

Name(s):

Period:

Date:

# Nearshore vs Offshore

## Graphing Linear Equations to make Decisions



### Objectives

By the end of this modules you will be able to

- ✓ Analyze and organize data not table format
- ✓ Find the rate of change for a set of data (slope)
- ✓ Write a linear function based on a set of data points from a real world situation
- ✓ Graph data with linear relationships
- ✓ Use graphed linear equations to answer questions comparing two situations

### Common Core High School Modeling Standards

A-CED.1, F-IF.5, F-IF.6, F-BF.1, F-LE.2, F-LE.5, S-ID.7

### Scenario

In sourcing your wearable health tracker, you've identified the variables that go into total landing cost and you need to figure out the cost per item when ordering from Mexico vs. China. Both of the companies you are working in offer pricing based on units of 10,000 items. You need to present the data to your board of directors so they can decide how many units to order and where to order from.

Your goal is to use the data received on the quotes to find the Total Landing Cost. You will then create a linear equation relating the total landing cost and the number of units. Once you graph this data, you will be able to prepare a report to present to your board of directors.

Here are the quotes you received from the two companies:

**Beijing Marketplace Industries**  
Quote for Wearable Device Manufacturing

Each unit contains 1,000 devices, this is the minimum order  
Costs listed are per device

# of units	Materials & Overhead	Labor	Shipping	Taxes
1	\$14	\$15	\$6	\$1
2	\$13	\$15	\$5	\$1
3	\$11	\$15	\$5	\$1
4	\$10	\$14	\$5	\$1
5	\$8	\$14	\$5	\$1
6	\$7	\$13	\$5	\$1

Shipping Timeline: 4 weeks

**Tijuana Maquiladora Industries**  
Quote for Wearable Device Manufacturing

Each unit contains 1,000 devices, this is the minimum order  
Costs listed are per device

# of units	Materials & Overhead	Labor	Shipping	Taxes*
1	\$16	\$14	\$3	\$0
2	\$15	\$14	\$3	\$0
3	\$14	\$14	\$3	\$0
4	\$13	\$14	\$3	\$0
5	\$13	\$14	\$2	\$0
6	\$12	\$14	\$2	\$0

No taxes on US deliveries due to NAFTA

Shipping Timeline: 1 week

## Preparation for the Report

In order to create a linear equation representing this data, we need to identify two values that we can use. Ultimately, your company needs to know the total landing cost of the item, and the smaller costs are not as important, so comparing the # of units and the total landing cost per device will be the best route to follow.

### Calculating Total Landing Cost

Take a look at the background reading for this assignment.

1. What variables are included in the total landing cost?

2. Complete the following data tables with the Total Landing Cost.

China	
# of units (x)	Landing cost per item (y)
1	
2	
3	
4	
5	
6	

Mexico	
# of units (x)	Landing cost per item (y)
1	
2	
3	
4	
5	
6	

### Representing Data with Linear Equations

In order to write a linear equation, you need points that all have a standard rate of change, which can be used as the slope in your equation.

### Determining Slope

3. Complete the following data tables in order to determine the slope for each of your linear equations. The slope of the line represents the rate of change for the

China	# of units (x)	Landing cost per item (y)	Change in # of units (y)	Change in Landing Cost (x)	Rate of change (slope)
	1				$\frac{\text{(change in y)}}{\text{(change in x)}}$
	2				
	3				
	4				
	5				
	6				

Mexico	# of units (x)	Landing cost per item (y)	Change in # of units (y)	Change in Landing Cost (x)	Rate of change (slope)
	1				$\frac{\text{(change in y)}}{\text{(change in x)}}$
	2				
	3				
	4				
	5				
	6				

**Writing a linear equation**

Now that you know that there is a constant slope throughout your data, you know you can write a linear equation that represents each situation.

Use the slope-intercept formula. Plug in the slope, and enter the coordinates from one point into the x & y positions to find the intercept.

