Danger! – An analysis of the death toll of natural disasters.

I. UNIT OVERVIEW & PURPOSE

The student will represent data for the death toll of lightning, hurricanes, tornadoes, and floods to determine if there is a "most dangerous" natural disaster in terms of human life. The student will analyze graphical displays of the data including dot plots, stem plots, and histograms, to identify and describe patterns and departures from patterns using central tendency and spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical displays. The students will argue the importance of warning systems and education about natural disasters. In lesson one, students will investigate the total fatalities for each natural disaster during the years 1940-2009. Groups will analyze the data and decide which graphical representation would best represent their data and present their findings to the class. On day 2, groups will be redesigned to include at least one member from each natural disaster from the day before. Students will determine which graphical representation is best to compare data sets. Students will use technology to present graphical comparisons. On day 3, students will discuss the results to determine if there is a most dangerous storm. Students will use the curve of best fit, if a correlation exists, and use the equation of best fit to make predictions on the data. Students will generate possible explanations for patterns in the data and generate ideas for how to decrease the death toll for natural disasters. Students will also discuss if there is any way to predict the death toll for upcoming years.

II. UNIT AUTHOR:

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III. COURSE:

Mathematical Modeling: Capstone Course

IV. CONTENT STRAND:

Data Analysis and Probability

V. OBJECTIVES:

- The student will create graphical displays of univariate data including, dot plots, stem plots, and histograms
- The student will identify and describe patterns and departures from patterns using central tendency and spread, clusters, gaps, and outliers.
- The student will use excel and power point to organize and present data.

- The student will compare distributions of two or more univariate data sets, analyzing center and spread (within group and between group variations), clusters and gaps, shapes, outliers, or other unusual features.

- The student will determine the equation of the curve of best fit, if it exists, and make predictions on data sets using mathematical models.

VI. MATHEMATICS PERFORMANCE EXPECTATION(s):

MPE.19 - The student will analyze graphical displays of univariate data including, dot plots, stem plots, and histograms, to identify and describe patterns and departures from patterns using central tendency and spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical displays.

VII. CONTENT:

The student will investigate the death tolls of natural disasters. Those disasters will include lightning strikes, tornadoes, hurricanes, and flooding. Mathematics will be used to discuss patterns in the data. Through mathematics, the students will see the importance of education, early warning systems, and good decision making.

VIII. REFERENCE/RESOURCE MATERIALS:

Microsoft Excel
Microsoft Power Point
Instruction for Histograms in Excel http://www.youtube.com/watch?v=_gQUcRwDiik
Instruction for Boxplots in Excel
http://zorak.monmouth.edu/~dwacha/Excel&BoxPlots.pdf
Instructions for Scatterplot http://www.youtube.com/watch?v=lxmDCL2oIhY
Death toll information - http://www.weather.gov/om/hazstats/images/70-years.pdf

IX. PRIMARY ASSESSMENT STRATEGIES:

Assessments will be student creations in Microsoft Excel and PowerPoint. Students will also be graded through participation in discussion.

X. EVALUATION CRITERIA:

See attached Rubric

XI. INSTRUCTIONAL TIME:

Three class periods on 90 minute block scheduling.

Lesson 1 Exploring Data using Box plots, Histograms, and Dotplots

Strand
Data Analysis and Probability

Mathematical Objective(s)

- The student will create graphical displays of univariate data including, dot plots, stem plots, and histograms
- The student will identify and describe patterns and departures from patterns using central tendency and spread, clusters, gaps, and outliers when looking at data of the death toll from natural disasters

.

- The student will use excel and power point to organize and present data.

Mathematics Performance Expectation(s)
MPE.19 - The student will analyze graphical displays of univariate data including, dot plots, stem plots, and histograms, to identify and describe patterns and departures from patterns using central tendency and spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical displays.

Related SOL

A.10 (Adaptable) The student will compare and contrast multiple univariate data sets, using box-and-whisker plots.

