   d. \( D(0) = \) ___________ which means……

   e. What is the domain of this function?

   f. What is the x-intercept of this function ______________ and what does it mean?
Linear Functions (Chapter 1)
For questions 21-29, use the given information to find the equation of the line and write your answer in slope intercept form. Circle your final answers:
21. The line has slope 3 and passes through the point (0,2):
   
22. The line has slope 3 and passes through the point (10, 2)
   
23. The line has slope 3/5 and passes through the point (10, 2)
   
24. The line has a y-intercept of -8 and an x-intercept of 6.
   
25. The line passes through the points (2, -8) and (6, 12):
   
26. The line passes through the points (10, 500) and (20, 1600)
   
27. The line passes through the points (1.5, 450) and (3.8, 220)
   
28. The line passes through the points shown in this table:

\[
\begin{array}{c|c|c|c|c|c}
X & 1 & 2 & 3 & 4 & 5 \\
Y & 110 & 100 & 90 & 80 & 70 \\
\end{array}
\]

29. The line passes through the points shown in this table:

\[
\begin{array}{c|c|c|c|c|c}
X & -5 & 0 & 5 & 10 & 15 \\
Y & 300 & 450 & 600 & 750 & 900 \\
\end{array}
\]

30. a. Find the equation of the line which passes through the points (2, 40) and (10, 96):

   \[f(x) = \text{__________________________}\]

   b. Use that equation to determine \( f(20) = \text{__________} \)

31. a. Find the equation of the line which passes through the points (1200, 6) and (3000, 3.75)

   \[p(x) = \text{__________________________}\]

   b. Find the x-intercept of this equation: \( \text{__________________________} \)
32. At the bowling alley, you have to rent a pair of shoes and then spend so much per game bowled. On Monday, you bowled 2 games for a total of $6.00. On Tuesday, you bowled 5 games for a total of $12.75.

a. How much does it cost per game: _____________________ (hint: find the slope)

b. How much is it for a pair of shoes: _____________________ (hint: find the y-intercept)

c. Write the total amount owed as a function of games played: _____________________

d. If you intend on bowling 10 games this weekend, how much money will it cost you? ______

Selected answers to problems 21-32:

22. $y = 3x-28$
23. $y = 3/5 x - 4$
25. $Y = 5x -18$
27. $Y = -100x + 600$
29. $Y = 30x+450$
30a. $f(x)=7x+26$
31a. $g(x) = -.00125x+7.5$
31b. $6000$

For problems 33-44, make sure to clearly label and define your variables.

33. The Plumber

My sink sprung a leak the other day and I had to call in a plumber to fix it. He charged $40 to make the trip to my house and then $25 an hour to do the repairs:

a. Express the cost for the plumber as a function of hours worked:

b. Determine how much the plumber costs if he spent 3 hours working on my sink:

c. If the plumber’s total labor bill was $165, he must have worked how many hours:

d. What is the slope of your function and what does it mean:

34. Tuition

Tuition and fees for undergraduates at WIU is $132.35 per hour

a. Express the total cost as a function of the number of hours taken:

b. If your total tuition and fees bill is $1,985.25, how many hours did you sign up for?

c. What is the y-intercept of this function and what does it mean?
35. Abnormal
In 1990, the population of Abnormal, Illinois was 80,000 and was increasing at the rate of 2000 per year.
   a. Express the population of Abnormal as a function of the years since 1990:
   b. What should the population of abnormal be this year:
   c. What is the x-intercept of this function and what does it mean?

36. Kazoo 1
To supplement my teacher’s salary, I have decided to sell kazoos. It costs me $.70 to make each kazoo plus $90 a week in overhead costs (machines, utilities, etc).
   a. Express my overall cost as a function of the number of kazoos I make per week:
   b. If I produce 100 kazoos per week, what will my overall cost be:
   c. If I have only $200 to spend per week, how many kazoos could I produce?
   d. What is the cost-intercept of this function and what does it represent:

37. Kazoo 2
My marketing research team has determined that if I charge $2 per kazoo, I can sell 80 kazoos. However, if I charge $6 per kazoo, I will sell only 20 kazoos. Assuming this is a linear relationship,
   a. Express the number of kazoos sold as a function of the price charged:
   b. If I charge $3.50 per kazoo, how many will I sell?
   c. If I want to sell 100 kazoos, how much do I need to charge?
   d. What is the slope of this function and what does it mean:
   e. What is the y-intercept of this function and what does it represent:
   f. What is the x-intercept of this function and what does it represent:

38. Joe Montana
The population of Joe, Montana was 18000 in 1980 but had decreased to 13,000 by 1990.
   a. Express the population of Joe as a function of years since 1980:
   b. What is the slope of your function and what does it mean:
   c. What is the x-intercept of your function and what does it mean:
   d. What will the population of Joe be in the year 2010: ___________________
39. Kurt Warner (in the year 2001)
In the preseason, Kurt Warner threw for 360 yards while the Rams scored 31 points in a win over Oakland. Against Buffalo, Mr. Warner threw for 320 yards and the Rams scored 27 points. Assuming a linear relationship between Kurt’s throwing yards and points scored by the rams,

a. How many points would you predict for the Rams when Kurt throws for 440 yards?

b. If opponents want to hold the Rams scoreless, they should limit Kurt’s passing yards to what?

c. What is the mathematical name for the point you found in b?

d. According to this relationship, the Rams should score 1 point for every ________ passing yards.

40. Cricket
A scientist monitored the chirping rate of crickets and believed it was dependent upon the temperature. She observed crickets for several evenings and came up with the following data:

<table>
<thead>
<tr>
<th>Temperature(F)</th>
<th>53</th>
<th>59</th>
<th>65</th>
<th>71</th>
<th>77</th>
<th>131</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chirps per minute</td>
<td>76</td>
<td>100</td>
<td>124</td>
<td>148</td>
<td>244</td>
<td></td>
</tr>
</tbody>
</table>

a. Determine the rate of change in chirping rate from 53 to 59 degrees; 59 to 65 degrees; and 65 to 71 degrees and use that to fill in the rest of the table:

b. What is the rate of change in chirps per every 6 degree temperature change? __________
What is the rate of change in chirps per every 1 degree temperature change? __________

c. Is this a linear function: ________ Why or why not:

d. Express the chirping rate of these crickets as a function of the temperature:

e. According to the slope of your function, every 1 degree increase in temperature results in ________ more chirps.