Slope-Intercept Formula

$$y = mx + b$$

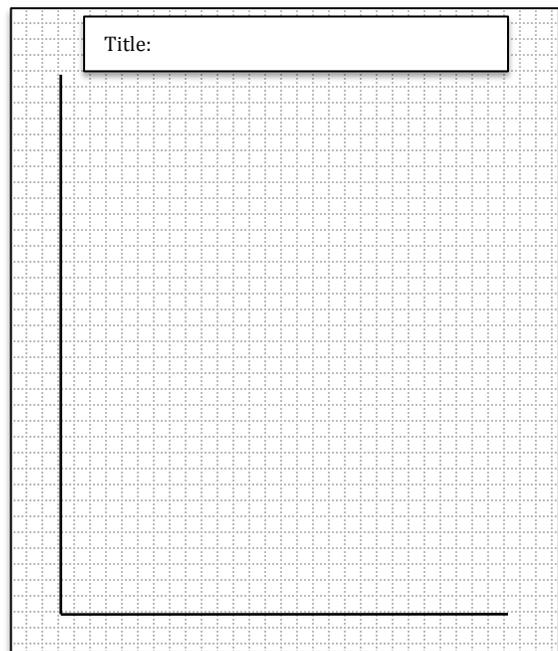
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4. For the information from China	5. For the information from Mexico
a. What is the SLOPE	a. What is the SLOPE
b. What is the INTERCEPT	b. What is the INTERCEPT
c. What is the linear equation that represents the landing cost vs. units ordered from China?	c. What is the linear equation that represents the landing cost vs. units ordered from Mexico?

*Graphing a linear equation:*

Here are some tips for graphing!

1. Determine the range for each of your axes. In this situation you can use your data table to determine ranges. The x values have a range of 1-6 and the y values have a range of 26-36. In this case you will want to add at least 1 to each end of the range to ensure the data will be represented, but rounding to 5s or 10s can also make for a nice graph. The range of x should be 0-7 and the range for y should be 25-37 (or you can round up to 40).
2. Label both axes
3. Add the numbers to the axes. Your goal should be to use up as much of the graph space as you can with your data points, so plan out how to space your numbers before you place them on the axes.
4. Add a title to your graph, and create a key to indicate which colored line represents which data set.
5. For the first equation choose two coordinate points to place on the graph. Using a straight edge, draw the line through those two points.
6. Repeat for the second equation using a different color.



## Presenting to the Board

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Now that you have graphed your data, you will need to prepare your presentation to the board. They have already emailed you the following questions. Remember that you would never give a one word answer to your board members, instead you will need to provide reasoning for each answer in order to explain the situation so they can make the best decisions.

1. If we want to make a minimum order to analyze quality, how many health tracking devices will we need to buy and who should we buy from? Why?
2. If we want to begin with only 3,000 devices, who should we buy from and why?
3. If we decide to buy in bulk and order a large amount of units, where should we buy from and why?
4. At what point is the cost the same between China and Mexico? Circle that point on the graph.

If the cost is the same, which would you recommend? What are the reasons why?

5. If we want to make a large order to fulfil our initial demand where should we buy from?
6. If we have limited warehouse space where should we order from? Why?
7. If we need to fulfil an order very quickly where should we order from?
8. If we decide to send these devices to another country will this comparison still remain the same? Why or why not.
9. What are the general benefits and drawbacks of manufacturing in Mexico?
10. What are the general benefits and drawbacks of manufacturing in China?

## Extension: Designing Your Presentation

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Now that you have graphed your data, you will need to prepare your presentation to the board. Create a poster or power point presentation that includes a graph of the data and also addresses the above questions.

