Let's buy a car!

I. UNIT OVERVIEW & PURPOSE:

The student will analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers.

II. UNIT AUTHOR:

Tierny Barksdale, Open High School, Richmond City Public Schools
Sarah Dulaney, West Point Middle School, West Point Public Schools
Beth Swain, Andrew Lewis Middle School, Salem City Schools

III. COURSE:

Mathematical Modeling: Capstone Course

IV. CONTENT STRAND:

Data Analysis and Probability

V. OBJECTIVES:

- Collect data related to purchasing a new or used car
- Construct graphical displays of univariate data
- Identify and describe patterns by using statistical measures

VI. MATHEMATICS PERFORMANCE EXPECTATION(S):

MPE.22 Analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical displays.

VII. CONTENT:

Students will conduct an analysis on buying one's first car. They will research issues such as type of car (build) as well as model (and year) and manufacturer, safety ratings, cost of insurance, cost of vehicle, average repair costs, and miles per gallon.

VIII. REFERENCE/RESOURCE MATERIALS:

Students will need access to computers with Internet access. They will need materials to collect and organize data from their peers, such as graphing calculators. Students will also need access to spreadsheet software such as Microsoft Excel.

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IX. PRIMARY ASSESSMENT STRATEGIES:

Students will be working in groups to create graphical representations of certain types of vehicles. They will be asked to make predictions on best car for certain categories. Students will have to explain the significance of each graph and how all statistical measures were calculated. They will analyze their own results and present their findings to their classmates. Students will also analyze the findings of other groups and eventually draw conclusions about which category of car might be best based on the various factors (cost, safety, mpg, etc.).

X. EVALUATION CRITERIA:

Final assessment will be analyzing all the data and making a purchase decision based on it. Rubric is included with assessment.

XI. INSTRUCTIONAL TIME:

10 - 15 45-minute periods or 5 - 8 80-minute blocks

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Lesson 1 - Make and Model

Strand
Data Analysis and Probability

Mathematical Objective(s)

- Use and reinforce content and data from spectrum of real-world sources including local, state, federal, and international data sources
- Research using technology
- Provide opportunities for individual and collaborative investigation
- Create appropriate graphs to display data using technology

Mathematics Performance Expectation(s)
MPE.22 The student will analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical displays.

Related SOL

PS.1 (Create and interpret graphical displays of data, including dotplots, stem-and-leaf plots, and histograms)

AFDA.3 (Collect and analyze data to make decisions and justify conclusions)

NCTM Standards

- Understand histograms, parallel box plots, and scatterplots and use them to display data
- For univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics
- Apply and adapt a variety of appropriate strategies to solve problems
- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems

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Materials/Resources

- Classroom set of graphing calculators
- Computers with Internet access and programs such as Microsoft Word and Excel
- Included data sheet for recording information about each vehicle

Assumption of Prior Knowledge

- Students should have knowledge of different types of graphs - how to construct and which type to use to best display data. If not, then a day of review might be necessary.
- Some students might struggle with finding reliable data, compiling it and deciding how to show the data in a graph. Students should be provided with a list of resources to access current data.
- Students will be exploring economics, supply and demand, as well as the impact of safety ratings and fuel efficiency.

Introduction: Setting Up the Mathematical Task

- In this lesson, students will research and compile data on new and used vehicles of a particular type. They decide upon an appropriate type of graph to display each data set and will create the corresponding graphs.
- It should take approximately 2 to 3 45-minute periods or 1 80-minute block.
    - Discussion on car buying - 10 minutes
    - Research 10 vehicles within group - 30 minutes
    - Create graph - 20 minutes
    - Calculate and analyze statistics - 30 minutes
- Students will begin the lesson with a discussion about buying a car for themselves. What is their ideal car and why? Is there another car that is more realistic for a first time car buyer? When purchasing a car, what things will be important to consider? What types of things should influence your decision on which vehicle to purchase? Should you buy new or used? Should you do research prior to looking for a vehicle?
- After a group discussion, students will be put into groups and assigned a certain type of vehicle to research
    - SUV, truck, sedan, hybrid, or van (other categories may be added to reduce the size of the groups)
    - Groups should decide on standard features wanted before searching for vehicles (i.e. 2 wheel or 4 wheel drive for trucks)
- Students should use the Internet and local major car dealerships to find prices.
- Student groups will create an appropriate graph using spreadsheet software to display the years and prices of their vehicles. They will also calculate measures of center and variation for the data.

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Student Exploration 1:

1. To begin the activity, the teacher will lead a discussion of what considerations should be made when purchasing a car.

2. Students will be put into groups and given one type of vehicle - SUV, Truck, Sedan, Hybrid, or Van. Each group will use the Internet and research the cost of a new vehicle and a used vehicle (no older than five years) of the type assigned. They must find at least 10 specific examples (five used and five new), using at least 3 major manufacturers. They may use local dealership websites to find vehicles.

3. Using Excel or a similar spreadsheet program, groups will chart the year and price of each model. The students will chose an appropriate type of graph to display the data.

4. Students will use the pricing data collected to calculate statistical measures, including mean, median, mode, and range. They will analyze the data by constructing a normal distribution curve.

5. Teachers will monitor progress and direct students to find reliable data, appropriate websites, appropriate graphing techniques.

Monitoring Student Responses

- Student will summarize all their findings in the penultimate lesson of this unit.
- Students will produce the data and graphs of their research as evidence of knowledge of this task.
- Students will submit a journal response as an exit ticket to the lesson.