f. If the temperature were 80 degrees, how many chirps would you expect to hear? __________

g. If you walked outdoors and heard 80 cricket chirps per minute, what temperature would it be? _____

h. What is the x-intercept of your function and what does it mean:

i. What is the y-intercept of your function and what does it mean:
41. Subway Link

The following table shows the fat and calorie intake of certain foods. This real data was taken directly from the subway napkin:

<table>
<thead>
<tr>
<th>Food Product</th>
<th>Veggie delight sub</th>
<th>Turkey breast sub</th>
<th>Roast Beef Sub</th>
<th>Subway club</th>
<th>Tuna sub</th>
<th>Whopper</th>
<th>Big Mac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat (grams)</td>
<td>3</td>
<td>4.5</td>
<td>5</td>
<td>6</td>
<td>22</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Calories</td>
<td>230</td>
<td>280</td>
<td>290</td>
<td>320</td>
<td>450</td>
<td>680</td>
<td>590</td>
</tr>
</tbody>
</table>

a. Use your linear regression features to express the calories as a function of fat grams:

\[ y = \text{______________} \] (round m and b to 1 decimal place each)

r = \text{______________} (round to 3 decimal places)

b. Does there seem to be a strong correlation between calories and fat? ______________

Is this a positive or negative correlation? _____________

c. What is the y-intercept of your equation? _____________ and what does this mean:

d. What is the slope of your function? ____________ and what does this mean:

e. In their advertisements, Subway often neglects to mention that some of their sandwiches are loaded with fat--like the Tuna sub above. Their meatball sub for example contains 26 grams of fat. Use your linear model to predict how many calories this sub has: _______________

f. Three Tacos at Taco Bell have a total calorie content of 510 calories. According to your model, how much fat would you expect in these tacos? _______________

g. A regular 2-piece chicken meal at KFC contains 34 grams of fat. How many calories are in this finger-lickin good meal? _______________
42. Matt's fraternity (Lambda, Lambda, Lambda) has decided to make T-shirts for their Spring formal "Disco Fever". They have looked at 2 screening companies and they charge the following rates:
   Note: the screening fee is a set amount charged by the company regardless of number of shirts ordered.

   Company A: Charges $25 for the screening fee and then $5.50 a piece for every T-shirt.
   Company B: Charges $45 for the screening fee but only $4.25 per shirt.

   a. For each company, write an equation that represents the total cost in terms of T-shirts ordered:

   For A: _____________________________   For B: __________________________________

   b. Sketch a graph of both of these functions on the same axes. Make sure to clearly mark and label your axes:

   c. Determine the intersection of your two functions: ________________________

   d. What does this point mean in terms of the situation being modeled? Make sure to include labels and units when recording your answer:

   e. If Lambda, Lambda, Lambda expects to order 25 shirts, which company should they go with and what will their total cost be?

43. N Stync

   Recently, N Stync played for a sold out crowd of 20,000 in St. Louis. Tickets for this show were $25 for those above 15 years of age and $20 for those 15 or younger. If the total income from ticket sales was $402,500, how many of each age group attended the show:

44. Jim and Elaine are supposed to travel to Minneapolis together. Jim leaves Macomb and drives 65 miles per hour. At the same time, Elaine leaves Roseville (20 miles ahead of Jim) and travels at 60 mph toward Minneapolis.

   a. Express Jim’s distance from Macomb as a function of the time since he left:

   b. Express Elaine’s distance from Macomb as a function of time since Jim left:

   c. Graph both functions and determine when Jim will catch up with Elaine: __________ and how far will he have traveled by this time: ______________.

45. Use the regression features of your calculator to determine the equation of the line through the points (360, 31) and (320, 27)

   a. y = _____________________________ and r = ______________________

   b. Find y when x = 440 : ______________________

   c. Find the x-intercept of this line: _______________
46. Find the equation for the line of best fit for the points 
(1, 5); (2, 8), (3, 12), (4, 15.5); and (5, 19.5)

a. y = ___________________________ and r = ______________________

b. Use your equation to determine y when x is 4: _______________

How close is this to the actual value given originally? ______________

47. Listed below are the hours of TV watched per week and the cumulative GPA of 8 college juniors.

<table>
<thead>
<tr>
<th>TV hours</th>
<th>3</th>
<th>7</th>
<th>15</th>
<th>25</th>
<th>10</th>
<th>5</th>
<th>12</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA</td>
<td>3.85</td>
<td>3.45</td>
<td>2.10</td>
<td>1.65</td>
<td>3.40</td>
<td>2.8</td>
<td>2.55</td>
<td>2.25</td>
</tr>
</tbody>
</table>

a. Determine the regression line for GPA in terms of TV hours: round to 2 decimal places

y= ___________________________  r = ______________________________

b. According to this line, a student who watches 20 hours of TV per week would earn a GPA of ________.

c. In order to achieve a 3.0, a person should not watch more than ______________ hours of TV.

d. What is the y-intercept of this line and what does it mean:

e. What is the slope of this line and what does it mean:

48. Listed below are the height (in inches) and cumulative GPA of 8 college juniors:

<table>
<thead>
<tr>
<th>height</th>
<th>70</th>
<th>72</th>
<th>65</th>
<th>76</th>
<th>66</th>
<th>72</th>
<th>70</th>
<th>68</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA</td>
<td>1.96</td>
<td>2.25</td>
<td>2.37</td>
<td>2.48</td>
<td>2.89</td>
<td>3.16</td>
<td>3.64</td>
<td>3.30</td>
</tr>
</tbody>
</table>

a. Determine the regression line for GPA in terms of height: round to 3 decimal places

y= ___________________________  r = ______________________________

b. According to this line, a student with a height of 74 inches would earn a GPA of ________________.

c. According to this line, we would expect a 5 foot, 3 inch student to have a GPA of ________________.

d. Why do you think this r-value is so low? Is this a strong correlation? Please explain your answers:

e. What is the y-intercept of this function and what does it literally mean in terms of the given variables:
49. Weights are hung on a spring so that the spring is stretched to different lengths. The mass and corresponding length are listed below:

<table>
<thead>
<tr>
<th>Mass (grams)</th>
<th>0</th>
<th>40</th>
<th>80</th>
<th>120</th>
<th>160</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (cm)</td>
<td>9</td>
<td>35</td>
<td>60</td>
<td>82</td>
<td>110</td>
<td>133</td>
</tr>
</tbody>
</table>

a. Plot the data using your calculator and indicate whether you believe there is a strong or weak linear correlation:_________

b. Determine the regression equation for length in terms of grams:  \( y = \) ________________

and the correlation coefficient:  \( r = \) ________________

c. Graph this equation. Does it fit the data well?______________

d. What is the slope of your equation: ___________ and what does it mean?

e. A mass weighing 100 grams should stretch the string how far? ________

f. Suppose this spring is used on a deli scale and you order some ham slices that stretch the spring to 200 cm. How much does the ham weigh?