PS.1 The student will analyze graphical displays of univariate data, including dot plots, stem plots,
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.

PS.2 The student will analyze numerical characteristics of univariate data sets to describe patterns
and departures from patterns, using mean, median, mode, variance, standard deviation, interquartile range, range, and outliers.

NCTM Standards List all applicable NCTM standards related to each lesson.

- understand histograms, parallel box plots, and scatter plots 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;
- Solve problems that arise in mathematics and in other contexts
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics
- Create and use representations to organize, record, and communicate mathematical ideas
- Use representations to model and interpret physical, social, and mathematical phenomena

Materials/Resources
Internet Access
http://www.weather.gov/om/hazstats/images/70-years.pdf

Instruction for Histograms in Excel http://www.youtube.com/watch?v=_gQUcRwDiik

Instruction for Boxplots in Excel http://zorak.monmouth.edu/~dwacha/Excel&BoxPlots.pdf

Instructions for Scatterplot http://www.youtube.com/watch?v=lxmDCL2oIhY

Laptops

Microsoft Excel

Microsoft Power Point

Worksheet 1

Rubric

Assumption of Prior Knowledge

Students should already know how to calculate measures of center and spread. Students should have already discussed gaps, clusters, and outliers and well as calculated fences for outliers. Students should have a background in working with data in Excel as well as skills in presenting with Power Point. Students should be able to discuss which measures of center would be the best representation of the given data. Students should be familiar with the types of natural disasters listed and have a general knowledge of their characteristics.

Introduction: Setting Up the Mathematical Task

In this lesson, you will investigate the death toll of 4 natural disasters, lightning, tornadoes, hurricanes, and floods. You will work individually and in teams to try to determine the most

dangerous natural disaster in terms of human life. Over the next 3 days we will use mathematics to determine which disaster has claimed the most lives over the period from 1940 to 2009. Which disaster do you feel would claim the most human life? Why?

Today's activity will look at multiple years to see if our conclusion holds true. Using Excel, you will work in groups to display the data from 1940 to 2009 in a box plot, dot plot, and histogram. You will analyze the data for measures of center and spread and discuss gaps, clusters and outliers. You will then choose the best graphical display to present your data to the class through power point. Discuss certain patterns or lack of patterns that you notice.

Student Exploration 1:

Use your favorite search engine to find information on the number of lives lost in the year 1955. Row one – Lightning, Row two – Tornado, Row Three – Hurricane, Row Four – Flood. Share with your group what you found. One spokesperson from each group will then share what they found. We will then discuss which natural disaster seems the most dangerous from our research.

The teacher will keep conversations going by asking specific students questions about the nature of each natural disaster. What are specific characteristics that make the weather phenomenon threatening? Does it make sense to you that the data is the way it seems for 1955? Does the data surprise you? Why do you think the result would have claimed more lives than the rest? Do you think we can make a conclusion based on the data we found for 1955? Why or why not?

Monitoring Student Responses

The teacher will be the facilitator of the discussion. Ask for volunteers first and then try to call on students who seem disengaged to offer opinions on the subject. Students should discuss the fact that one year is not enough data to draw any conclusions. We need to look at multiple years to get a true understanding of the effect these natural disasters have on human life.

Student Exploration 2:

Students will then be provided with the data for their row from 1940 to 2009 - http://www.weather.gov/om/hazstats/images/70-years.pdf Each group should only get the information for their particular disaster. The group will work together to complete the worksheet to find measures of center and spread. The group will then use excel to represent the data as a graphical display. One member will make the dot plot, one member will make a box plot, and the third member will make the box and whisker plot. Groups will then analyze all three graphs to discuss which measures of center represent the overall data most accurately. They will also discuss patterns they see in the data or lack thereof. Does the data contain clusters or gaps? What are the outliers, if any? After discussions, group members will discuss which graph is the best representation for the data and begin to prepare their presentation of findings. If you choose more than one graph to make your presentation, please explain why you feel you needed both or all. Each group will share their findings in a power point presentation.