Assessment

- **Questions**
  - Based on your research, which is better: new or used? Explain.
  - Based on your research, which make and model would you recommend for someone to purchase? Why?
- **Journal/writing prompts**
  - Explain why you chose the type of graph you used to display the data. What are the advantages or disadvantages of that type of graph?
  - Explain how you knew your data was reliable. Cite your sources.

Extensions and Connections (for all students)

- Students can compare and contrast prices for basic models vs. luxury/loaded models.
- Students can compare prices of used vehicles older than five years.

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Strategies for Differentiation

- Provide a list of dealership websites
- Provide a template for recording data to help students stay organized
- Use technology of text-to-read for lower level readers
- Include a timeline rubric of completion for time management

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Name: _____

Group: _____

Make and Model

Use the Internet to research the cost of new and used vehicles (no older than 5 years) of the type assigned to the group. Include at least 10 specific examples, five new and five used, using at least 3 major manufacturers.

Make	Model	Year	Cost	Dealership	New or Used

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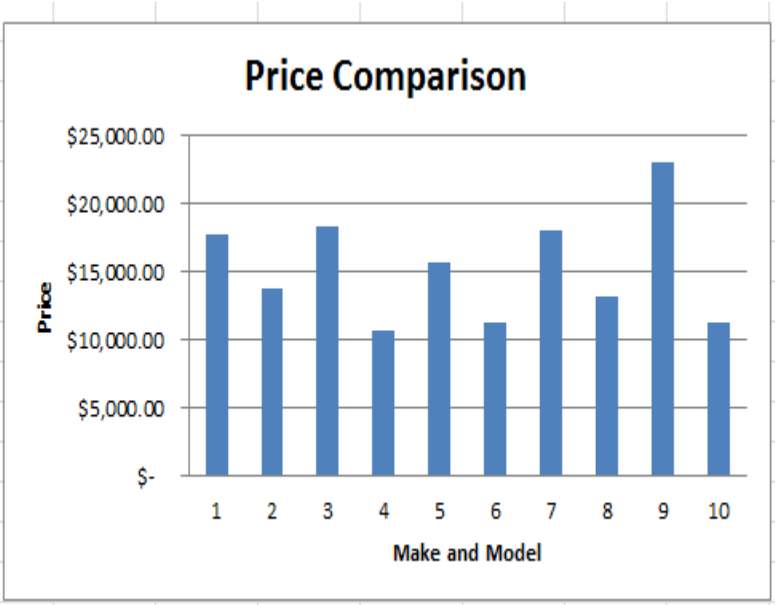
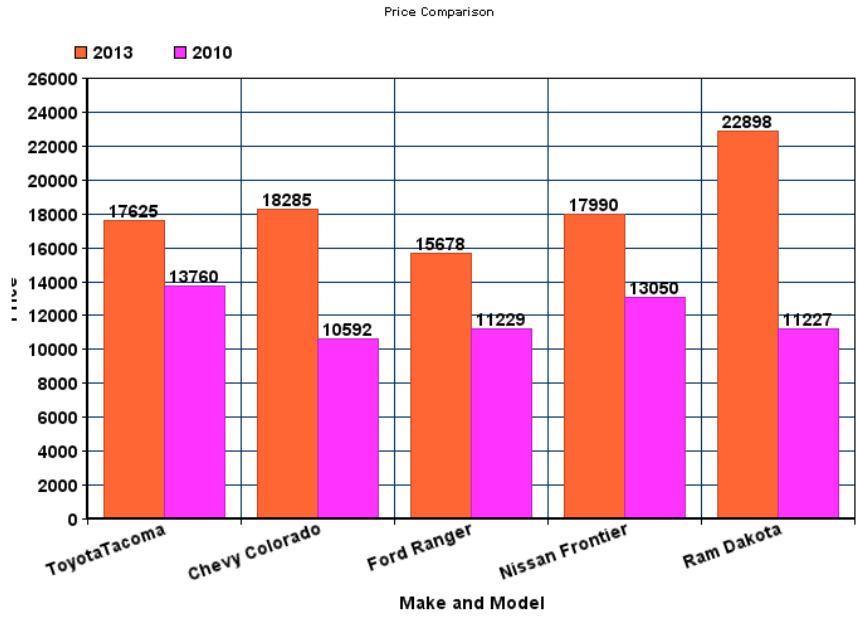
Example of table and graph students could produce using Excel:

	Make	Year	Price
1	Toyota Tacoma	2013	$17,625.00
2	Toyota Tacoma	2010	$13,760.00
3	Chevy Colorado	2013	$18,285.00
4	Chevy Colorado	2010	$10,592.00
5	Ford Ranger	2012	$15,678.00
6	Ford Ranger	2010	$11,229.00
7	Nissan Frontier	2013	$17,990.00
8	Nissan Frontier	2010	$13,050.00
9	Ram Dakota	2013	$22,898.00
10	Ram Dakota	2010	$11,227.00



Possible student graph using http://www.onlinecharttool.com



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Name: _____

Group: _____

Make and Model

Use the Internet to research the cost of new and used vehicles (no older than 5 years) of the type assigned to the group. Include at least 10 specific examples, five new and five used, using at least 3 major manufacturers.