50. The force with which a fallen tree hits the ground has a linear relationship with the height of the tree. The following table lists heights of trees and the force with which they hit the ground.

<table>
<thead>
<tr>
<th>Height (feet)</th>
<th>15</th>
<th>70</th>
<th>22</th>
<th>62</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force (in force units)</td>
<td>410</td>
<td>1779</td>
<td>583</td>
<td>1583</td>
<td>934</td>
</tr>
</tbody>
</table>

Using the Linear Regression features of your calculator, find an equation that represents this linear relationship. (use x for height and y for force).

a. Fill in the blanks \( a = \) ___________ \( b = \) ___________

b. Write the equation in slope intercept form _________________________

c. Use your equation from part b to find the force of an 80 foot tree falling.

d. Use your equation from part b to find the height of a fallen tree that hits the ground with 1000 force units.
51. A book maker knows that the cost of making books is linearly related to the number of books being made. For a certain run of books, his records show that 800 copies cost $986 and 2000 copies cost $2235.

a. Find a linear equation to represent this relation with cost dependent on number of copies.
b. Explain what the startup cost and cost per book are in this case.
c. Find the cost of printing 1500 books.

52. Explain whether or not the following table represents a function.

<table>
<thead>
<tr>
<th>X</th>
<th>12</th>
<th>15</th>
<th>17</th>
<th>11</th>
<th>15</th>
<th>20</th>
<th>23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>14</td>
<td>18</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>25</td>
<td>27</td>
</tr>
</tbody>
</table>

53. The following table represents a function. Explain whether or not it is a linear function.

<table>
<thead>
<tr>
<th>X</th>
<th>8</th>
<th>12</th>
<th>20</th>
<th>2</th>
<th>22</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>50</td>
<td>78</td>
<td>134</td>
<td>8</td>
<td>148</td>
<td>92</td>
</tr>
</tbody>
</table>

54. Acme car rentals charges a flat fee plus a certain amount per mile driven. For 500 miles they charge $75.50 and for 1000 miles they charge $90.25.

a. Find a linear equation in slope-intercept form to represent this relation with cost dependent on number of miles. Do not round. ____________________________

b. Explain what the slope and y-intercept mean in this case.

c. Find the cost of driving 1500 miles.

55. Freeton starts with a population of 160000 people and grows 12000 people per year. Faciopolis starts with 250000 people but is losing 9000 people per year.

a. Find how long (to the nearest month) it will take the populations to be equal.

b. And what the populations will be at that time.

56. Billy Bob buys some baby ducks and some baby geese. He buys a total of 85 birds and spends a total of $89.25. Baby ducks cost $.75 each and Baby geese cost $1.25 each. Find how many of each he bought.
57. At the beginning of Beth’s pregnancy, she measured 29 inches around her waist. Every week, Beth’s waistline increased by half an inch.

   a. Write Beth’s waistline measurement as a function of the number of weeks she has been pregnant.
   b. When Beth’s pregnancy is full-term (40 weeks), how big around will she measure?
   c. If Beth measures 45 inches around, how many weeks has she been pregnant?

**Quadratic Functions (Chapter 2)**

58. Use the function \( f(x) = 2x^2 - 6x - 36 \) to sketch a labeled graph and to determine:

   a. the y-intercept: 
   b. the x-intercept: 
   c. the vertex: 
   d. the axis of symmetry: 
   e. the domain: 
   f. the range: 
   g. \( f(-7.5) = \) 
   h. all x such that \( f(x) = 10 \): 

59. Given the function: \( Q(x) = 3x(100 - x) \)

   a. Fill in the following table:
   
<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q(x)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   b. What is the vertex? 
   c. What is the axis of symmetry? 
   d. What is the domain? 
   e. What is the range? 
   f. What is the y-intercept? 
   g. What are the x-intercepts? 
   h. Find all x such that \( Q(x) = 3000 \): 

Math 100 problem supplement
60. Rocky the flying chicken is shot straight up from a cannon with an initial velocity of 96 feet per second. If this cannon was perched on top of a 30 foot tall building, determine an equation for Rocky’s height as a function of time and use this function to answer the following:

\[
H(x) = -16x^2 + vx + h
\]

function: \( H(x) = \) ________________

remember, in general: \( H(x) = -16x^2 + vx + h \)

a. How high did Rocky get?

b. When did Rocky hit the ground?

c. When was Rocky more than 100 feet in the air?

d. How high was Rocky after 2.25 seconds?

e. How long was Rocky traveling upward?

61. A diver is atop the 60 foot high springboard. She bounces a couple of times and then springs directly upward at a velocity of 75 feet per second.

a. Record her height in feet as a function of time in seconds:

b. How long does it take for this diver to hit the water? ________________

Why is this important to know when planning a competitive dive?

c. How high will this diver get? __________ When will she reach this height? __________

d. What could the diver do to both allow herself to go higher and to increase the amount of time available in her dive?

e. A camera will be installed to take a photograph exactly 1.25 seconds after the diver launches from the platform. How high will the diver be at this time? ________________

f. Another stationary camera is positioned at the 50 foot height mark. At what time(s) should this camera snap a photo in order to capture the diver exactly at this height?

g. What is the practical/problem domain of this situation?
62. Kazoo's R Us sells kazoos. Their profit is given by the function: \[ P(x) = -15x^2 + 120.5x - 77 \]
where \( P(x) \) is profit in dollars and \( x \) is price charged per kazoo.

a. Fill in the following table:

<table>
<thead>
<tr>
<th>Price charged in dollars</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total profit in dollars</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. Why do they not want to charge $8 per kazoo?

