

Mathematical Models with Applications
Entrepreneurship: Keeping Score with Mathematics

Unit II: Grape Expectations

Teacher Notes, Student Activities, and Transparencies

Section 1: Sources of New Ideas Teacher Notes

Context Overview:

This section provides the background students need in order to come up with their own business ideas. Students begin by evaluating the entrepreneurial ideas presented in Unit 1. These case studies illustrate that new business ideas often are generated by consumer dissatisfaction with the availability or quality of existing products or services. In addition, legislation can create a need for specific goods and services.

Goal:

The goal of this section is for students to develop a business idea and form working teams.

TEKS Addressed:

Although the work in this section is not strictly mathematical in context, the critical thinking skills that students must use support mathematical thinking.

Materials:

Various product catalogs with unique items (such as *The Sharper Image*)

Procedures:

Student Activity—Got an Idea?

Refer to the three case studies in Unit I, Section 3 and the readings in Unit I, Section 1. Review these with students and discuss the questions below.

Questions and Possible Answers:

1. How did the founders of the three companies in the case studies in Unit I, Section 3 come up with the ideas for their companies?

Dell Computer Corporation: *Michael Dell asked himself, “Why not sell computers directly to the customer and pass along the dealer and wholesaler savings to them?”*

Justin Boots: *A cowboy asked Joe Justin to make a pair of boots for him.*

Taco Cabana: *Felix Stehiling bought a Dairy Queen and a vacant space across the street from the Crystal Pistol Bar to be used as a parking lot, and decided to open a taco stand.*

2. How did the founders of the six companies described in Reading 1 of Unit I, Section 1 come up with the ideas for their companies?

Look back at one or two examples from the reading and have whole group discussion about how these entrepreneurs came up with their ideas. Then divide students into small groups (3 to 4) and have them work on their own for the rest of the examples from Reading 1.

Heavenly Potpourri Pies: *A consumer saw a creative idea.*

Bob Evans Restaurants: *Bob Evans' truck driver customers wanted to buy uncooked sausage to take home. Bob Evans was in the "distribution channel" and saw an additional opportunity.*

Colette Fitzpatrick: *An individual with low overhead was able to provide quality service at a very competitive price.*

Wendy's: *Dave Thomas was in the "distribution channel" as a manager of restaurants. He saw a way to improve quality resulting in better customer satisfaction.*

Kitty Litter: *Edward Lowe developed an innovative product.*

Marion Merrill Dow: *Marion Kauffman was in the distribution channel and saw a better way to do business.*

3. Read the following story, "Grape Expectations," about a student who developed a business idea. How did Chuck come up with the idea for his CD business?

Chuck anticipated that the band Grape Expectations would be a hit with his classmates and decided to record their performance at the school dance.

4. Make a list of possible sources of new ideas for a potential business.

From the student discussions about Chuck Dickens, the three case studies from Unit I, Section 3, and the examples from Unit I, Reading 1, the following sources of new ideas should emerge: consumer needs, existing competitive products, distribution channels, government legislation (such as requiring smoke detectors and first-aid kits being required), and own development. Students probably will not use these exact terms but will come up with similar general ideas.

5. Make a list of all the successful and unsuccessful new products that have come about in your parents' or your lifetime. Describe why you think each product idea was good or bad.

Students may think there are no opportunities for new ideas or that all the good ideas have already been taken. Have them make a list of all the new products they can think of in their lifetime or their parent's lifetime. They should list both successful and unsuccessful ideas. This process will help them start thinking of all the opportunities that are out there.

Velcro: *Was successful because it provided a convenient, effective way to refasten items.*

Post-it® notes: *Were successful because they can be attached without the use of damaging tape.*

Technology: *Laptop computers, pagers, cell phones, palm organizers, Nintendo, Gameboys, and DVD players were successful because they were innovative and were appropriate*

for the changing modern lifestyle.

Books on tape: *Was successful because people spend more time commuting in cars and have less time to read.*

Edsel car: *Was unsuccessful because consumers did not embrace the new style as anticipated.*

Dotcom companies: *Were often unsuccessful because of wary consumers, insufficient capital, and legal actions taken against them.*

6. The Big Dream Approach to coming up with a new idea requires that the entrepreneur(s) dream about the problem and its solution—i.e., “think big.” Every possibility should be recorded and investigated without regard to all the problems involved or the resources required. In other words, ideas should be conceptualized without any constraints until an idea is developed into a workable form.

Working in groups, use the Big Dream Approach to develop possible ideas for a new business. Record several ideas below.

The Big Dream Approach is a creativity building technique. Discuss with students the description of the approach found in the activity sheet. Have groups use this technique to begin to generate some possible business ideas.

Optional Activity and Questions with Possible Answers:

1. Bring in some mail order catalogs with a variety of products to get the students thinking about different ideas. Discuss interesting services. Below is another case study that may be shared with students.