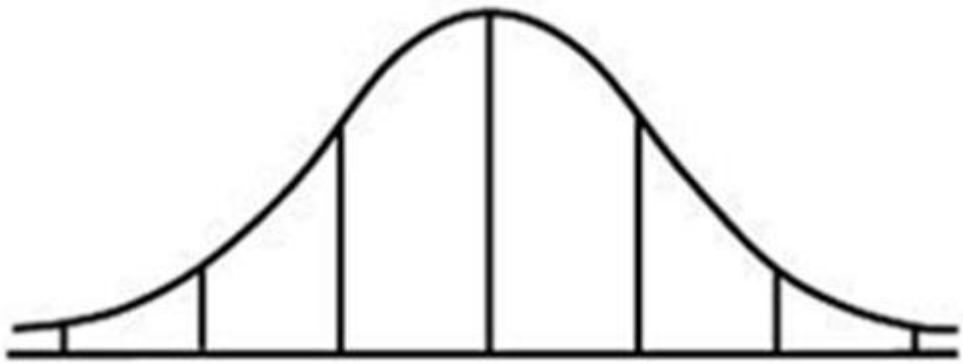
1) Calculate the following statistics for the pricing data:

Mean: _____ Median: _____

Mode: _____ Range: _____

2) Construct and label a normal curve distribution detailing the dispersion of the pricing for the group of vehicles.

Standard deviation: _____



3) Choose one vehicle and calculate its z-score.

Make and model: _____ Price: _____

Z-Score: _____

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4) Based on the analysis of the statistics above, which cars are priced below the mean? Above the mean?

_____

_____

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5) Is there a correlation between the model year and having a positive or negative z-score? If not, is there another pattern in the dispersion?

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6) Overall, is the pricing spread out or close together for the 10 cars chosen? Explain.

_____

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Lesson 2 - Let's get insured!

Strand
Data Analysis and Probability

Mathematical Objective(s)

- Use and reinforce content and data from spectrum of real-world sources including local, state, federal, and international data sources
- Research using technology
- Provide opportunities for individual and collaborative investigation
- Create appropriate graphs to display data using technology

Mathematics Performance Expectation(s)

MPE.22 The student will analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical display.

Related SOL

PS.1 (Create and interpret graphical displays of data, including dotplots, stem-and-leaf plots, and histograms)

AFDA.3 (Collect and analyze data to make decisions and justify conclusions)

NCTM Standards

- Understand histograms, parallel box plots, and scatterplots and use them to display data
- For univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics
- Apply and adapt a variety of appropriate strategies to solve problems
- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems

Materials/Resources

- Classroom set of graphing calculators
- Computers with Internet access and programs such as Microsoft Word and Excel
- Included data sheet for recording information about each vehicle

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Assumption of Prior Knowledge

- Students should have knowledge of different types of graphs - how to construct and which type to use to best display data. If not, then a day of review might be necessary.
- Some students might struggle with finding reliable data, compiling it and deciding how to show the data in a graph. Students should be provided with a list of resources to access current data.
- Students will be exploring economics, supply and demand, as well as the impact of safety ratings and fuel efficiency.

Introduction: Setting Up the Mathematical Task

- In this lesson, students will research and compile data on cost of insurance for a vehicle. They will decide upon an appropriate type of graph to display the data and will create the graph.
- It should take approximately 2-3 45-minute periods or 1 80-minute block.
    - Discussion - 10 minutes
    - Research insurance costs - 30 minutes
    - Create graph - 20 minutes
    - Calculate and analyze statistics - 30 minutes
- Students will begin the lesson with a discussion about the cost of insurance to see if they have any prior knowledge.
- After a group discussion, students will be put into groups and will be asked to research the cost of insuring a car.
- Students should use the Internet and/or call insurance agencies to get quotes on prices.
- Student groups will create an appropriate graph for their data and also calculate measures of center and dispersion.

Student Exploration 1:

1. To begin the activity, the teacher will lead a discussion of what considerations should be made when purchasing insurance for a car. What things are important and should influence the decision? Should you do research prior to purchasing? What things should you research?

2. Students will be put into groups (groups from lesson 1 should be used) and be asked to research quotes from at least 3 major insurance companies for each model. The insurance will be for one driver and full coverage. At least 1 of the companies should have a local office.

3. Using Excel, groups will chart the price found for each model and choose an appropriate type of graph to display the data.

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4. Students will use the insurance premium data collected to calculate statistical measures, including mean, median, mode, and range. They will analyze the data by constructing a normal distribution curve.

5. Teachers will monitor progress and direct students to find reliable data, appropriate websites, appropriate graphing techniques. Teacher may have to call or contact agencies or agents to get reliable quotes since many online quotes require addresses and other personal information.

Monitoring Student Responses

- Students will submit a journal response as an exit ticket to the lesson.

Assessment

- **Questions**
  - Based on your research, which company would you purchase insurance from? Give detailed explanations as to why you chose the company you did.
  - Compare and contrast buying insurance from a company with a local office and a company with no local office.
- **Journal/writing prompts**
  - What things surprised you about buying insurance? Be as specific as possible.

Extensions and Connections (for all students)

- Students could investigate cost for different levels of coverage.
- Students could investigate changes in cost for different ages, genders, and zip codes.

Strategies for Differentiation

- Use grid paper to assist students in creating graphs
- Provide a list of insurance agencies that are nationally known and have local offices
- Have a local insurance agent as a guest speaker to explain the types of insurance coverage and the process of purchasing insurance

Name: _____ Group: _____

Insurance

Use the Internet to research the cost of insuring each vehicle. The insurance will be for one driver and full coverage. To obtain an auto insurance quote, please be consistent about using the following information:

Zip Code: _____

Make	Model	Year	New or Used	Quote (Annual)	Insurance Company

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Make	Model	Year	New or Used	Quote (Annual)	Insurance Company

Notes: _____

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Name: _____

Group: _____

Insurance

Use the Internet to research the cost of insuring each vehicle. The insurance will be for one driver and full coverage.