How could charging a higher amount result in a lower profit?

c. How much money will they make if they sell the kazoos for $4.50? _________________

d. How much should they charge to break even? _________________

e. How much should they charge per kazoo to earn a maximum profit? _________________

f. What is their maximum profit at this price? _________________

63. To secure his chickens, Farmer Brown wants to construct a fence against the barn wall. He has 300 feet of chicken wire to construct this pen. Determine a function for the area of the enclosed pen in terms of the length of one side of the pen and use that function to answer the following:

\[ A(x) = \frac{300 - 2x}{x} \]

a. What is the maximum area of such a pen? _________________

b. What dimensions will create a pen with maximum area?

c. If Farmer Brown wanted an area of 10000 square feet, what should the dimensions of the pen be?

d. If Farmer Brown makes the side lengths of the pen 80 feet, what would the resulting area be?
64. Use your quadratic regression features to determine the equation of the parabola that passes through the points (-1,0) (0, 8) and (5, 12).

   a. equation is  \( y = \) ______________________

   b. Determine the vertex __________ and axis of symmetry: ________________

   c. Determine the x-intercepts: _________________________

   d. Determine the y-intercept: _________________

   e. Determine y when x is 6.25: ______________

   f. Determine x when y is 50: ______________

   g. Determine the domain: ____________ and range: _______________ of your function

65. Given the following table:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell phone subscribers in millions</td>
<td>5.28</td>
<td>7.56</td>
<td>11.03</td>
<td>16.01</td>
<td>24.13</td>
</tr>
</tbody>
</table>

   a. Let 1990 equal year 0 and determine the quadratic function that best fits this data:

   \( y = \) ____________________________

   b. Use your function to predict how many cell phone subscribers there were in 2000:

   c. According to your model, when will there be 100 million cell phone subscribers?

   d. Determine the y-intercept of your function: _________________

   What does this represent:

66. Suppose a punter kicks a football straight up from a height of 4 feet with an initial velocity of 80 feet per second.

   a. How high does the ball go? ______________

   b. When does it reach this height? ______________

   c. When does the ball reach the ground? ______________

   d. What is the hang-time of the ball? ________________ Meaning, how long is it in the air.
67. Suppose a punter kicks a football straight up from a height of 4 feet. Usually it is not possible to measure the initial velocity, but you can measure the ball's hang-time and then calculate the initial velocity. In this case, suppose the ball hits the ground 6 seconds after it was punted (meaning the hang time of the punt was 6 seconds).

   a. At 6 seconds, the ball's height was ________ feet.
      As a coordinate, this would be ( _____, ______)

   b. The height function currently looks like \( h(x) = -16x^2 + vx + 4 \) since we do not yet know the velocity. However, plug 6 in for x and 0 in for y and then solve for v to obtain the initial velocity:

      What was the initial velocity of the punter’s kick? _____________________

   c. Now, express the height of the football as a function of time since leaving the punter’s foot:

      \( H(x) = \) ________________________________

   d. How high does the football get?

   e. When does it reach its maximum height?

   f. When is it more than 50 feet in the air? ___________________

   g. Fill in the following table for this function:

<table>
<thead>
<tr>
<th>Time(seconds)</th>
<th>0</th>
<th>.5</th>
<th>1</th>
<th>1.5</th>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>3.5</th>
<th>4</th>
<th>4.5</th>
<th>5</th>
<th>5.5</th>
<th>6</th>
<th>6.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height(feet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

68. The following table represents a function. Explain whether you think it is linear, quadratic or neither. If you use a graph, make a fairly neat and accurate drawing with specific points shown and labeled. Or you can show the scale of the graphing window that you used.

<table>
<thead>
<tr>
<th>X</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>30</td>
<td>49.5</td>
<td>64</td>
<td>73.5</td>
<td>78</td>
<td>77.5</td>
<td>72</td>
<td>61.5</td>
</tr>
</tbody>
</table>

69. The following table represents a function. Explain whether you think it is linear, quadratic or neither. If you use a graph, make a fairly neat and accurate drawing with specific points shown and labeled. Or you can show the scale of the graphing window that you used.

<table>
<thead>
<tr>
<th>X</th>
<th>-4</th>
<th>-2</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>11.12</td>
<td>9.32</td>
<td>7.52</td>
<td>5.72</td>
<td>3.92</td>
<td>2.12</td>
<td>.31</td>
<td>-1.48</td>
</tr>
</tbody>
</table>
70. An acrobat is launched straight up out of a cannon toward a trapeze which is 75 feet above the ground. His height ‘h’ in feet depends on the time ‘t’ in second which he has been in the air after leaving the mouth of the cannon. The mouth of the cannon is 10.5 feet off of the ground and the cannon launches him at about 90 feet per second.

a. Write an equation to represent this situation

\[ h(t) = \]

b. After about how many seconds will he have the chance to grab the trapeze on the way up?

On the way down?

c. If the misses the trapeze both times and does not hit the cannon, after how many seconds will he hit the ground? (There is no safety net)

71. Billy-Bob needs to put a rectangular border of gravel around his pig pen but not in it. The pen is up next to his barn so he only needs to put gravel around 3 sides of it. The pen is a 35’ by 50’ rectangle. The side along the barn is 50’ long. He can only afford 3000 square feet of gravel.

a. Draw a simple diagram of this situation showing the pen, the barn side, measurements, and ‘w’ the width of the border.

b. Write an equation showing the area ‘a’ of the border dependent on the width ‘w’

\[ a(w) = \]

c. Explain the maximum width he can make his border.

72. A very large cable is suspended between two identical towers and is used to support a bridge’s road bed. Assume the suspended cable has a hanging shape that is similar to a parabola. The cable is attached to the first tower at a height of 250 ft above the bridge’s road bed. Two other points along the suspended cable were also measured. The data is shown in the table below.

<table>
<thead>
<tr>
<th>Distance from the 1st tower as measured along the road bed (feet)</th>
<th>0</th>
<th>150</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of suspension cable above the road bed (feet)</td>
<td>250</td>
<td>148</td>
<td>82</td>
</tr>
</tbody>
</table>

Make a scatter-plot of the data. Let the distance from the first tower along the road bed be on the x-axis (\(L_1\)) and let the height of the cable above the road bed be on the y-axis (\(L_2\)).

a. Determine the best-fit quadratic formula for the suspension cable.

b. How high is the cable above the road bed at it’s lowest point?

c. How many feet is it from the base of the first tower to a point on the road bed, at which the cable is 50 feet above the road bed at this point?

d. How many feet is it to the next tower?
73. The small town of Zap had 45 people in 1810, 86 people in 1820, and 114 people in 1830.

   a. Use the census data to determine the best-fit quadratic equation (QuadReg) for the data.
   
   b. What was the town’s maximum population and when did this occur?
   
   c. During what year did the town become a ghost town? Give a date, such as during 1868.

