

## Section 3.5 Mathematical Modeling

**Objective:** In this lesson you learned how to write mathematical models for direct, inverse, and joint variation and how to use the least squares regression feature of a graphing utility to find mathematical models of actual data.

Course Number

Instructor

Date

### Important Vocabulary

Define each term or concept.

Vary directly

Directly proportional

Vary inversely

Sum of square differences

Least squares regression line

### I. Introduction (Page 303)

Describe what is meant by “fitting a line to data.”

#### *What you should learn*

How to use mathematical models to approximate sets of data points

### II. Direct Variation (Page 304)

When a variable  $y$  is directly proportional to a variable  $x$ , the

**constant of variation** is . . . \_\_\_\_\_

\_\_\_\_\_. Another

name for the constant of variation is the \_\_\_\_\_

\_\_\_\_\_.

#### *What you should learn*

How to write mathematical models for direct variation

**Example 1:** If  $y$  varies directly as  $x$ , and  $y$  is 6 when  $x$  is 4, find the value of  $y$  when  $x$  is 20.

**III. Direct Variation as  $n$ th Power** (Page 305)

If  $y = kx^n$  for some nonzero constant  $k$ , then describe the relationship between  $y$  and  $x$  in two different ways.

***What you should learn***

How to write mathematical models for direct variation as an  $n$ th power

**Example 2:** If  $y$  is directly proportional to the third power of  $x$ , and  $y$  is 750 when  $x$  is 10, find the value of  $y$  when  $x$  is 8.

**IV. Inverse Variation** (Page 306)

If  $y$  varies inversely as  $x$ , then  $y$  is \_\_\_\_\_  
to  $x$ .

***What you should learn***

How to write mathematical models for inverse variation

If  $x$  and  $y$  are related by an equation of the form  $y = k/x^n$ , then  $y$

\_\_\_\_\_  
or  $y$  \_\_\_\_\_.

**Example 3:** If  $y$  varies inversely as  $x$ , and  $y$  is 4 when  $x$  is 16, find the value of  $y$  when  $x$  is 10.

**V. Joint Variation** (Page 307)

If  $z$  **varies jointly** as  $x$  and  $y$ , then  $z =$  \_\_\_\_\_  
\_\_\_\_\_.

***What you should learn***

How to write mathematical models for joint variation

Another way to say that  $z$  varies jointly as  $x$  and  $y$  is . . .

**Example 4:** If  $z$  varies jointly as  $x$  and  $y$ , and if  $z = 10$  when  $x = 4$  when  $y = 15$ , find the value of  $z$  when  $x = 12$  and  $y = 7$ .

**VI. Least Squares Regression** (Page 308)

To find the least squares regression line for a set of data, . . .

***What you should learn***

How to use the least squares regression feature of a graphing utility to find mathematical models

The correlation coefficient  $r$  of a set of data gives a measure of \_\_\_\_\_ . The closer  $|r|$  is to 1, the better . . .

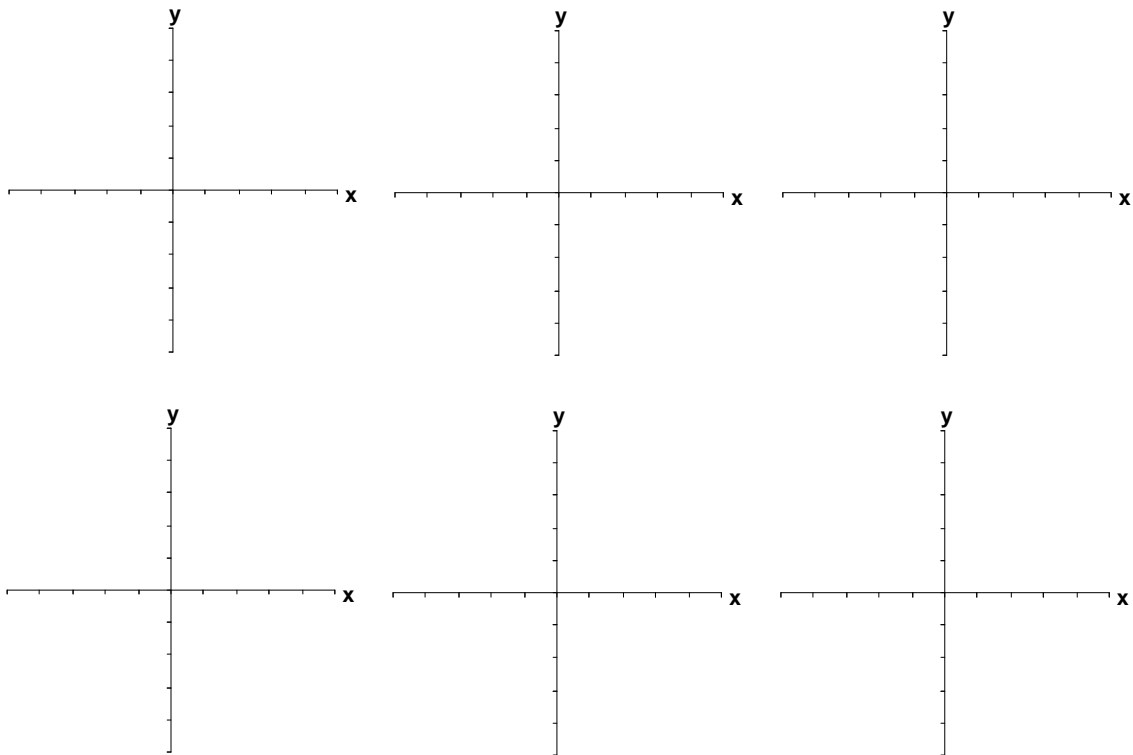
**Example 5:** The numbers of U.S. Air Force personnel  $p$  on active duty for the years 1995 through 1999 are shown in the table. Use the regression capabilities of a graphing utility to find a linear model for the data. Let  $t$  represent the year with  $t = 5$  corresponding to 1995.

Year	1995	1996	1997	1998	1999
$p$	400	389	379	363	358

(Source: U.S. Department of Defense)

**Additional notes**

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<p><b>Homework Assignment</b></p> <p>Page(s)</p> <p>Exercises</p>
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