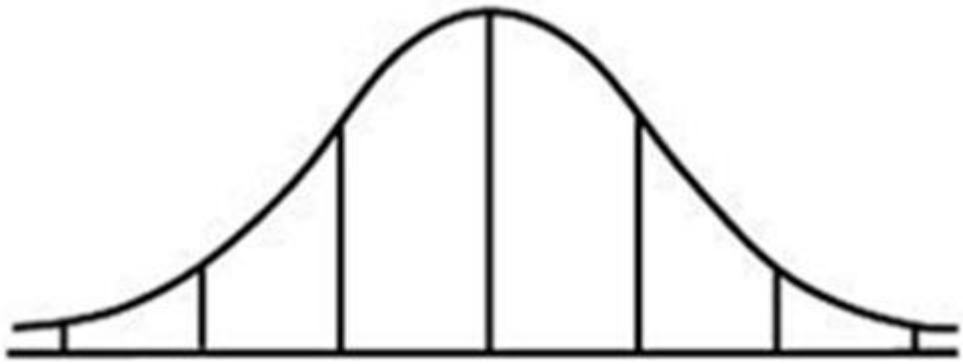
1) Calculate the following statistics by using each vehicle's average annual insurance premium data:

Mean: _____ Median: _____

Mode: _____ Range: _____

2) Construct and label a normal curve distribution detailing the dispersion of the insurance premiums for the group of vehicles.

Standard deviation: _____



3) Choose one vehicle and calculate its z-score.

Make and model: _____ Price: _____

Z-Score: _____

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4) Based on the analysis of the statistics above, which cars have insurance premiums below the mean? Above the mean?

_____

_____

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5) Is there a pattern that explains the z-score for certain vehicles? Look at used/new, model & manufacturer, mileage, color, etc.

_____

_____

_____

6) Overall, are the insurance premiums spread out or close together for the 10 cars chosen? Explain.

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_____

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Lesson 3 - Miles and miles to go!

Strand
Data Analysis and Probability

Mathematical Objective(s)

- Use and reinforce content and data from spectrum of real-world sources including local, state, federal, and international data sources
- Research using technology
- Provide opportunities for individual and collaborative investigation
- Create appropriate graphs to display data using technology

Mathematics Performance Expectation(s)
MPE.22 The student will analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical display.

Related SOL

PS.1 (Create and interpret graphical displays of data, including dotplots, stem-and-leaf plots, and histograms)

AFDA.3 (Collect and analyze data to make decisions and justify conclusions)

NCTM Standards

- Understand histograms, parallel box plots, and scatterplots and use them to display data
- For univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics
- Apply and adapt a variety of appropriate strategies to solve problems
- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems

Materials/Resources

- Classroom set of graphing calculators
- Computers with Internet access and programs such as Microsoft Word and Excel
- Included data sheet for recording information about each vehicle

Assumption of Prior Knowledge

- Students should have knowledge of different types of graphs - how to construct and which type to use to best display data. If not, then a day of review might be necessary.
- Some students might struggle with finding reliable data, compiling it and deciding how to show the data in a graph. Students should be provided with a list of resources to access current data.
- Students will be exploring economics, supply and demand, as well as the impact of safety ratings and fuel efficiency.

Introduction: Setting Up the Mathematical Task

- In this lesson, students will investigate the costs of mileage and repairs for each vehicle in their group. Students will consider the average of 12,000 miles per year and the advertised mpg. Students will also follow the manufacturer's guidelines on maintenance and research the costs to fulfill the given schedule.
- It should take approximately 2-3 45-minute periods or 1 80-minute block.
    - Discussion - 10 minutes
    - Research mpg / maintenance costs - 30 minutes
    - Create graph - 20 minutes
    - Calculate and analyze statistics - 30 minutes
- Begin by prompting students to think of the lowest price per gallon they have ever seen for gas; follow-up with discussing when and where. Discuss how these responses are different from the current local prices. How much does it cost to fill up the tank? Then, ask about what other maintenance must be taken care of in order for the car to remain in good condition (oil changes, new battery, tires, etc). Inquire as to whether students have personally taken care of these costs and ask to detail their experiences. On average, what might be the annual cost for maintaining a vehicle outside of fuel?
- Students will read through the AAA brochure, "Your Driving Costs," located online at http://newsroom.aaa.com/wp-content/uploads/2013/04/YourDrivingCosts2013.pdf [updated annually; may need to search AAA website for most up-to-date version]. Discuss findings.
- After a group discussion, students will be put into groups and will research fuel mileage and maintenance costs for each vehicle.
- Student groups will create an appropriate graph for their data and also calculate measures of center and dispersion.

Student Exploration 1:

1. Students will begin by using the manufacturer's website or a third party website, such as Edmunds.com or http://www.fueleconomy.gov, to find the advertised fuel mileage and maintenance schedule. If students have trouble, it might help to search for "true cost to own" for the vehicle in question.

2. Students will record the mpg and then calculate how many gallons would be needed for an annual average of 12,000 miles. Then, students will calculate the expected cost at current gas prices for the year's worth of gasoline. Students should specify the grade of gasoline purchased for the vehicle.

3. Students will then calculate measures of center and standard deviation for each (mpg, number of gallons annually, cost annually). Students will create a graph for mpg.

4. Students will compare maintenance schedules for new and used models of each vehicle. Depending on the current mileage of a used car, the expected upcoming maintenance and costs will vary. Students will calculate expected annual costs for each vehicle, including changing the oil and other recommended services.

Monitoring Student Responses

- Students will submit a journal response as an exit ticket to the lesson.

Assessment

- **Questions**
  - Does fuel efficiency matter to you? Why or why not?
  - When considering the cars considered popular by your peers, does the cost of maintaining the vehicle matter? Why or why not?
- **Journal/writing prompts**
  - Has researching maintenance costs for vehicles changed your perspective on car buying?
  - Is there a correlation between cost of vehicle and the miles per gallon? If so, what is it?
  - Do the newer vehicles always have better MPG rates? If so, why do you think that is?