**Exponential Functions (Chapters 3 and 4)**

74. Solve the following percent change problems.

   a. The cost of health insurance is increasing from $2800, presently, to $3024 next year. Find the percent change.

   b. The school budget for Fieldwood School District was $1,362,000 last year. Next year's budget will be 12% higher. Find next year's budget.

   c. Last year's average attendance at Pirates games was 16,500. This year attendance is down 4.2%. Find this year's attendance.

   d. This year's average attendance at Flyers games is 14,500 per game. This is down 7.2% from last year. Find last year's average attendance per game.

   e. This year at the Hamilton Manufacturing Company there have been an average of 15.6 absences from work each month. This is up 6.1% from last year. Find the average number of absences from work each month last year.

   f. There were 658 car accidents in Wilson County in 2001. This is 42 fewer than the number of accidents in 2000. Find the percent change.

   g. In June there were 462 new cases of the virus. This is up 10% from the number of new cases in May. Find the number new cases of the virus in May.

   h. There were 568 car accidents in Johnson County in 2001. In 2002 there were 32 fewer accidents than in 2001. What is the percent change?

   i. Car accidents in Willmore County are up 8% from 1996 to 1997. In 1997 there were 66 more accidents compared to the previous year. How many car accidents were there in 1996?

   j. Peterson Supply Company plans to cut their budget for computers next year by $950. This will be an 8% decrease. Find the amount they plan to spend on computers next year.

75. A patient is given an injection of 40 mg pain killer at 2 p.m. Each hour 20% of the pain killer is removed from the blood. Create a model for this situation and use the model to predict how many mg of the pain killer are in the bloodstream at 6 p.m.
76. In 1998 there were 410 cases of AIDS in Wilford County. Each year, the number of new cases has increased 3%. Create a model for this situation and use the model to predict when there will be 500 AIDS cases in Wilford County. Round your answer to the nearest year.

77. At 3 p.m. a patient has 36 mg of a medication in the bloodstream. At 4 p.m. there is 29 mg in the bloodstream. (The medication is removed exponentially, from the bloodstream.) Create a model to predict when there will be 10 mg of the medication in the bloodstream.

78. In 2000 the average cost of a 19 inch television was $810. In 2003 the average cost was $760. If the cost is decreasing exponentially, create a model for this situation and use it to predict the average cost of a 19 inch television in 2005. Round your answer to the nearest dollar.

79. You purchase a new Honda Accord for $18,300, which depreciates (loses some of it's value) at a rate of 9.6% per year.
   a. Write an exponential model for the depreciation of the car.
   b. What is the car's value after 5 years?

80. Your grandparents started a savings account for you when you were born. They invested $3000. The annual interest rate is 4.5%.
   a. Write an exponential growth model for the savings account.
   b. What is the value of the account on your 21st birthday?

81. A new antibiotic was tested on a culture of 500 bacteria. After adding the antibiotic, the bacteria died at a rate of 17% per hour.
   a. How many bacteria were still alive after 10 hours?
   b. How many hours and minutes did it take for half of the bacteria to die?

82. Assume a group of 6 mice triples every 4 weeks.
   a. What is the weekly growth factor?
   b. What is the weekly percent increase?
   c. If left with an unlimited food supply, what will be the mouse population in 1 year?

Selected answers to 79-82:
79. (a) - 9.6% (b) (1 - 0.096 ) or 0.904 (c) A = 18,300( 1 - 0.096 )^t
   (d) A = $11,048 after 5 years  80. (a) ( 1 + 0.045) = 1.045  (b) A = 3000( 1 + 0.045)^t  or
   A = 3000(1.045)^t  (d) $7560.72  81. (a) A = 500( 1 -0.17 )^t (b) 78  (c) 3.72 hr = 3 hour
   and 43 minutes  82. (a) b = 1.3161 (b) r = + 31.61% (c) t = 52 weeks, so 9,575,765 mice
83. A radioactive isotope has a half-life of 16 days (this means half of it is gone in 16 days). You start with 60 g.

a. Write an exponential model representing the amount of the radioactive substance as a function of time.

b. What is the daily percent decrease?

c. How much of the radioactive isotope will remain after 25 days?

d. When will only 10 g of the radioactive isotope will remain?

84. The amount of a radioactive isotope (different isotope than the previous problem) initially was 200 g. Five days later 162 g remained.

a. Write an exponential model representing the amount of the radioactive substance as a function of time.

b. What is the daily percent decrease?

c. What is the half-life? (How long does it take for half of the substance to decay away?)

d. How much of the radioactive isotope will remain after 21 days?

e. When will only 25 g of the radioactive isotope will remain?

85. As a detective for the NYPD, you are assigned to investigate a homicide. When you arrive on the scene, you discover a dead body and determine that its temperature is 78 degrees. With the hope of determining time of death, you continue to monitor the temperature every hour and come up with the following table:

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp (°F)</td>
<td>78</td>
<td>69</td>
<td>61.5</td>
<td>55</td>
<td>48.5</td>
</tr>
</tbody>
</table>

a. Write an exponential model representing temperature as a function of time.

b. Use this model to determine when the body temperature will reach 20 degrees.

c. According to your model, what was the body temperature 1 hour before you found the body?

d. Given that standard body temperature is 98.6 degrees Fahrenheit, determine how long the body had been dead before you arrived.

e. Describe in words the rate at which this temperature is decreasing.
86. The data table shows the weight of a baby in ounces at various ages in months.

<table>
<thead>
<tr>
<th>Child’s Age in months</th>
<th>0</th>
<th>6</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child’s weight in ounces</td>
<td>120</td>
<td>168</td>
<td>240</td>
</tr>
</tbody>
</table>

a. Make a scatter-plot and find the best-fit exponential regression model for the baby’s growth. Put age on the x axis.

b. How good a fit is the exponential equation? Comment(s)

c. How much will the baby weigh at the age of 2 years?

d. Using the exponential model, how much will the child weigh when it is 6 years old. Give the answer in pounds.

e. Comments on part (d).

f. Would a linear regression model work better? Comments.