## College & Career Connections

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Career Spotlight	College Connections	
<b>International Logistics Manager</b> Logisticians analyze and coordinate an organization's supply chain—the system that moves a product from supplier to consumer.  Median Annual Salary: \$65,000 EDUCATION: A bachelor's degree is recommended, however, specific programs at community colleges targeted to the field may be sufficient for many positions.	<b>International Logistics &amp; Transportation</b> The certificate/A.S. degree program in International Logistics and Transportation prepares students to work in industries affected by the distribution of goods, such as global, international, and cross border trade.  Schools offering this program of study: Southwestern College <a href="http://www.swc-logistics-transportation.org/">http://www.swc-logistics-transportation.org/</a>	<b>Global Supply Chain Management</b> This program teaches students how to perform typical tasks of a supply chain manager, such as designing and managing the relationships that keep products moving on the global playing field.  Schools offering this program of study: CSU San Marcos <a href="http://www.csusm.edu/oscm/">http://www.csusm.edu/oscm/</a>

## Extension & Application

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Great article covering this issue: <http://www.meddeviceonline.com/doc/nearshore-or-offshore-how-to-decide-where-you-should-manufacture-your-medical-device-0001>

Chase Bank has a great infographic on the comparison between Mexico & China showing Mexico's increased advantage

<https://www.chase.com/content/dam/chasecom/en/commercial-bank/documents/china-vs-mexico-infographic.pdf>

Additional resources can be found at [www.CareerAcademics.org](http://www.CareerAcademics.org)

## References

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<http://careersinsupplychain.org/job-roles-profiles/Profile/LogMgr.asp>

<http://www.inboundlogistics.com/cms/article/evaluating-the-true-cost-of-overseas-manufacturing/>

<https://www.worldindustrialreporter.com/wp-content/uploads/2012/09/Calculating-Landed-Costs1.pdf>

<http://pubsonline.informs.org/doi/pdf/10.1287/ited.1100.0045#page=9&zoom=auto,0,362>

<http://offshoregroup.com/2013/10/25/mexico-vs-china-by-the-numbers/>

<http://www.bls.gov/ooh/business-and-financial/logisticians.htm>

[https://www.glassdoor.com/Salaries/international-logistics-manager-salary-SRCH\\_K00,31.htm](https://www.glassdoor.com/Salaries/international-logistics-manager-salary-SRCH_K00,31.htm)

## KEY: Preparation for the Report

In order to create a linear equation representing this data, we need to identify two values that we can use. Ultimately, your company needs to know the total landing cost of the item, and the smaller costs are not as important, so comparing the # of units and the total landing cost per device will be the best route to follow.

### Calculating Total Landing Cost

Take a look at the background reading for this assignment.

1. What variables are included in the total landing cost?

2. Complete the following data tables with the Total Landing Cost.

China	
# of units (x)	Landing cost per item (y)
1	\$36
2	\$34
3	\$32
4	\$30
5	\$28
6	\$26

Mexico	
# of units (x)	Landing cost per item (y)
1	\$33
2	\$32
3	\$31
4	\$30
5	\$29
6	\$28

### Representing Data with Linear Equations

In order to write a linear equation, you need points that all have a standard rate of change, which can be used as the slope in your equation.

### Determining Slope

3. Complete the following data tables in order to determine the slope for each of your linear equations. The slope of the line represents the rate of change for the

China	# of units (x)	Landing cost per item (y)	Change in # of units (y)	Change in Landing Cost (x)	Rate of change (slope)
	1	36			$\frac{(\text{change in } y)}{(\text{change in } x)}$
	2	34	1	2	-2
	3	32	1	2	-2
	4	30	1	2	-2
	5	28	1	2	-2
	6	26	1	2	-2

Mexico	# of units (x)	Landing cost per item (y)	Change in # of units (y)	Change in Landing Cost (x)	Rate of change (slope)
	1	33			$\frac{(\text{change in } y)}{(\text{change in } x)}$
	2	32	1	1	-1
	3	31	1	1	-1
	4	30	1	1	-1
	5	29	1	1	-1
	6	28	1	1	-1

**Writing a linear equation**

Now that you know that there is a constant slope throughout your data, you know you can write a linear equation that represents each situation.