Extensions and Connections (for all students)

- Students can research the size of the gas tank to calculate estimated frequency of filling up the tank.

- Students can extend the maintenance schedule for the next five years to show changes in costs by creating a line graph. Students should detail each year's expected services.
- Students can investigate the cost of performing some maintenance individually instead of taking the car to an auto shop (changing the oil, for example).

Strategies for Differentiation

- Use grid paper to assist students in creating graphs.
- Have someone from a local dealership (salesperson, service department head) as a guest speaker to explain the process and importance of maintaining a vehicle.

Name: _____

Group: _____

Fuel Mileage

Use the Internet to research the fuel mileage of new and used vehicles. Calculate the fuel cost per year using 12,000 miles as the expected annual mileage.

Current cost per gallon: _____

Fuel grade: _____

Make	Model	Year	MPG - City	MPG - Hwy	Fuel Cost per Year
			Combined:		
			Combined:		
			Combined:		
			Combined:		
			Combined:		
			Combined:		
			Combined:		

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Make	Model	Year	MPG - City	MPG - Hwy	Fuel Cost per Year
			Combined:		
			Combined:		

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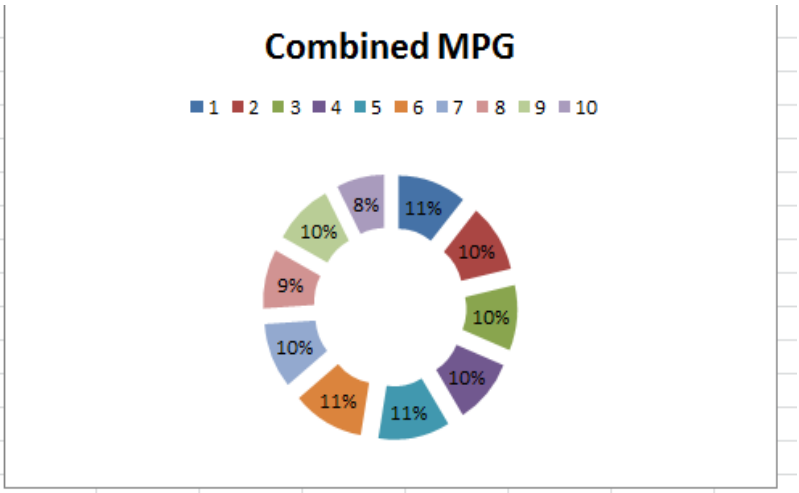
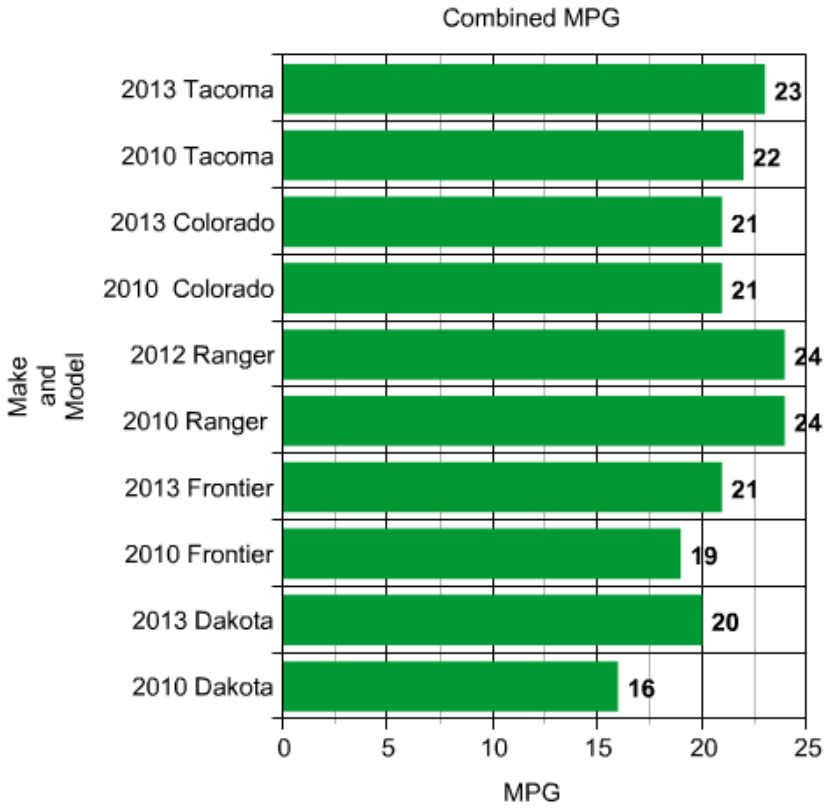
Possible student graph created using Excel:

	Make	Year	Combined MPG
1	Toyota Tacoma	2013	23
2	Toyota Tacoma	2010	22
3	Chevy Colorado	2013	21
4	Chevy Colorado	2010	21
5	Ford Ranger	2012	24
6	Ford Ranger	2010	24
7	Nissan Frontier	2013	21
8	Nissan Frontier	2010	19
9	Ram Dakota	2013	20
10	Ram Dakota	2010	16



Possible student graph using http://nces.ed.gov/nceskids/createagraph/default.aspx



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Name: _____

Group: _____

Fuel Mileage

Use the Internet to research the fuel mileage of new and used vehicles.