Case Study: The Beach Carrier

Mary Ricci has a new product concept, the Beach Carrier, that she is ready to bring to market. Ricci is creative, optimistic, enthusiastic, flexible, and motivated. She is willing to put substantial time into developing the Beach Carrier and bringing it to market. Although she lacks capital, Ricci is unwilling to license or sell the pattern to a manufacturer; she is determined to maintain control and ownership of the product throughout the introduction and market penetration phases. Ricci believes there is a significant amount of money to be made and refuses to sell her product concept for a flat fee.

The product: The Beach Carrier is a bag large enough to carry everything needed for a day at the beach, including a chair. When empty, the bag can be folded down to a 12"-X-12" square for easy storage. The bag's 36"-X-36" size, adjustable padded shoulder strap, and variously sized pockets make it ideal for carrying chairs and other items to the beach or for using in other outdoor activities, such as concerts, picnics, and barbecues. The bag can also be used to transport items (such as ski boots) that are difficult to carry. Manufactured in a lightweight, tear-resistant, fade-proof fabric that dries quickly, the bag will be available in a variety of fluorescent and conservative colors.

From the categories discussed in question 2, what category of new ideas does The Beach Carrier fall into?

Own development.

2. What personal characteristics do the entrepreneurs you've read about seem to share?

Risk takers, creative, see opportunity when others do not.

Student Activity Got an Idea?

1. How did the founders of the companies in the three case studies in Unit I, Section 3 come up with the ideas for their companies?
2. How did the founders of the six companies described in Reading I of Unit I, Section 1 come up with the ideas for their companies?
3. Read the following story, “Grape Expectations,” about a student who developed a business idea.

Grape Expectations An Entrepreneur Is Born

Everyone was at last night’s school dance, and it was an awesome night. Everyone believed they had witnessed the launch of the newest, and perhaps greatest, rock band since the Beatles. The name of the band was Grape Expectations.

One of the students, Chuck Dickens, was in charge of media, and his job was to record the band’s performance for the school’s local cable channel. He did his job very well, and it was not long before everyone at the school wanted a CD copy of Grape Expectations’ performance. At first, Chuck gave a few friends a free copy of the CD to test their appetite for this new sound. Sure enough, putting a few copies of the CD into circulation fueled the fire, and the number of students begging for a copy increased. Chuck decided that these CDs represented an opportunity to make money. So, after consulting with the band, he set about the task of starting a new company: Grape Expectations.

How did Chuck come up with the idea for his CD business?

4. Make a list of possible sources of new ideas for a potential business.

5. Make a list of all the successful and unsuccessful new products that have come about in your parents' or your lifetime. Describe why you think each idea was good or bad.

6. The Big Dream Approach to coming up with a new idea requires that the entrepreneur(s) dream about the problem and its solution—thinking big. Every possibility should be recorded and investigated without regard to all the negatives involved or the resources required. In other words, ideas should be conceptualized without any constraints, until an idea is developed into a workable form.

Working in groups, use the Big Dream Approach to develop possible ideas for a new business. Record several ideas below.

Section 2: Data Collection and Analysis Teacher Notes

Context Overview:

This section investigates the population determination (market definition), sampling methodology, design, and development of a questionnaire and the collection, analysis, and display of data. The team will scale up their market from that sample to a potential customer base. Students will compare their questionnaire results with local data and use percents to scale up their sample data to this level. Teams will analyze trends in these data, find a trend line, and use it to make predictions about the future of their market size. They will then use ratio analysis, based on competitive and demographic information, to determine the actual market size.

Goal:

The goal of this section is to provide an opportunity for students to apply data analysis in a business scenario.

TEKS Addressed:

1(A) The student is expected to compare and analyze various methods for solving a real-life problem.

1(B) The student is expected to use multiple approaches (algebraic, graphic, and geometric methods) to solve problems from a variety of disciplines.

1(C) The student is expected to select a method to solve a problem, defend the method, and justify the reasonableness of the results.

2(A) The student is expected to interpret information from various graphs, including line graphs, bar graphs, circle graphs, histograms, and scatterplots to draw conclusions from the data.

2(D) The student is expected to use regression methods, available through technology, to describe various models for data such as linear, quadratic, exponential, etc., select the most appropriate model, and use the model to interpret information.

3(A) The student is expected to formulate a meaningful question, determine the data needed to answer the question, gather the appropriate data, analyze the data, and draw reasonable conclusions.

3(B) The student is expected to communicate the methods used, analysis conducted, and conclusions drawn for a data analysis project by written report, visual display, oral report, or multi-media presentation.

3(C) The student is expected to determine the appropriateness of a model for making predictions from a given set of data.

Materials:

Spreadsheet software (optional), graphing technology

Access to World Wide Web or population almanacs

Access to telephone directory

Vocabulary:

Population determination: The first step in testing a new product idea with consumers is to define the consumer population that will be trying the product. All individuals, companies, and stores with a potential interest in the product or service need to be identified and characterized. Some of these characteristics might include age, sex, level of education, employment, marital status, location, or other traits that are particular to the product or service.

Simple random sample: Sampling is the process of selecting a subset (portion) of the population that represents it. While there are various sampling methods available such as systematic sampling, stratified sampling, and cluster sampling, the most commonly used method—and the one that is easiest to use—is random sampling. In random sampling, every part of the population has an equal chance of being in the sample.