Use the slope-intercept formula. Plug in the slope, and enter the coordinates from one point into the x & y positions to find the intercept.

Slope-Intercept Formula

$$y = mx + b$$

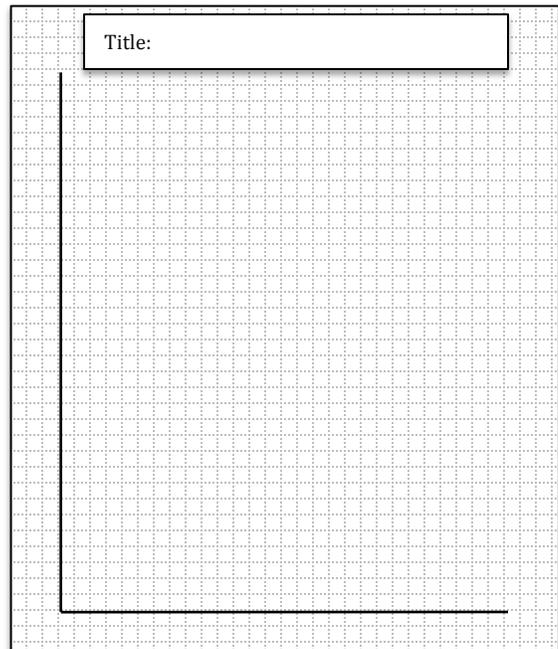
↓      ↓  
 $m$        $b$

4. For the information from China	5. For the information from Mexico
a. What is the SLOPE	a. What is the SLOPE
b. What is the INTERCEPT	b. What is the INTERCEPT
c. What is the linear equation that represents the landing cost vs. units ordered from China? <span style="color: red; font-weight: bold;">Equation: <math>y = -2x + 38</math></span>	c. What is the linear equation that represents the landing cost vs. units ordered from Mexico? <span style="color: red; font-weight: bold;">Equation: <math>y = -1x + 34</math></span>

**Graphing a linear equation:**

Here are some tips for graphing!

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## Presenting to the Board

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1. If we want to make a minimum order to analyze quality, how many health tracking devices will we need to buy and who should we buy from? Why?  
**Mexico – the cost per unit is less.**

2. If we want to begin with only 3,000 devices, who should we buy from and why?  
**Mexico – This is only 3 units so the cost per device is less than china**

3. If we decide to buy in bulk and order a large amount of units, where should we buy from and why?  
**China – the cost per unit is less if you buy in bulk**

4. At what point is the cost the same between China and Mexico? Circle that point on the graph.  
**If you buy 4 units the cost is the same \*circle that point on the graph**

If the cost is the same, which would you recommend? What are the reasons why?

**Mexico is the better choice if the cost is the same. They have a shorter shipping time and we can communicate more easily since we are on a similar time zone.**

5. If we want to make a large order to fulfil our initial demand where should we buy from?  
**China – the cost per unit is less if you buy in bulk**

6. If we have limited warehouse space where should we order from? Why?  
**Mexico – We can purchase fewer items, then re-order quickly if we need more.**

7. If we need to fulfil an order very quickly where should we order from?  
**Mexico – They are closer and can import more quickly.**

8. If we decide to send these devices to another country will this comparison still remain the same? Why or why not.

**No. These comparisons assume that we are selling in the USA and NAFTA is working. If they are to be exported a different tax will be applied and an entirely new comparison will need to be worked out.**

9. What are the general benefits and drawbacks of manufacturing in Mexico?

**Benefits: Mexico is nearby, which makes it cheaper to transport and allows for better collaboration and communication with the factory. NAFTA allows for lower taxes and fees.**

**Drawbacks: Mexico cannot offer the bulk discounts because they do not discount their overhead costs and they have smaller factories.**

10. What are the general benefits and drawbacks of manufacturing in China?

**Benefits: Lower cost labor means lower cost items & greater discounts on increased orders.**

**Drawbacks: The distance means that it takes a long time to arrive. Taxes and fees are also added to the total.**