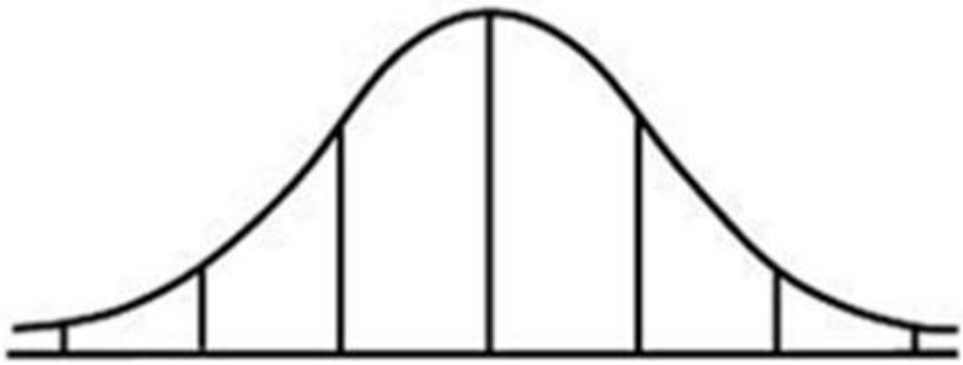
1) Calculate the following statistics by using each vehicle's combined MPG data:

Mean: _____ Median: _____

Mode: _____ Range: _____

2) Construct and label a normal curve distribution detailing the dispersion of the combined MPG for the group of vehicles.

Standard deviation: _____



3) Choose one vehicle and calculate its z-score.

Make and model: _____ Price: _____

Z-Score: _____

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4) Based on the analysis of the statistics above, which cars have MPG below the mean? Above the mean?

_____

_____

_____

5) Is there a pattern that explains the z-score for certain vehicles? Look at used/new, model & manufacturer, transmission, etc.

_____

_____

_____

6) Overall, is the fuel mileage spread out or close together for the 10 cars chosen? Explain.

_____

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Lesson 4 - Safety First!

Strand
Data Analysis and Probability

Mathematical Objective(s)

- Use and reinforce content and data from spectrum of real-world sources including local, state, federal, and international data sources
- Research using technology
- Provide opportunities for individual and collaborative investigation
- Create appropriate graphs to display data using technology

Mathematics Performance Expectation(s)
MPE.22 The student will analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical display.

Related SOL

PS.1 (Create and interpret graphical displays of data, including dotplots, stem-and-leaf plots, and histograms)

AFDA.3 (Collect and analyze data to make decisions and justify conclusions)

NCTM Standards

- Understand histograms, parallel box plots, and scatterplots and use them to display data
- For univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics
- Apply and adapt a variety of appropriate strategies to solve problems
- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems

Materials/Resources

- Classroom set of graphing calculators
- Computers with Internet access and programs such as Microsoft Word and Excel
- Included data sheet for recording information about each vehicle.

Assumption of Prior Knowledge

- Students should have knowledge of different types of graphs - how to construct and which type to use to best display data. If not, then a day of review might be necessary.
- Some students might struggle with finding reliable data, compiling it and deciding how to show the data in a graph. Students should be provided with a list of resources to access current data.
- Students will be exploring economics, supply and demand, as well as the impact of safety ratings and fuel efficiency.

Introduction: Setting Up the Mathematical Task

- In this lesson, students will research and analyze the safety ratings for each of the group's vehicles. Students will gather ratings from both the NHTSA and IIHS. For a quicker search, students may also look at edmunds.com, which has records of safety ratings.
- It should take approximately 2-3 45-minute periods or 1 80-minute block.
    - Discussion - 10 minutes
    - Research safety ratings - 30 minutes
    - Create graph - 20 minutes
    - Calculate and analyze statistics - 30 minutes
- Begin by showing the class an article or listing of cars that are considered most safe and most dangerous – a simple search of "safest cars in year 20XX" and "most dangerous cars in year 20XX" should turn up many results. Discuss if there are any surprises. Does anyone know someone who drives one of these vehicles? Why are some cars built safer than others? What regulations are in place by law (such as safety belts and airbags)? How have safety laws evolved over time?
- After a group discussion, students will be put into groups and research safety ratings of each vehicle.
- Student groups will create an appropriate graph for their data and also calculate measures of center and dispersion.

Student Exploration 1:

1. Students will begin by discussing lists of safest and most dangerous cars. They should compare and contrast the features shared on these lists.
2. Students will then use the Internet to find safety ratings for each of the vehicles in the group and record their findings on the data sheet.

3. Students will also calculate measures of center and dispersion for the different ratings to find a rough average for their group type of vehicle. Students should include analysis on which features improve safety or decrease safety.
4. Students will create a graph of overall safety rankings using spreadsheet software.
5. Students will use the safety rating data collected to calculate statistical measures, including mean, median, mode, and range. They will analyze the data by constructing a normal distribution curve. The teacher may need to guide students on how to calculate measures when using the IIHS data, which is not numerical. Students may translate as following: Good = 4, Acceptable = 3, Marginal = 2, Poor = 1.

Monitoring Student Responses

- Students will submit a journal response as an exit ticket to the lesson

Assessment

- **Questions**
  - Did the rankings surprise you? Why or why not?
- **Journal/writing prompts**
  - How important are safety ratings when purchasing a vehicle?

Extensions and Connections (for all students)

- Students can calculate statistics for vehicles included on “Safest” or “Most Dangerous” lists to see if their findings match with the article.
- Students may investigate the correlation between IIHS ratings and NHSTA ratings.

Strategies for Differentiation

- Use grid paper to assist students in creating graphs.
- Give students a handout explaining the different safety ratings and how they are factored or have them read about safety ratings at a site such as http://www.safercar.gov/Vehicle+Shoppers/5-Star+FAQ

Name: _____

Group: _____

Safety Ratings

Use the Internet to research the safety ratings of each vehicle. Record the safety ratings from both the Insurance Institute of Highway Safety (IIHS, http://www.iihs.org/RATINGS/) and the National Highway Traffic Safety Administration (NHTSA, http://www.safercar.gov/).