Market plan and questionnaire design: The most effective way to begin is for the entrepreneur to make a list of the information that will be needed to create a market plan. A plan can help an entrepreneur determine whether there is a market for the product, who the customer will be, and whether the product is marketable in its present form.

Thus, one of the plan's objectives should be to conduct a market questionnaire to determine what people think of the product or service and whether they would buy it, and to collect some background information about the demographic makeup and attitudes of these individuals. The questionnaire might also be designed to determine the following:

- how much potential customers would be willing to pay for the product or service;
- where potential customers would prefer to purchase the product or service, and
- where the customer would expect to hear about or learn about such a product or service.

The questionnaire, or data collection device, should include questions specifically designed to fulfill one or more of the objectives listed. Questions should be designed so that they are clear and concise, do not bias the respondent, and are easy to answer.

Bar graphs: A graph in which the length of the bars shows the frequency of data values.

Pie chart: A circle graph where each wedge is a percentage of the circle that represents the percentage of the frequency of data values.

Mean: The mean, also called the arithmetic mean, is calculated by dividing the sum of the values in the data set by the number of data values.

Median: The middle data value in an ordered data set. When there are two middle values, the median of the data set is the mean of these two values.

Mode: The value that appears most often in a data set.

Market size: The actual size of a venture’s potential market, whether it be local, statewide, national, or worldwide.

Trend line: A line which passes through or near most points in a data set and shows a trend in the data. Note: There is more than one possible trend line for a given set of data, while there is exactly one linear regression equation for a given set of data.

Scatterplot: A graph of ordered pairs that displays the relationship between two sets of data.

Procedures:

Student Activity 1: Sample Questionnaire Activity

1. Give the students the questionnaire handouts included with Activity 1. Discuss the types of questions used in the sample questionnaire.
2. Ask students to use the response grid handout to fill in the frequency of each response on the handout labeled “Analysis of Sample Questionnaire Results” and to determine mean, median, and mode when the activity requests this information. Go over the different types of graphs students might use to display the data—specifically, bar graphs, line graphs, and pie graphs.
3. Once the students have the frequencies filled in, choose three questions as a class to model with the different graphs. Ask the students to choose three other questions to model with graphs. Why would it be useful to find the mode, instead of the mean, of the price consumers are willing to pay?

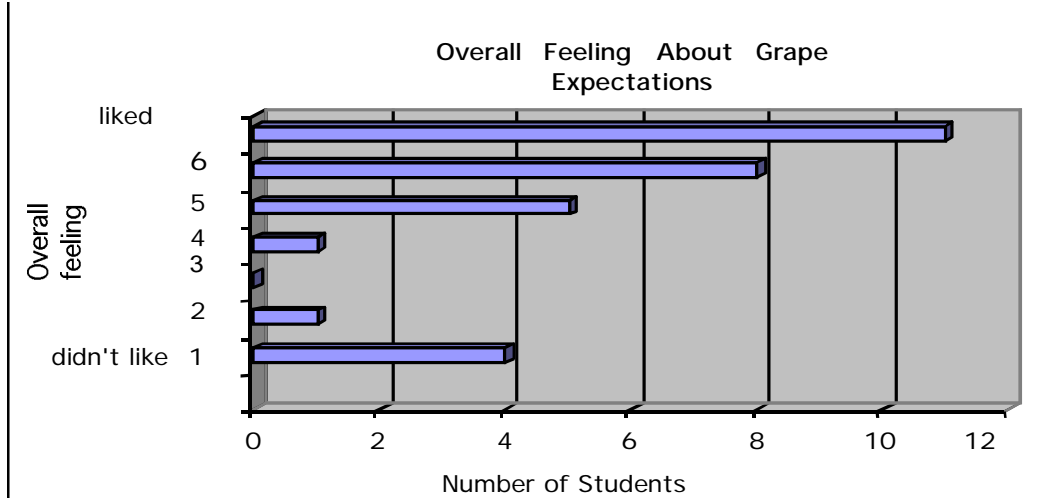
The mode represents the most frequent response. In terms of sales, we want to charge the price most people will pay.

Questions and Possible Answers:

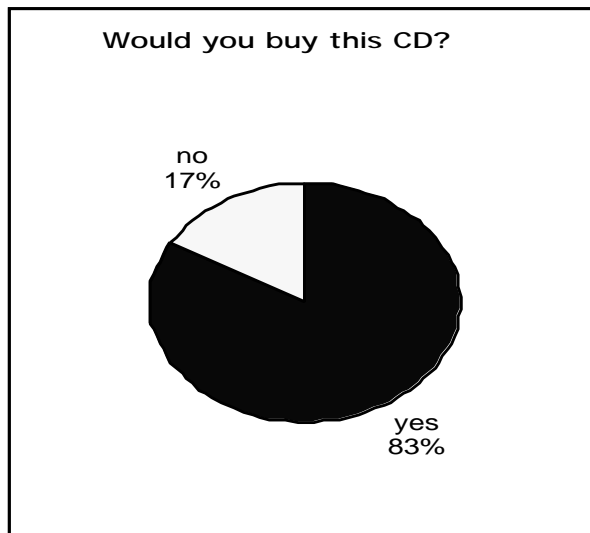
Handout D: Sample Questionnaire Results

1. On a scale from 1 to 7 (with 1 being “did not like at all” and 7 being “liked very much”) indicate your overall feeling about the band’s (Grape Expectations) music.