87. A new Ford 150 pickup truck was purchased for business purposes. The value of the truck goes down, or depreciates, as the years pass. Assume the owner paid $28,500 for the truck, and the depreciation rate is 11% per year

a. What is the value of the truck after 3 years?

b. How long until the truck is worth one half of its original purchase price? Give the answer in years and days.

c. What is the decay factor, b, for the problem?

88. A colony of fruit flies is to be grown in a large bottle. At day zero, there are 6 fruit flies introduced to the bottle. At the end of 14 days there are 96 fruit flies in the bottle.

a. Calculate the rate of growth, r, for the fruit flies.

b. What is the value of the growth factor?

c. How many fruit flies will be in the bottle after 20 days?

d. How many days does it take to reach a population of 200 fruit flies in the bottle?

89. Some atoms, such as Carbon-14 atoms, are unstable and undergo a natural continuous decay process called radioactive decay. That is, they change into a different atom and also give off energy and subatomic particles during their decay process. Assume that you are working with a 12.00 milligram sample of a newly discovered element called Macombium-231, and that it decays at a rate of 0.15 % per year.

a. How many years will it take until only one half of the original amount of the chemical element remains? (This amount of time is known as the element’s half-life, since half of the element has decayed.)

b. How many years must pass until only 1 milligram of the Macombium-231 remains?
Polynomial functions and optimization (chapters 5 and 8)

90. There’s the snap, the place holder sets the ball, and the kicker kicks the football with an upward velocity of 70 feet/second.

a. Construct a height vs. time model of the form $y(t) = -16t^2 + v_0t + y_0$ for the kicked football.

b. How many seconds is the football in the air before it hits the ground in the end zone?

c. How high did it go?

d. The crossbar connecting the goal posts is 10 feet off the ground. How many seconds did it take for the football to just barely pass over the crossbar?

91. Over the years, Cubic City has had some major population swings due to economic factors. The data table shows the population in thousands of people for the census years of 1940, 1970 and the year 2000. A special census was taken in 1945.

<table>
<thead>
<tr>
<th>Year</th>
<th>1940</th>
<th>1945</th>
<th>1970</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (thousands of people)</td>
<td>60</td>
<td>65</td>
<td>56</td>
<td>72</td>
</tr>
</tbody>
</table>

a. Make a scatter-plot for the data and find the best-fit cubic regression equation.

b. Shortly after 1940 the population reached a maximum (a turning point). What was the maximum population and during what year did this occur?

c. As the economy worsened, the population fell to a low point before rebounding. What was the lowest population after 1940, and during what year did this happen?

d. According to the population model, during what year will the population of the city reach 100 thousand people?

e. What does the model predicted the population was for the 1960 census?

Selected answers for 90-91: 90. (a) $y(t) = -16t^2 + 70t$ (b) $t = 4.375$ seconds  
(c) Maximum height = 76.5 feet  (d) $t = 4.227$ seconds to crossbar
91. (a) $y = 0.001t^3 - 0.0813t^2 + 1.3806t + 60$ (b) max at 66.7 thousand during 1950 (c) min at 48.5 thousand during 1988 (d) during the year 2009 (e) for the 1960 census, 63.1 thousand people
92. The graph below shows the stock price each year since 1990 for the internet company Wahoo. Analyze this graph carefully and then answer the following questions:

![Graph showing stock price changes from 1990 to 2000.]

a. What was the value of this stock in 1990? ____________

b. In what years was the value of this stock $100? ________________

c. What was the maximum value achieved by this stock? _____________ and in what year did it occur? ________________

d. In what 1 year period did this stock price fall the fastest? ______________

e. If you had purchased this stock in 1995 and sold it in 2002, how much money did you make (or lose) per share?

f. If you had purchased this stock in 1990 and sold it in 2002, how much money did you make (or lose) per share?

g. If you had purchased 1000 shares of this stock in 1990 and then sold all of them in 2000, how much total money did you make over that 10 year period?

h. This graph depicts a function. Describe in words the input: _________________ and output _________________ of this function.
93. Lagomorphologists have determined that a certain rabbit population can be modeled by the function

\[ R(x) = 0.0025x^5 - 1.35x^4 + 12.75x^3 + 45x^2 + 162 \]

where \( x \) is time in years and \( R(x) \) represents number of rabbits.

Graph this equation and use it to determine

a. The original number of rabbits: __________
b. The number of rabbits after 4 years: __________
c. Time(s) at which there are 3000 rabbits: __________
d. The maximum number of rabbits achieved: __________
   and when this maximum population is reached: __________
e. When this population becomes extinct: __________
f. The time values that actually make sense in this problem: ______________

94. Biologist have determined that the polynomial function:

\[ P(x) = -0.00001x^3 + 0.002x^2 + 1.5x + 100 \]

approximates the population \( x \) days later of a group of wild turkeys left to reproduce on their own with no natural predators. Sketch a graph of this function and use it to determine:

a. The original population of turkeys: __________
b. The maximum turkey population __________
   and when it occurs: __________
c. Days when this population is increasing: ______________
d. Days when this population exceeds 300 turkeys: ______________
e. When this population becomes extinct: __________
f. Record a scenario that could explain the "growth" exhibited by this Turkey population:

g. Change your viewing window and determine all the x-intercepts of your graph:
Which of these values make sense in the actual problem and why?
95. For \( f(x) = x^3 - 5x + 12 \) sketch a graph of \( f(x) \) and determine the following:

a. A good viewing window for your graph:

b. \( f(-3) \)

c. Complete the following table:

<table>
<thead>
<tr>
<th>X</th>
<th>-10</th>
<th>-5</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>F(x)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d. Find the turning points of \( f(x) \):

Maximum at ______________                  Minimum at _________________________

e. Domain of \( f(x) = \) _______________     Range of \( f(x) = \) _______________

f. The x-intercept(s) of \( f(x) \): ______________________________

g. Determine x-values such that \( f(x)=10 \): ______________________________

96. For \( n(x) = 3x^3 - 18x + 12 \) determine

a. The y-intercept: ___________

b. The x-intercept(s): ______________

c. The minimum: _________________

d. The maximum: _________________

e. \( n(4) = \) __________ \( n(-7.333) = \) __________ \( n(27.525) = \) __________

f. All x such that \( n(x) = 0 \): __________________

g. The range of \( n(x) \): _______________
97. The population of a herd of deer is given by the function:

\[ P(x) = -0.05x^3 + 4.2x^2 - 5x + 160 \]

where \( x \) is time measured in months and \( P(x) \) is the total population of the herd.