Monitoring Student Responses
The teacher will circulate throughout the room to monitor student calculations and discussions. Guide students in correcting mistakes in calculations or provide questioning to guide students in their thought process.

Assessment

- First segment of the rubric attached to the end of this unit.
- Journal Entry (to be included with the worksheet) – What has mathematics helped you to learn about the natural disaster upon which you focused? Are there any interesting patterns that you discovered from the graphical displays? Do you feel that your disaster could be the most dangerous storm? Why or why not?

Extensions and Connections (for all students)

- Possible extensions may be to Earth Science. Students could investigate the causes of natural disasters.

Strategies for Differentiation

- For ELL learners, teachers should work with the ELL teacher to provide bridges between mathematics vocabulary and the student's primary language.
- Learning disabled students may benefit from teacher provided step by step instructions on how to use excel or PowerPoint.
- Visual learners will benefit from the graphical representations and the ability to be creative in power point.
- Auditory learners will benefit from the classroom and group discussions.
- High ability students may start to begin to compare groups for similarities or differences and offer opinions to lead into tomorrow's lessons.

Student Learning Styles

The lesson provides structured guidance and well defined outcomes. It provides for student exploration and analysis. It provides students the opportunity to ask questions and come up with conclusions. It allows students to contribute their feelings about the topic and why it's important to them. It also allows students to be creative.

Lesson 2 Comparing Data

Strand
Data Analysis and Probability

Mathematical Objective(s)

- The student will compare distributions of two or more univariate data sets, analyzing center and spread (within group and between group variations), clusters and gaps, shapes, outliers, or other unusual features.

- The student will use excel and power point to organize and present data.

Mathematics Performance Expectation(s)
MPE.19 - The student will analyze graphical displays of univariate data including, dot plots, stem plots, and histograms, to identify and describe patterns and departures from patterns using central tendency and spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical displays.

Related SOL

A.10 (Adaptable) The student will compare and contrast multiple univariate data sets, using box-and-whisker plots.

PS.1 The student will analyze graphical displays of univariate data, including dot plots, stem plots,
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.

PS.2 The student will analyze numerical characteristics of univariate data sets to describe patterns
and departures from patterns, using mean, median, mode, variance, standard deviation, interquartile range, range, and outliers.

NCTM Standards List all applicable NCTM standards related to each lesson.

- understand histograms, parallel box plots, and scatter plots 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;
- Solve problems that arise in mathematics and in other contexts
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics
- Create and use representations to organize, record, and communicate mathematical ideas
- Use representations to model and interpret physical, social, and mathematical phenomena

Materials/Resources
Laptops

Microsoft Excel

Microsoft Power Point

Worksheet 2

Rubric

Assumption of Prior Knowledge

Students should be familiar with the data they collected the day before and the conclusions they came to about their natural disaster. Students should have skills in presenting with Power Point. Students should be able to discuss which measures of center would be the best representation of the given data. Students should be familiar with the types of natural disasters listed and have a general knowledge of their characteristics.

Introduction: Setting Up the Mathematical Task

Students will begin by summarizing their work from the day before in their groups. Each students will come to the board and write one or a few key words that expresses what mathematics taught them about their particular natural disaster. After the list is complete, ask students how we determine which disaster is the most dangerous. Comparisons must be made before we can reach this decision.

Student Exploration 1:

Students will be regrouped so that each natural disaster is represented in the new groups. Students will compare the graphs they made yesterday to find similarities and differences in the data. Students will complete worksheet 2 for guidance in discussion. Students will begin to discuss why they think the patterns are occurring. Choose one member from each group (kinesthetic learner) to visit other groups to gather ideas. Choose which graphs show comparisons better and prepare a power point page that shows the comparisons the best. Make sure to discuss measures of center and spread in your comparisons and what that tells you about the data.