Did not like 1(4) 2(1) 3(0) 4(1) 5(5) 6(8) 7(11) Liked very much



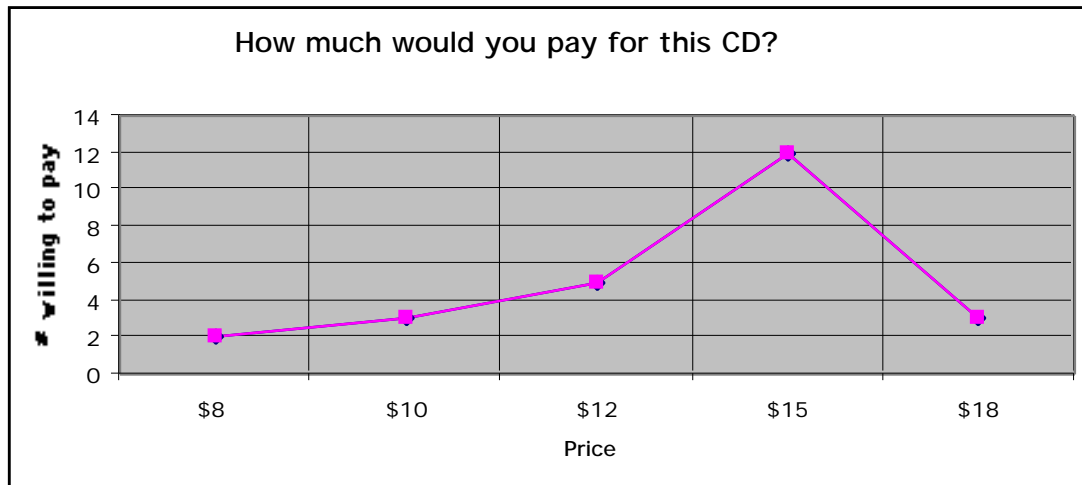
2. Would you be interested in buying a CD of Grape Expectations' talent show performance?
25 Yes 5 No



3. If you answered yes to question 2, how much would you be willing to pay for a Grape Expectations CD?
3 \$10
5 \$12
12 \$15
3 \$18

2 Other \$8, \$9

The mode is \$15.



