ACE Assignment Guide for Problem 2.1

Applications: 1–3 | Connections: 17–19

Answers to Problem 2.1

A. **1.** For 20 bikes, Rocky will charge $770 and Adrian will charge $600.

2. For 40 bikes, Rocky will charge $1,140 and Adrian will charge $1,200.

3. For 32 bikes, Rocky will charge $1,013 and Adrian will charge $960 (assuming linear interpolation between given data points).

B. **1.** If a group has $900 to spend, it can rent 26 bikes from Rocky or 30 from Adrian.

2. If a group has $400 to spend, it can rent 5 bikes from Rocky or 13 from Adrian.

C. Students should realize that for both shops rental cost increases steadily as number of bikes increases.

1. The cost for renting from Rocky starts higher but increases more slowly than cost for renting from Adrian; Rocky's charge per bike decreases as the number of bikes increases. In fact, if one makes a coordinate graph of the costs for renting from Rocky, the pattern will resemble the data for jumping jacks or riding bicycles, in which the data points rise rapidly at first, but that rate of increase drops off.

2. If students study the data very carefully, they'll discover that Adrian charges a flat rate of $30 per bike.

D. Students probably will not use the word *interpolate*, but they should understand that estimating costs for numbers of bicycles not on the graph or in the table depends on assuming given points provide upper and lower bounds for the estimate.

E. Some students may point out that costs for specific numbers of bicycles are easier to read from a table. The general trend in pricing is easier to read from a graph.

F. Students will have different opinions about which data representation—table or graph is most useful in making a decision and in presenting the case for one's choice. Given the data in the table and the graph, students should decide that Adrian offers a better deal for a number of bikes less than about 36 and Rocky offers the better deal for more than 36 bikes (though interpolation between 35 and 40 bikes is not certain in Rocky's offer).

2.2 Finding Customers: Linear and Nonlinear Patterns

Focus Question How are the relationships between independent and dependent variables in this Problem different from those in Problem 2.1? How are the differences shown in tables and graphs of data?

Launch

Review the economic terms involved—price is what each customer will pay to take part in the Bike Tour and income is the money that the tour business will take in from those customers.

Key Vocabulary

- income

Materials

Labsheets

- 2.2A: Finding Customers
- 2.2B: Predicting Income
- grid paper
- Coordinate Grapher Tool
- Data and Graphs Tool

Explore

Keep an eye on how students choose the independent and dependent variables. Also encourage students to describe exactly what happens to the number of customers as the price increases to $150, $200, and so on. Ask them to provide reasons.

You want students to think hard about how to choose independent and dependent variables and scales for a graph.

Summarize

The key objectives of this Problem are to illustrate examples of a decreasing linear relationship and a quadratic relationship that has a maximum value for the dependent variable (a concave down parabola graph).

- *For each price, how much money would be collected if the people who said they would pay that price actually do so?*
- *How does the number of customers change as the price increases?*
- *How is that pattern shown in the table and the graph?*
- *How is the relationship between price and income different from all preceding relationships? How is that difference shown in the table and graph of (price, income) data?*

Assignment Guide for Problem 2.2

Applications: 4–7 | Connections: 20–21
Extensions: 22

Answers to Problem 2.2

A. 1. The number of people who said they would take the tour depends on the price. In this Problem, price is the dependent variable and the number of the customers is the independent variable. (See Figure 1.)

2. The number of customers decreases steadily as the price increases—10 lost customers for every increase of $100 in price.

3. The change in number of customers is shown in the table by the decrease in that row. The change is shown in the graph by the downward (left-to-right) slope of the points and the connecting line.

4. You could find the number of customers for a price between two entries in the table by proportional reasoning. For example, if the price in the middle of the interval is half of the way from one price to the next higher price in the table, then the number of customers will be half of the way from one number to the next lower number in the table. For $175, one would expect 32.5 customers (of course, you can't have exactly 32.5 customers). For $325 one would expect 17.5 customers.

B. **1.** (See Figure 2.)

2. (See Figure 3.)

3. As tour price increases, tour income increases until it reaches a maximum of $6,250 at a tour price of $250. Then it begins to decrease until it reaches $0 when the tour price is set at $500. (There are no willing customers.)

Based on the data and graph in parts (1) and (2), it looks like a tour price of about $250 is optimal. It will yield tour income of $6,250.

Figure 1

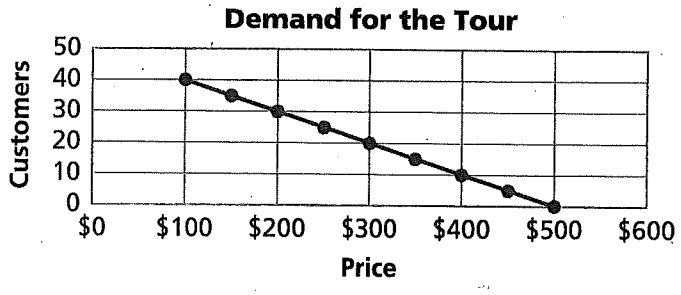
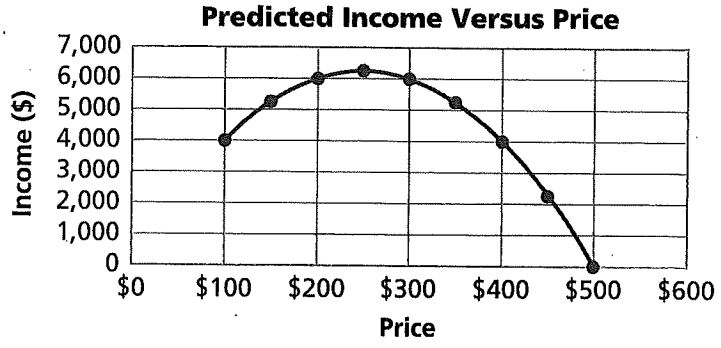


Figure 2

Predicted Tour Income

Tour Price	$100	$150	$200	$250	$300	$350	$400	$450	$500
Number of Customers	40	35	30	25	20	15	10	5	0
Tour Income ($)	4,000	5,250	6,000	6,250	6,000	5,250	4,000	2,250	0

Figure 3



Assignment Guide for Problem 2.3

Applications: 8–9 | Connections: 23

Answers to Problem 2.3

A. 1. (See Figure 1.)

2. (See Figure 2.)

3. a. The pattern in the table and graph shows business profit starting as a negative value (or loss) for a tour price of only $100. Then profit increases rapidly to a maximum of a bit more than $3,000 for tour prices around $325. Then profit declines as prices increase beyond $350 per customer.

b. The pattern should make some sense. If the price is too low, there will be many customers and large operating costs, but too little income to pay those costs (thus the loss of $2,000 for tour price of $100). As the price increases, the number of customers decreases, but so does the operating cost per customer. However, when the price rises too far, it leads to a loss of customers and income that overwhelms the associated decrease in operating costs.

c. Based on the analysis of profit predictions, a tour price of about $325 seems best because both the table and graph suggest this will yield maximum profit.

Figure 1

Predicted Tour Profit

Tour Price	$100	$150	$200	$250	$300	$350	$400	$450	$500
Customers	40	35	30	25	20	15	10	5	0
Tour Income ($)	4,000	5,250	6,000	6,250	6,000	5,250	4,000	2,250	0
Operating Cost ($)	6,000	5,250	4,500	3,750	3,000	2,250	1,500	750	0
Tour Profit or Loss	−2,000	0	1,500	2,500	3,000	3,000	2,500	1,500	0

Figure 2