Monitoring Student Responses

The teacher will circulate to make sure students are responding to the questions. The teacher may ask simple questions to keep conversation going but try not to give students any ideas on answers to the questions. Look for key topics such as comparing on the same scale and make sure students are moving in the correct direction.

Assessment

- Groups will present their findings. Continue to complete middle part of the rubric.
- Journal Entry (to be included with the worksheet) – What have you learned over the last few days that is important to you. How has math played a key role in providing that information?

Extensions and Connections (for all students)

- Possible extensions may be for students to explore warning systems that are already in place for natural disasters and careers that involve weather.

Strategies for Differentiation

- For ELL learners, teachers should work with the ELL teacher to provide bridges between mathematics vocabulary and the student's primary language.
- Learning disabled students may benefit from teacher provided step by step instructions on how to PowerPoint.
- Visual learners will benefit from the graphical representations and the ability to be creative in power point.
- Auditory learners will benefit from the classroom and group discussions.
- Kinesthetic learners will benefit from movement from group to group to gather ideas.
- High ability students may investigate careers that involve studying and preparing for natural disasters.

Student Learning Styles

The lesson provides structured guidance and well defined outcomes. It provides for student exploration and analysis. It provides students the opportunity to ask questions and come up with conclusions. It allows students to contribute their feelings about the topic and why it's important to them. It also allows students to be creative.

Lesson 3 Investigating Relationships and Making Predictions on Data

Strand
Data Analysis and Probability

Mathematical Objective(s)

- The student will determine the equation of the curve of best fit, if it exists, and make predictions on data sets using mathematical models.

Mathematics Performance Expectation(s)
MPE.19 - The student will analyze graphical displays of univariate data including, dot plots, stem plots, and histograms, to identify and describe patterns and departures from patterns using central tendency and spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical displays.

MPE.2 – The student will collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real world problems, using mathematical models.

Related SOL

A.11 The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve real-world problems, using mathematical models. Mathematical models will include linear and quadratic functions.

AFDA.3 The student will collect data and generate an equation for the curve (linear, quadratic, exponential, and logarithmic) of best fit to model real-world problems or applications. Students will use the best fit equation to interpolate function values, make decisions, and justify conclusions with algebraic and/or graphical models.

AII.9 The student will collect and analyze data, determine the equation of the curve of best fit, make
predictions, and solve real-world problems, using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.

PS.3 The student will compare distributions of two or more univariate data sets, analyzing center and
spread (within group and between group variations), clusters and gaps, shapes, outliers, or other unusual

PS.4 The student will analyze scatterplots to identify and describe the relationship between two variables, using shape; strength of relationship; clusters; positive, negative, or no

association; outliers; and influential points. Appropriate technology will be used to generate scatterplots and identify outliers and influential points.

NCTM Standards List all applicable NCTM standards related to each lesson.

- understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable;
- for bivariate measurement data, be able to display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools;
- Solve problems that arise in mathematics and in other contexts
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics
- Create and use representations to organize, record, and communicate mathematical ideas
- Use representations to model and interpret physical, social, and mathematical phenomena

Materials/Resources

Laptops

Microsoft Power Point

Worksheet 3

Rubric

Assumption of Prior Knowledge

Students should be able to classify a function as linear, quadratic, exponential, polynomial or logarithmic. Given a set of bivariate data, the student should be able to determine the type of correlation, if any, and find the equation for the curve of best fit. The students should be able to use the equation for the curve of best fit to make predictions on the data set.

Introduction: Setting Up the Mathematical Task

The teacher will choose one presentation from the day before to display on the board. Students should then complete worksheet number 3 individually. When students have completed the worksheet, break them into different groups than the previous 2 days and have them share their answers to the questions. At this point, they may add information to their worksheet. The worksheet will ask them to choose a most dangerous natural disaster in terms of human life and ask them to analyze the reasons why. It will also ask questions about the

change in data for individual disasters and ask them to generate ideas in how to save lives. Is there any way to predict future data?