4. How would like to get the CD?

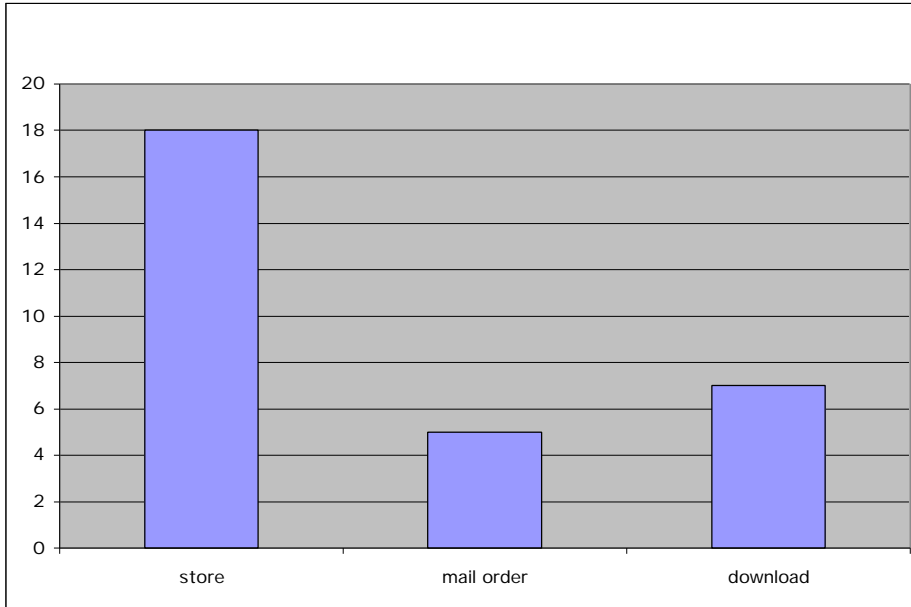
18 Buy from a store

3 Mail-order the CD

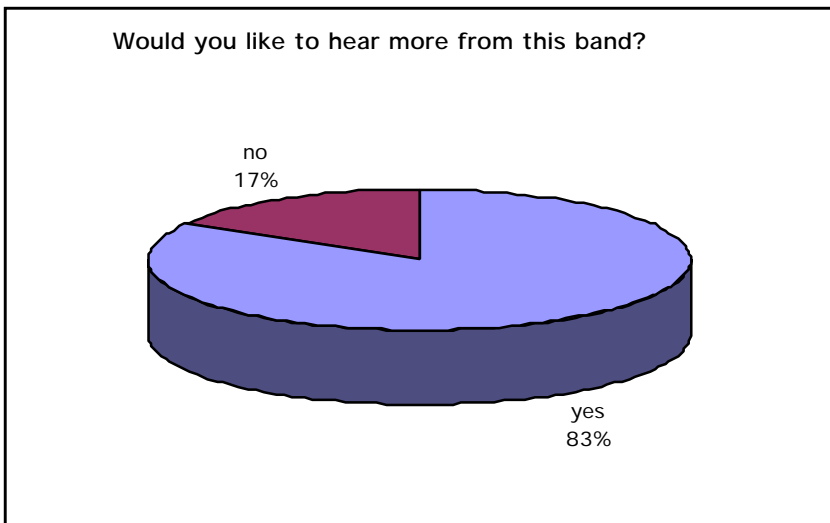
4 Download the CD from the Internet

 Other: _____

How would you like to get the CD?

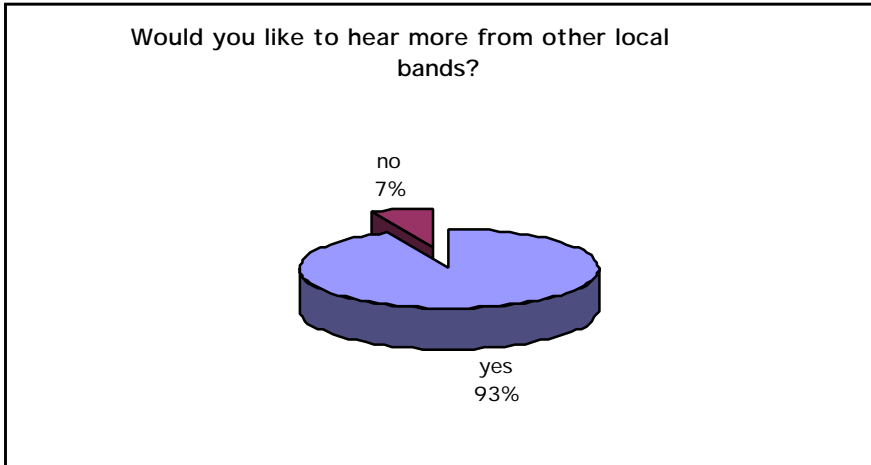


5. Would you like to hear more from this band?
25 Yes 5 No



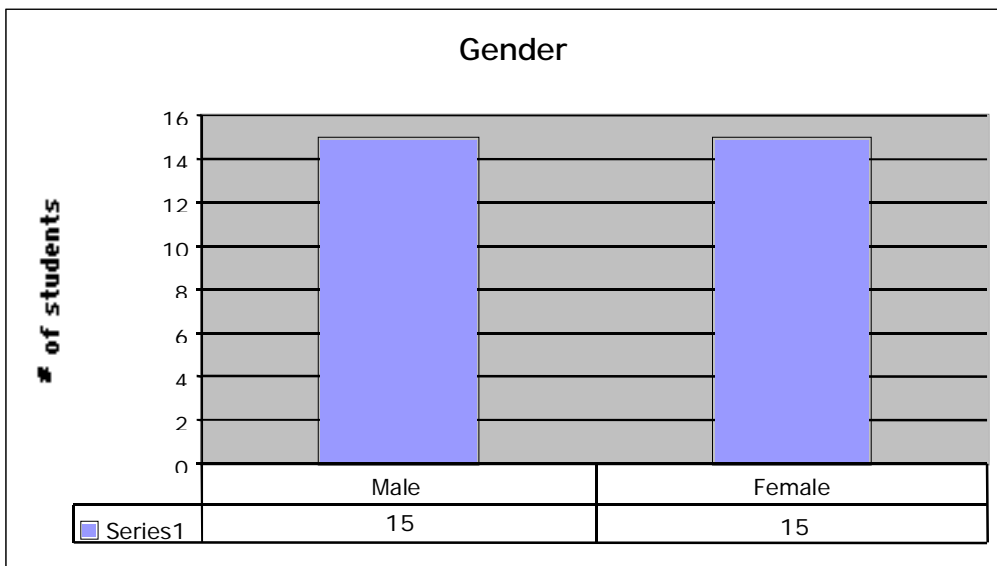
6. Would you like to hear CDs from other local bands?
28 Yes 2 No