1. Make: _____
   Model: _____
   Year: _____

NHSTA Ratings		**IIHS Ratings**	
Passenger:		Frontal offset test:	
Driver:		Side impact test:	
Side impact front:		Roof strength test:	
Side impact rear:		Rear crash protection / head restraint	
Rollover:			

2. Make: _____
   Model: _____
   Year: _____

NHSTA Ratings		**IIHS Ratings**	
Passenger:		Frontal offset test:	
Driver:		Side impact test:	
Side impact front:		Roof strength test:	
Side impact rear:		Rear crash protection / head restraint	
Rollover:			

3. Make: _____
   Model: _____
   Year: _____

NHSTA Ratings		**IIHS Ratings**	
Passenger:		Frontal offset test:	
Driver:		Side impact test:	
Side impact front:		Roof strength test:	
Side impact rear:		Rear crash protection / head restraint	
Rollover:			

4. Make: _____
   Model: _____
   Year: _____

NHSTA Ratings		**IIHS Ratings**	
Passenger:		Frontal offset test:	
Driver:		Side impact test:	
Side impact front:		Roof strength test:	
Side impact rear:		Rear crash protection / head restraint	
Rollover:			

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5. Make: _____
   Model: _____
   Year: _____

NHSTA Ratings		**IIHS Ratings**	
Passenger:		Frontal offset test:	
Driver:		Side impact test:	
Side impact front:		Roof strength test:	
Side impact rear:		Rear crash protection / head restraint	
Rollover:			

6. Make: _____
   Model: _____
   Year: _____

NHSTA Ratings		**IIHS Ratings**	
Passenger:		Frontal offset test:	
Driver:		Side impact test:	
Side impact front:		Roof strength test:	
Side impact rear:		Rear crash protection / head restraint	
Rollover:			

7. Make: _____
   Model: _____
   Year: _____

NHSTA Ratings		**IIHS Ratings**	
Passenger:		Frontal offset test:	
Driver:		Side impact test:	
Side impact front:		Roof strength test:	
Side impact rear:		Rear crash protection / head restraint	
Rollover:			

8. Make: _____
   Model: _____
   Year: _____

NHSTA Ratings		**IIHS Ratings**	
Passenger:		Frontal offset test:	
Driver:		Side impact test:	
Side impact front:		Roof strength test:	
Side impact rear:		Rear crash protection / head restraint	
Rollover:			

9. Make: _____
   Model: _____
   Year: _____

NHSTA Ratings		**IIHS Ratings**	
Passenger:		Frontal offset test:	
Driver:		Side impact test:	
Side impact front:		Roof strength test:	
Side impact rear:		Rear crash protection / head restraint	
Rollover:			

10. Make: _____
    Model: _____
    Year: _____

NHSTA Ratings		**IIHS Ratings**	
Passenger:		Frontal offset test:	
Driver:		Side impact test:	
Side impact front:		Roof strength test:	
Side impact rear:		Rear crash protection / head restraint	
Rollover:			

Name: _____

Group: _____

Fuel Mileage

Use the Internet to research the safety ratings of each vehicle. Record the safety ratings from both the Insurance Institute of Highway Safety (IIHS, http://www.iihs.org/RATINGS/) and the National Highway Traffic Safety Administration (NHTSA, http://www.safercar.gov/). Choose one rating from each to look at correlation (such as NHSTA Rollover and IIHS Roof Strength).

1) Calculate the following statistics for the chosen rating:

NHSTA Rating: _____

Mean: _____ Median: _____

Mode: _____ Range: _____

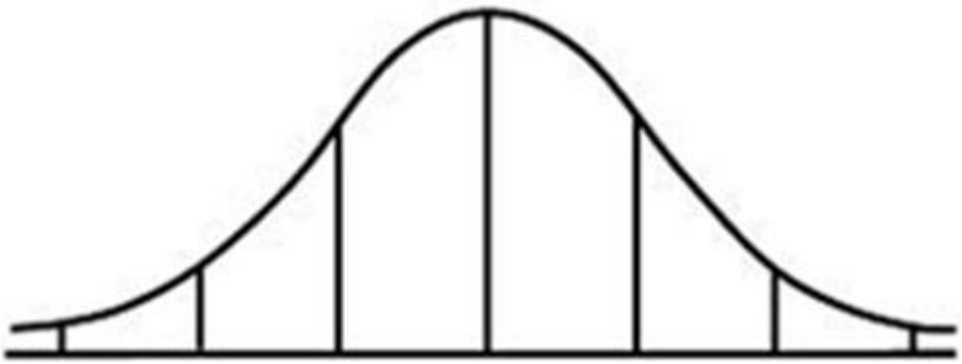
IIHS Rating: _____

Mean: _____ Median: _____

Mode: _____ Range: _____

2) Construct and label a normal curve distribution detailing the dispersion of the rating for each.

NHSTA Standard deviation: _____



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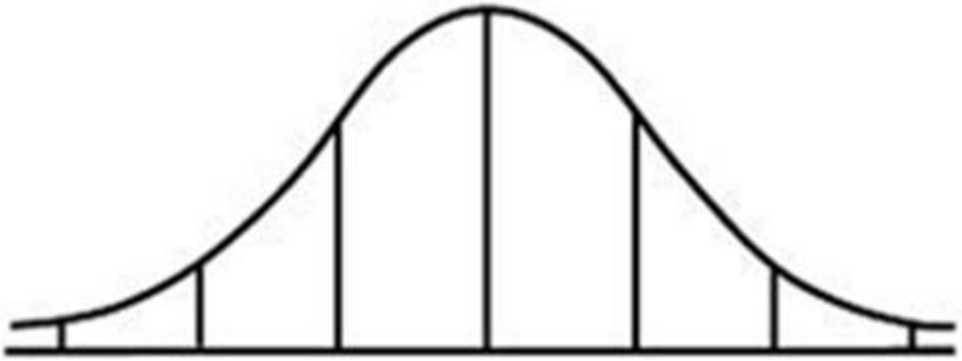
IIHS Standard Deviation: _____



3) Based on analysis of the above distributions, do the rankings seem to be consistent? Explain.