Student Exploration 1:

Students will join their original group to see if there is a correlation between the year and the number of deaths for their original natural disaster. If so, what type of correlation and what is the equation of the line of best fit. If no correlation, what does that say about the data? If possible, predict the number of deaths that would have occurred in the year 2010. How about 2020? Is there any way we can change this? (Bottom Part of Worksheet 3)

Monitoring Student Responses

The teacher will circulate to make sure students are responding to the questions. The teacher may ask simple questions to keep conversation going. Ideally two important topics should come out in group discussions, education and warning systems. Try to guide students in that direction if they are not discussing this on their own.

Assessment

- Students will present findings on power point. If not, just discuss orally.
- Journal Entry (to be included with the worksheet) – How has mathematics made you more aware of natural disasters? Have you learned anything that you feel is important to you that has nothing to do with mathematics? What have you learned and why is it important to you?
- Comparison graphs in Power point.

Extensions and Connections (for all students)

- Possible extensions may be for students to explore the years for which outliers exist and find out reasons why there were so many more deaths in those years or so many fewer deaths.

Strategies for Differentiation

- For ELL learners, teachers should work with the ELL teacher to provide bridges between mathematics vocabulary and the student's primary language.
- Learning disabled students may benefit from teacher provided step by step instructions on how to do PowerPoint.
- Visual learners will benefit from the graphical representations and the ability to be creative in power point.
- Auditory learners will benefit from the classroom and group discussions..
- High ability students may start to begin to explore warning systems already in place for each natural disaster.

Student Learning Styles

The lesson provides structured guidance and well defined outcomes. It provides for student exploration and analysis. It provides students the opportunity to ask questions and come up with conclusions. It allows students to contribute their feelings about the topic and why it's important to them. It also allows students to be creative.

Worksheet 1 – (Make separate copies with only ONE natural disaster actually listed for each group)

Over the next 3 days, you will investigate the death toll of the natural disasters LIGHTNING, TORNADOS, HURRICANES, FLOODS.

Which disaster do you feel would claim the most human life? Why?

_____
_____

Individual Work:

Use the web browser of your choice to investigate the death toll of LIGHTNING, TORNADOS, HURRICANES, FLOODS in the year 1955.

How many lives were lost due to this type of natural disaster? _____

Class Discussion:

What are the totals for each disaster for 1955?

Lightning _____ Tornados _____ Hurricanes _____ Floods _____

Which natural disaster seems to be the most deadly? _____

Are you comfortable with making this determination from the data presented here? Why or why not?

_____
_____

Group work:

Use the handout (only give each group the list with their data) to analyze the data. Using Excel, you will work in groups to display the data from 1940 to 2009 in a box plot, dot plot, and histogram. You may choose within your groups which members will do which graphs. Find all measures of center and spread including the 5-number summary. Include all measures that we have discussed in class.

Discuss any patterns you see in the data. Discuss any gaps, clusters, and/or outliers and record important points below.

Choose the best graphical display to present your data to the class through power point. If you choose more than one graph, please explain why?

Journal Entry to be turned in: What has mathematics helped you to learn about the natural disaster upon which you focused? Are there any interesting patterns that you discovered from the graphical displays? Do you feel that your disaster could be the most dangerous storm? Why or why not?

Extension: Use the internet to research environmental factors that cause this natural disaster.

Worksheet 2

In your group, please come up with a bulleted list of the important points from yesterday's work. Have one person from your group come up to the board to share your information with the rest of the class.

How do we determine which natural disaster is the most dangerous in terms of human life?

NEW Groups:

You will create 3 power point slides. One member of the group will compare all box plots from yesterday in one slide. The second member will compare all histograms in one slide. The third member will compare all dot plots in one slide. The fourth member will travel from group to group to help answer the following questions.

What are some similarities between the four sets of data?

What are some differences between the four sets of data?

Make note of any characteristics of the data that are unique to……..

Lightning

Tornados

Hurricanes

Floods

What did you use to compare the data sets?