If so, name the bands you are interested in. _____



7. The following information is needed for categorizing the results of the survey. Please check the appropriate box.

Gender: 15 Male 15 Female



8. Employment: (choose 1)
 3 Work full time
 20 Work part time
 7 Unemployed

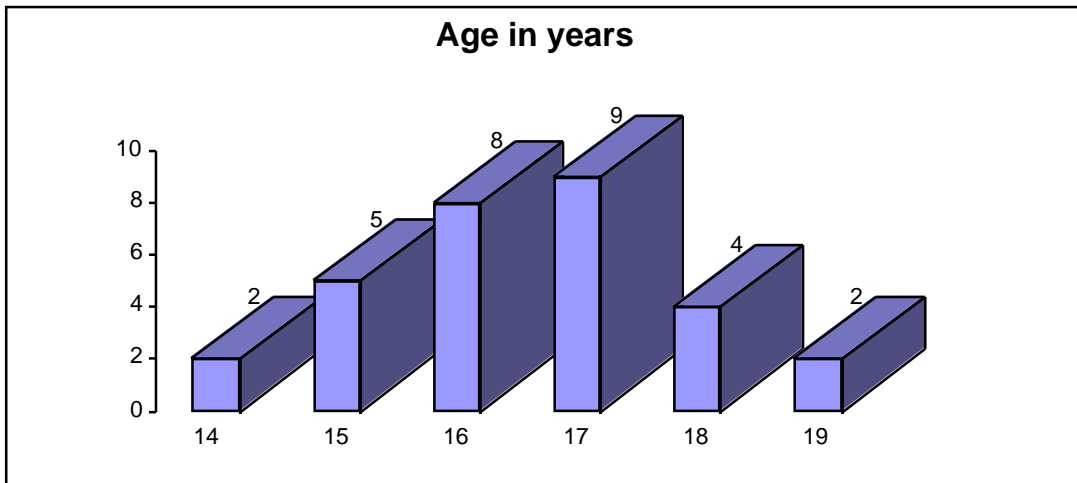
9. Grade in school:
 (5) 9th (7) 10th (9) 11th (9) 12th

Mean grade: 10.73 Median grade: 11th Mode: 11.5

10. Age:

<u>2</u>	14
<u>5</u>	15
<u>8</u>	16
<u>9</u>	17
<u>4</u>	18
<u>2</u>	19

Mean Age: 16.46 years
Median Age: 17 years
Mode Age: 17 years



11. A **customer profile** tells us about the typical customer our product will reach. This profile can be created by finding the mean of certain demographic information, such as age or education. Based on the results above, fill in the customer profile below.

Discuss the definition of “customer profile” with students. Then have them fill in the mean age and mean grade level into the sample customer profile.

Sample Customer Profile for Grape Expectations

The typical customer is 16.46 years old and has completed 10.73 years of school.

Student Activity 2: Determining the Market Size

Describe the Grape Expectations sample questionnaire for the students. In using the following guidelines to help students work through the questionnaire, you may use the sample Answers table below. The table and guidelines use the past and future student body as the sample market.

1. Ask students to tally the results of the questionnaire by grade level.
2. Have students use the percentage they determined in question 1 to calculate what percentage of the market sample would buy their product/service.
3. If possible, students should use the World Wide Web, almanacs, or the local school office to find local data on their market audience. For example, if a team decides their market is women ages 18–24, the team should find the number of women in that age group for your city. The U.S. Census Bureau provides a lot of demographic information, and websites such as AskJeeves (www.ask.com) are another good source of information. In our country, any public information that is not a security risk can be obtained. Students may call the local government offices to ask for demographic data for your area. An additional source of data is a special issue of the journal *Sales and Marketing Management Magazine* called *Survey of Buying Power*. Most libraries will have this journal as well as Census Bureau updates.

Students can use the percentage from question 2 to determine a larger market sample. For example, assume the market sample consisted of 20 women ages 18–24 and the results of the questionnaire showed that 15 percent of these women would purchase their product. Data research shows that there are actually 500 women in our city that fit into the required age group. To find the actual local market size, we would multiply our percentage by the total number ($.15 \times 500 = 75$). What assumptions do we make when we scale up our market sample to the local population?

We assume that our market sample is a true sample of the total population.

4. Ask students to make a scatterplot of market size versus time over the past 3 to 5 years using data obtained from the same data source used in question 3.
 - Is your market increasing, decreasing, or staying relatively stable over time?
5. Students should use a graphing calculator to find a trend line. Remind them to find the average rate of change between their data points as a starting point for slope and to use their initial data point as a y-intercept.
6. Based on the trend line formula, students can predict our potential sales for the year by substituting values in for x .
 - What assumptions do we make when we predict our potential sales for the year 2003–2004?

We assume that our population will continue to grow as modeled by the trend line.

Questions and Possible Answers:

**Student Activity 2: Determining the Market Size
 Answers for Grape Expectations**

1. Based on the results from your questionnaire, create a matrix that describes the number of people willing to purchase your product or service by age or grade level.

Grade	9 th	10 th	11 th	12 th
Yes	4	6	7	8
No	1	1	2	1

2. In the matrix you developed in question 1, find the percentage of each population subgroup that is willing to buy your product or service.