a. Fill in the table and sketch a graph of this function and **label your axes**. You only need to include values that make sense in the situation being modeled:

<table>
<thead>
<tr>
<th>Months</th>
<th>deer</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td></td>
</tr>
</tbody>
</table>

b. What is the initial population of this herd? ________________

c. When does the deer population equal 3000? ________________

d. When does the deer population exceed 3000? ________________

e. How large will this herd get? ________________

f. When will it reach its maximum population? ________________

g. According to this model, when will this deer herd become extinct? ________________

h. Determine \( P(30) \): ________________ and explain what this means in terms of the model:

**Selected answers for 96 and 97:**

96d. (-1.41, 28.97)  96g. all reals  97b. 160 deer  97d. between 35 and 71 months
A box is constructed from a rectangular sheet of cardboard by cutting out a square of \( x \) inches from each corner and then folding up the sides. The dimensions of the original piece of cardboard are 40 inches by 60 inches. The resulting volume--\( V \)-- of the box is a function of the length of the square removed--\( x \)--and is given by the following equation:

\[
V(x) = x (40-2x)(60-2x)
\]

Use this equation to sketch a graph of this function and to answer the following questions:

a. Fill in the table:

<table>
<thead>
<tr>
<th>( x )-length of Square in Inches</th>
<th>( V(x) )-volume Of box in Cubic inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>6656</td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

b. What is the value of \( V(24) \)? Could this actually happen? Explain your answer:

c. What would be the volume of the box resulting from a square length of 5 inches?

d. What would be the volume of the box resulting from a square length of 10 inches?

e. What is the maximum volume possible for this box? and what size square should be removed to produce this maximum volume?

f. What are the \( x \)-intercepts of this function? and what do they represent in terms of the story problem described:
99. Bobby-Jo's Salvation

Remember, we now know that Bobby-Jo's revenue is given by the equation:
\[ R(x) = x(-.00125x + 7.5) \] where \( x \) is the number of yo-yos produced.
But we also know his total cost is given by the function:
\[ C(x) = 1.20x + 1500 \] where \( x \) is again the number of yo-yo's produced.
Since profit is always equal to revenue minus cost, we should now be able to express Bo-Jo's profit as a function of the number of yo-yos he produces (\( x \)) per week:

\[ P(x) = R(x) - C(x) \]

You do not need to multiply this out just record \( R(x) - C(x) \) both from above.

a. Carefully enter this profit function into Y1 (use parentheses) and fill in the following table:

<table>
<thead>
<tr>
<th>Yo-yos</th>
<th>0</th>
<th>1000</th>
<th>2000</th>
<th>3000</th>
<th>4000</th>
<th>5000</th>
<th>6000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. Graph this function and determine its vertex: __________________
What does this mean to Bobby-Jo?
Hint: In order to maximize his profit, Bo-Jo should produce _______________ yo-yos. He would then make a profit of $ _______________.

c. What are the x-intercepts of this function: _______________ and what do they mean?
d. In conclusion, Bobby-Jo should produce _______________ yo-yo's per week.

Making that many yo-yos will cost Bo-Jo $ _______________ (use cost function)
He will then bring in a revenue of $ _______________ (use revenue function)
When he does this, he will make a maximum profit of $ _______________ per week or $ _______________ per year.

Which means Bobby-Jo should no longer be struggling in the yo-yo business.

Of course, the yo-yo business is know for its ups and downs However😊
Statistics (Chapter 12)
100. An exercise in gathering and analyzing statistics. Issue: *How many times per day do WIU students ride the bus?*

a. How many times did you ride the bus last Friday?

b. How many students are there in class today?

c. Number of students in this class who rode the bus on Friday (frequency distribution)

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[any greater numbers:

d. For this data,

mean = median = mode (if any) = midrange =

[Find the mean and median by using “1-variable statistics” on your calculator.]

e. Find the mean and median “by hand”.

f. Remember, the issue under study was “*How many times per day do WIU students ride the bus?*”. The population for this would be all WIU students, for all days of the week. We have taken a sample of the population. But it is NOT a random sample. What kind of ‘bias’ can you think of that would make it likely that this class’s bus-riding on Friday does NOT accurately represent the entire population?

101: Contest scores. [This really is the true data.]

<table>
<thead>
<tr>
<th>4</th>
<th>2</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
</table>

Shown in the chart to the right is the data giving the number of correct answers from students in the High School Seniors Written Contest of the February 2001 WIU regional competition of the state-wide High School Math Contest.

<table>
<thead>
<tr>
<th>10</th>
<th>6</th>
<th>5</th>
<th>9</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>4</th>
<th>1</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>5</th>
<th>1</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
</table>

a. Construct a frequency distribution for this data.

b. Plot a histogram for this data.

c. Find the mean, median, mode, and midrange for this data.

d. For mean, median, mode, and midrange, which do YOU think best describes what the students’ scores were like? Explain briefly why you think your choice does a good job of fitting the data. [There is no absolutely right answer to this question; you are asked to make a case for your choice.]
102. Listed below are the 40 exam scores for math 100 students with 1 or less absences:

82, 87, 64, 78, 72, 91, 98, 104, 81, 84, 76, 53, 84, 97, 102, 67, 84, 88, 92, 73,
83, 57, 74, 98, 82, 71, 68, 84, 86, 74, 79, 63, 89, 94, 72, 77, 85, 78, 99, 83,

a. Determine the mean, median, mode, range and standard deviation of this data:

mean = _______________  median = _______________
mode = _______________  range = _______________
s.d. = _______________

b. Determine the minimum, quartile1, median, quartile 3, and maximum of this data:
Remember, this is called the 5-point summary or 5 number summary for a data set:

min: _______  Q1: ________  Med: ___________  Q3: ___________  Max: ___________

How many exam scores fall below Q1: __________

How many exam scores fall between Q1 and the median: __________

How many exam scores fall between the median and Q3: _______________

How many exam scores fall above Q3: _______________

How many total exam scores fall below the median: _______________

How many total exam scores fall above the median: _______________

Does the median split the data into two equal parts? __________  Does the mean? _______

c. Create a histogram for this data. Use a class width of 10  (50 to 59, 60 to 69, etc):
Describe the skewness of this distribution:

Answers to 102a:  mean 81.325;  med: 82.5;  mode 84  range: 51  s.d. 11.81
Answers to 102b in order:  53, 73.5, 82.5, 88.5, 104
103. Listed below are the 13 exam scores earned by math 100 students with 2 or more absences:
   81, 75, 52, 86, 43, 27, 61, 72, 19, 48, 79, 35, 67

a. Determine the mean, median, mode, range and standard deviation of this data:
   mean = _______________  median = _______________
   mode = _______________  range = _______________
   s.d. = _______________

b. Determine the 5-point summary for this data:
   min: _______  Q1: ________ Med: __________ Q3: _______  Max: ___________

   How many total exam scores fall below the median: _______________
   How many total exam scores fall above the median: _______________
   How many total exam scores fall below the mean: _______________
   How many total exam scores fall above the mean: _______________

   Does the median split the data into two equal parts? ________ Does the mean? _______

c. Create a histogram for this data. Use a class width of 10 (20 to 29, 30 to 39, etc):

104. Create a box-plot for the data in problem 102 and one for the data in problem 103 and graph them both on the same axes. Remember, a box-plot is just a visual depiction of the 5-point summary!

105. What sort of conclusions regarding absences and exam scores can you deduce from the answers in problems 102, 103 and 104? Explain how the data supports your conclusion:
106. Using the calculator only for arithmetic, determine the mean, median, mode and range of the following salaries: 25,000; 32,000, 35,000; 35,000; 41,000; 43,000, 58,000, 75,000; 122,000

mean: ________________    median: ________________
mode: ________________                 range: _________________

107. Now, do the same with the following salaries:
25,000; 32,000, 35,000; 35,000; 41,000; 43,000, 58,000, 75,000; 122,000; 2,000,000

mean: ________________    median: ________________
mode: ________________                 range: _________________

Which of these values changed most dramatically with the addition of the $2 million figure? Please explain your answer.

108. Two Math 100 sections just completed an exam and their summary statistics are below:

   Section 1:    mean = 78.2    standard deviation = 12.3
   Section 2:    mean = 78.2    standard deviation = 21.4

   a. What does this data tell the instructor about the exam results for these 2 sections?
      b. Which class had more consistent test scores?
      c. Which class probably had some really low test scores?

109. It turns out that the average daily high temperature in Macomb, Illinois and in Santa Monica, California is exactly the same at 71 degrees Fahrenheit. Which city do you think has the higher standard deviation in daily high temperatures? ____________
Please explain your answer:
110. At the Sepsi Bottling company, they have two machines that fill the 12 fluid ounce pop cans. The summary statistics for how much each machine places in each pop can are shown below:

<table>
<thead>
<tr>
<th></th>
<th>Mean amount per can</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine A</td>
<td>12.0 fluid ounces</td>
<td>.31 ounces</td>
</tr>
<tr>
<td>Machine B</td>
<td>12.0 fluid ounces</td>
<td>2.14 ounces</td>
</tr>
</tbody>
</table>

a. Even though these machines have the same average, why will Sepsi want to replace or repair Machine B:

b. Why could buying pop cans filled by machine B be a frustrating experience?

111. ABC and CBS both did viewer polls on age and the results are listed below:

<table>
<thead>
<tr>
<th></th>
<th>Average viewer age</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>47.5</td>
<td>24.8</td>
</tr>
<tr>
<td>CBS</td>
<td>48.2</td>
<td>7.5</td>
</tr>
</tbody>
</table>

a. What do these results mean to the two networks?

b. Why might ABC be happier with these results than CBS?

112. Suppose a basketball player has a high points per game average but also has a high standard deviation in that category. How could this ballplayer and his performance be described?
Various problems:

113. Assume that the number of square feet of shade, at noon on June 21st, cast by an oak tree is related to its age as shown in the table below.

<table>
<thead>
<tr>
<th>Age of tree (in years)</th>
<th>10</th>
<th>35</th>
<th>50</th>
<th>75</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shade on June 21 (square feet)</td>
<td>100</td>
<td>530</td>
<td>650</td>
<td>780</td>
<td>950</td>
</tr>
</tbody>
</table>

a. Make a scatter plot of this data with age on the x-axis. What is the shape of this plot? ___________

Run LnReg on the data to determine the best fit natural log-type formula and record that equation.

b. Using the model from part (a), estimate the amount of shade cast by a 100 years old oak tree on June 21.

c. A court yard in Washington D.C. has an old oak tree that casts 1,165 square feet of shade on June 21st. Estimate the age of the tree.

d. About what year (as a date) was the oak tree planted in the court yard as a very small seedling?

e. One of the oldest known oak tree casts 1,310 square feet of shade on June 21. Approximately how old is this tree?

f. Investigation: Do you know how a tree-specialist determines the actual age of a living tree?

114. Use the given table to answer the following questions.

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>10</td>
<td>12.5</td>
<td>15.7</td>
<td>19.5</td>
<td>24.4</td>
<td>30.5</td>
</tr>
</tbody>
</table>

a. Would this data set be best modeled by a linear or an exponential function?

Record your answer and explain why:

b. If the data is linear, determine the slope. If the data is exponential, determine the growth or decay factor.

c. Record the equation for the function model that best fits this data.
115. Use the given table to answer the following questions.

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>10</td>
<td>12.5</td>
<td>15</td>
<td>17.5</td>
<td>20</td>
<td>22.5</td>
</tr>
</tbody>
</table>

a. Would this data set be **best** modeled by a linear or an exponential function?

Record your answer and explain why:

b. If the data is linear, determine the slope. If the data is exponential, determine the growth or decay factor.

c. Record the equation for the function model that best fits this data.

116. Use the data in the table to determine whether each sequence of numbers would best be described as linear, quadratic, or exponential. Record your function-type answers in the right-hand column and determine what numerical value should go in column 6 for each sequence. Look for patterns in the numbers that are characteristic of the function models discussed in class.

<table>
<thead>
<tr>
<th>Input (x-values)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Function type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Linear</td>
</tr>
<tr>
<td>Sequence B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Linear</td>
</tr>
<tr>
<td>Sequence C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Linear</td>
</tr>
<tr>
<td>Sequence D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Linear</td>
</tr>
<tr>
<td>Sequence E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Linear</td>
</tr>
</tbody>
</table>

117. Using logarithms to solve each of the following for x:

a. \(100(1.09)^x = 500\)

b. \(500e^{-0.45x} = 50\)

c. \(5(2)^x = 100\)

d. \(100(0.7)^x = 2\)