_____

_____

_____

_____

_____

_____

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Lesson 5 - Let's Make a Deal

Strand

Data Analysis and Probability

Mathematical Objective(s)

- Use and reinforce content and data from spectrum of real-world sources including local, state, federal, and international data sources
- Research using technology
- Provide opportunities for individual and collaborative investigation
- Create appropriate graphs to display data using technology

Mathematics Performance Expectation(s)

MPE. 22 The student will analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical displays.

Related SOL

PS. 1 (Create and interpret graphical displays of data, including dotplots, stem-and-leaf plots and histograms)
AFDA.3 (Collect and analyze data to make decisions and justify conclusions)

NCTM Standards

- Understand histograms, parallel box plots, and scatterplots and use them to display data
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others
- Apply and adapt a variety of appropriate strategies to solve problems
- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems.

Materials/Resources

- Classroom set of graphing calculators
- Accompanying handouts
- Computer and Internet access with Microsoft Office Suite software installed

Assumption of Prior Knowledge

- It is assumed students have some prior knowledge of basic Microsoft office software, graphs and their construction; as well as the ability to determine what type is appropriate in various scenarios.
- A student should be able to correctly analyze trends in data and departures from those trends.
- Despite their prior experiences, students may still struggle with the decision making process of this activity and must be encouraged to take a position, ready to defend. The discussion of measures of central tendency, box and whisker plots, and histograms should have been explored prior to this lesson

Introduction: Setting Up the Mathematical Task

- In this lesson, you will analyze various types of graphs based on real-world data and advise consumers as to the best choice of vehicle from various categories. Ultimately the class will decide which is the best overall selection.
- It should take approximately 3-4 45-minute periods or 2 80-minute blocks.
    - Presentations - 10 minutes each group
    - Discussion within groups - 15 minutes
    - Create commercial - 60 minutes
- Begin lesson by reflecting on the previous 4 lessons, taking care to allow each group to make a statement regarding their vehicle of choice. Then pose the question- “what if you were required to purchase only one of these vehicles and only had the data collected from this Unit? What questions might you have? What would be the most important aspect to you and why?
- Allow groups to reconvene and discuss these concerns. Present the handout, “Let’s Make a Deal”, to students as they are working. Have them complete the page and present to class. The instructor should monitor student progress and field questions as they arise.
- Students will make their mathematical thinking and understanding public, by creating a 3 to 5 minute commercial “selling” their ideal selection, using some source of internet based multimedia. They must include the graphs and research to back up their position. From the commercials, the class will vote on the most convincing group presentation.

Student Exploration 1:

1. Each group will present their findings, which should include visual examples of vehicles as well as all graphs and statistics from the previous lessons.
2. Following all presentations, groups will reconvene to consider which vehicle would be the best choice for purchasing based on the data presented by all groups.
3. Students will complete "Let's Make a Deal" handout.
4. Once the group has made a decision on which vehicle to purchase, the group will create a 3-5 minute commercial that "sells" their ideal selection.

Student/Teacher Actions:

- Students should be working in groups to complete the "Let's Make A Deal" handout which helps them organize the results from the 4 preceding lessons and justify their selections. Then, after a class discussion, each group will create a commercial selling their particular vehicle over the others in 3 to 5 minutes, using an internet based multimedia.
- Teachers are fielding questions and probing for higher levels of analysis in regards to charts and graphs being used.
- Possible questions that may arise might include assistance with technical equipment and/or mathematical computation.

Extensions and Connections (for all students)

- One way to extend this lesson is to have students think about important issues to their community, have them create surveys to distribute and compile data to analyze then educate via multimedia. This lesson would have connections to sampling and data analysis objectives in the statistics and AP Statistics course curriculum.

Strategies for Differentiation

- The idea of converting mathematical analysis of data into a 3 to 5 minute commercial will appeal to kinesthetic, auditory, or visual learners
- Writing down the findings and thoughts into the "Let's Make a Deal" handout will assist students with processing, memory, motor issues;
- English language learners (ELLs) are better supported through the use of graphs.
- The task of creating a commercial to sell your vehicle promotes a sense of competition which often is a characteristic of high-ability students.

"Let's Make A Deal"

Now that you have completed all the background research for making an intelligent decision on your car purchase, it's time to make a deal. Organize your thoughts in the chart below next to the category you were assigned. Then complete the other boxes as you listen to presentations. Finally, rank the effectiveness of each group in order, with "1", being the best overall choice. Be ready to defend your selection.

Best Vehicle (Make/Model)	**Insurance**	**Mileage and Maintenance**	**Safety and Durability**	**Rank**
sedan				
truck				
van				
SUV				
hybrid				

Notes:

_____

_____

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Final Assessment

1. From the data presented, pick one vehicle to purchase:

2. Give a detailed explanation as to why you chose this vehicle. Please use specific details from the data presented to support your decision.

Rubric:

4 - student gave a detailed explanation using 5 or more specific details from the data

3 - student gave an explanation using 3-4 specific details from the data

2 - student gave an explanation using 1-2 specific details from the data

1 - student gave an explanation but no specific details from the data

0 - student gave no explanation

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