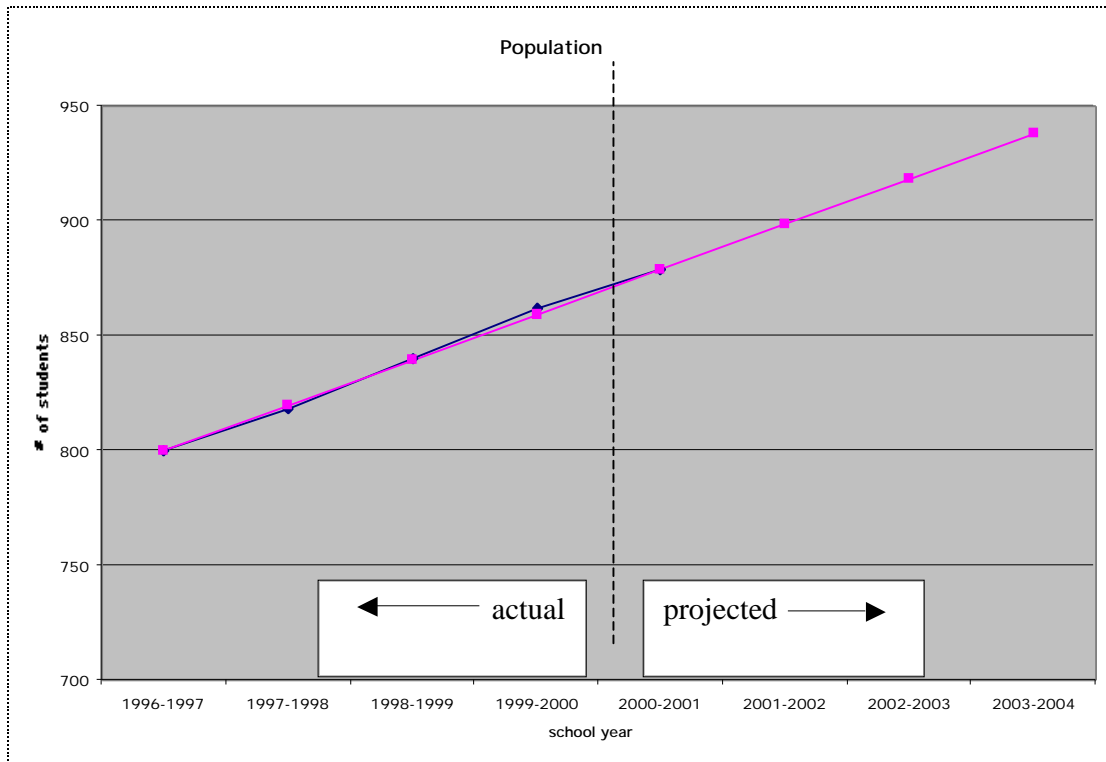
Grade	9 th	10 th	11 th	12 th
Percent	80%	85.7%	77.8%	88.9%

3. Find the number of people in each age/grade category. Multiply this number by the percentage willing to buy your product or service. This value projects the market size using demographic information based on the survey results and assumptions.

Grade	9 th	10 th	11 th	12 th
Enrollment	245	212	224	198
Potential Sales (% x enrollment)	196	181	174	176

Total potential sales = 727 students
 Percentage of total population = 82.7%

4. Make a scatterplot of the local market data over the past 3 to 5 years.



5. Find a trend line for this data.

Trend Line: $y = 19.75x + 780.25$

6. Use your trend line to predict your market size in 3 years.

Population prediction for 2003–2004: 938.25

Predicted potential sales for 2003–2004: $82.7\% \times 938.25 = 776$ students

Student Activity I

Handout A: Sample Questionnaire Questions

Questionnaire design for new product research:

Questioning Techniques	Example	Advantages	Disadvantages
Dichotomous questions	Do you usually like to try new products? Yes No	<ul style="list-style-type: none"> ➤ Easy to answer ➤ Can be used to screen before asking further questions ➤ Easy to tabulate ➤ Provides definite answer 	<ul style="list-style-type: none"> ➤ Forces a choice ➤ Provides no detailed information
Multiple choice	Which of the following four packages do you like? Package A Package B Package C Package D	<ul style="list-style-type: none"> ➤ Usually avoids forcing an arbitrary choice ➤ Easy to answer ➤ Easy to tabulate 	<ul style="list-style-type: none"> ➤ Choices may not be all-encompassing ➤ Choices may not be clearly distinctive
Preference	Which of these products do you most prefer? Brand A Brand B Brand C Brand D	<ul style="list-style-type: none"> ➤ Gives information on preference ➤ Easy to respond to 	<ul style="list-style-type: none"> ➤ Preference may not reflect purchase choice ➤ Choices may present some confusion
Rating scale	On a scale from 1 to 7 (with 1 being “did not like at all” and 7 being “liked it very much”) indicate your overall feeling about the new product by circling the number that corresponds to your feeling. 1 2 3 4 5 6 7	<ol style="list-style-type: none"> 1) Gives important information on relative feelings about various product attributes 2) Does not force an arbitrary choice 3) Provides a wide range of responses for comparative purposes 	<ol style="list-style-type: none"> 1) Distinctions on scale may not be clear to respondent 2) Provides scale gradations that may not be commensurate with knowledge of respondent

Questioning Techniques	Example	Advantages	Disadvantages
Ranking	Rank in order, from 1 to 5 (with 1 being the best and 5 being the worst), your opinion of the following products Product A Product B Product C Product D Product E	<ol style="list-style-type: none"> 1) Provides valuable information on relative consumer opinions about products or attributes 2) Provides a definite answer 3) Yields information quickly 	<ol style="list-style-type: none"> 1) Is probably the most confusing type of question for consumers to answer 2) Provides no information on how good the best product is 3) Provides no information on relative differences between ranks of products
Open-ended	Why did you choose that particular product?	<ol style="list-style-type: none"> 1) Does not bias response with established answers 2) Provides wide range of information 3) Provides information in more depth 	<ol style="list-style-type: none"> 1) Requires interpretation of answers 2) Requires skill and may vary between interpreters 3) Difficult to tabulate

10. Age: _____ under 15
 _____ 15
 _____ 16
 _____ 17
 _____ 18
 _____ Over 18

Student Activity 1

Handout C: Sample Questionnaire Response Grid

Subject #	Overall	Buy	Price	Getting CD	Hear more	Other bands	Gender	Employed	Grade	Age
1	5	yes	\$8	download	yes	yes	M	not	9	14
2	7	yes	\$15	store	yes	yes	F	part	10	16
3	1	no		download	no	no	M	part	11	17
4	5	yes	\$10	download	yes	yes	M	part	10	16
5	7	yes	\$15	store	yes	yes	F	part	12	18
6	1	no		store	no	yes	F	not	9	15
7	6	yes	\$12	mail order	yes	yes	M	part	11	17
8	6	yes	\$12	store	yes	yes	M	part	12	17
9	7	yes	\$15	store	yes	yes	M	part	10	16
10	1	no		mail order	no	yes	F	part	12	17
11	1	no		download	no	no	F	not	10	15
12	6	yes	\$15	store	yes	yes	M	full	12	19
13	7	yes	\$15	store	yes	yes	F	part	11	17
14	5	yes	\$12	store	yes	yes	M	not	9	14
15	7	yes	\$15	store	yes	yes	F	part	12	18
16	6	yes	\$18	store	yes	yes	F	part	11	16
17	4	yes	\$12	store	yes	yes	M	not	10	15
18	7	yes	\$15	store	yes	yes	F	full	12	19
19	7	yes	\$18	store	yes	yes	F	part	11	16
20	7	yes	\$15	store	yes	yes	M	part	12	18
21	6	yes	\$9	mail order	yes	yes	F	part	10	16
22	6	yes	\$12	mail order	yes	yes	M	part	11	17
23	7	yes	\$15	store	yes	yes	F	not	9	15
24	2	no		mail order	no	yes	F	part	11	17
25	6	yes	\$15	store	yes	yes	M	not	9	15
26	7	yes	\$15	store	yes	yes	M	part	11	17
27	7	yes	\$18	store	yes	yes	F	Part	11	16
28	5	yes	\$10	download	yes	yes	M	part	10	16
29	6	yes	\$15	download	yes	yes	F	full	12	18
30	5	yes	\$10	download	yes	yes	M	part	12	17

Student Activity 1

Handout D: Analysis of Sample Questionnaire Results

Below is the sample questionnaire for Grape Expectations. Using the Sample Questionnaire Response Grid, fill in the frequency of each result. Choose three questions and create one pie graph, one bar graph and one line graph to display the results of the three questions. Also, find the mean age, mean grade level, and mode price.

1. On a scale from 1 to 7 (with 1 being “did not like at all” and 7 being “liked very much”) indicate your overall feeling about the band’s (Grape Expectations) music.

Did not like 1(____)2(____)3(____)4(____)5(____)6(____)7(____) Liked very much

2. Would you be interested in buying a CD of Grape Expectations’ talent show performance?

_____ Yes _____ No

3. If you answered yes to question 2, how much would you be willing to pay for a Grape Expectations CD?

_____ \$10
_____ \$12
_____ \$15
_____ \$18
_____ Other _____

The mode is _____.

4. How would you like to get the CD?

_____ Buy from a store
_____ Mail order the CD
_____ Download the CD from the Internet
_____ Other: _____

5. Would you like to hear more from this band?

_____ Yes _____ No

6. Would you like to hear CDs from other local bands?

_____ Yes _____ No

If so, name the bands you are interested in. _____

7. The following information is needed for categorizing the results of the survey. Please

check the appropriate box.

Gender: Male Female

8. Employment: (choose 1) Work full-time
 Work part-time
 Unemployed

9. Grade in School:

9th 10th 11th 12th

Mean grade: _____

Median grade: _____

Mode grade: _____

Which is the most appropriate number to use for your analysis, and why?

10. Age: 14
 15
 16
 17
 18
 19

Mean Age: _____

Median Age: _____

Mode Age: _____

Which is the most appropriate number to use for your analysis, and why?

Sample Customer Profile for Grape Expectations

A **customer profile** tells us about the typical customer our product will reach. This profile can be created by finding the mean of certain demographic information, such as age or education. Based on the results above, fill in the customer profile below. The typical customer is _____ years old, and has completed _____ years of school.

Student Activity 2

Determining the Market Size

1. Based on the results from the Grape Expectations questionnaire, create a matrix that describes the number of people willing to purchase the CDs by age or grade level.

2. In the matrix you developed in question 1, find the percentage of each population subgroup that is willing to buy the CDs

3. Find the number of people in each age/grade category. Multiply this number by the percentage willing to buy the CDs. This value projects the market size by demographic information based on the survey results and assumptions.

4. Make a scatterplot of the local market data over the past 3 to 5 years.

5. Find a trend line for this data.

6. Use your trend line to predict the market size in 3 years.