Journal Entry: What have you learned over the last few days that is important to you. How has math played a key role in providing that information?

Extension: Use the internet to research possible careers that would study weather phenomenon.

Worksheet 3

After hearing the presentations from yesterday, which natural disaster would you rule the most deadly?

_____

Would you have had a different opinion if you just looked at the year 1940? If so, why?

_____

Is there a way we could look at the data to see how it has changed through the years?

_____

Bivariate Data

Each group has been assigned one natural disaster. Enter the data into your graphing calculator to determine if there is a correlation between the year and the number of deaths. If so, what type? What does this lead you to believe about the numbers of deaths in future years?

_____

Predict the number of deaths that would have occurred in the year 2010. _____

Use the internet to find out if your prediction was close to the actual number of deaths in 2010. Describe your findings below.

Elaborate on reasons that you feel have contributed to the overall correlation in your data. Why do you think the deaths have increased or decreased over the years?

Are there any ideas that you have that may help to save lives?

Journal Entry: How has mathematics made you more aware of natural disasters? Have you learned anything that you feel is important to you that has nothing to do with mathematics? What have you learned and why is it important to you?

Danger! – Scoring Rubric

Objective	3	2	1	0	Total
1. The student will create graphical displays of univariate data including, dotplots, stemplots, and histograms. (Lesson 1)	Correctly displays data in all 3 graphical representations.	Correctly displays data in exactly 2 graphical representations.	Correctly displays data in exactly 1 graphical representation.	Incorrectly displays data in all 3 graphical representations.	
2. The student will identify and describe patterns and departures from patterns using central tendency and spread, clusters, gaps, and outliers. (Lesson 1)	Data is interpreted and explained correctly.	Data is interpreted and explained correctly with no more than 2 mistakes.	Data is interpreted and explained correctly with no more than 5 mistakes.	Central tendencies and spread values are incorrectly calculated. There is no mention of clusters, gaps and outliers.	
3. The student will use excel and power point to organize and present data.(Lesson 1).	The chosen graph is correctly displayed in power point.	The chosen graph is displayed in power point with no more than 2 mistakes.	The chosen graph is displayed in power point with no more than 5 mistakes.	The graph is incorrect in all aspects.	
4. The student will compare distributions of two or more univariate data sets, analyzing center and spread (within group and between group variations), clusters and gaps, shapes, outliers, or other unusual features. (Lesson 2)	The student correctly displays their chosen graph and appropriately compares measures of center and spread OR The student provides ample information collected from each group about comparisons of the data.	The student displays the graphs correctly, measures are recorded correctly, but are incorrectly compared in the presentation OR ample information is collected but not from every group.	The student displays graphs correctly but with incorrect measures OR The student has the correct measures but graphs are displayed incorrectly OR information collected from groups is minimal.	Student graphs are incorrectly displayed and measures of center and spread are incorrect OR the student does not gather information from other groups about their comparisons.	
5. The student will participate in group discussions. (Lesson 2)	The student participates in group discussions on comparing data sets as well as the group presentation of the data.	The student participates in group discussions on comparing data but has a minimal role in the presentation.	The student has minimal participation in group discussions and has a minimal role in the presentation.	The student does not participate in the comparison discussions or the presentation.	

6. The student will determine the equation of the curve of best fit, if it exists, and make predictions on data sets using mathematical models. (Lesson 3)	The student correctly identifies a correlation, calculates the equation for the curve of best fit and uses it to correctly make predictions on the data.	The student correctly identifies a correlation, calculates the equation for the curve of best fit but make an inaccurate prediction on the data.	The student correctly identifies a correlation, but incorrectly calculates the equation for the curve of best fit, which leads to an inaccurate prediction.	The student incorrectly identifies a correlation between data sets.	
7. The student will express mathematical thinking and learned material through daily journals. (All lessons)	The student submits 3 journals complete with personal learning experiences.	The student submits 2 journals complete with personal learning experiences.	The student submits 1 journal complete with personal learning experiences.	The student submits no journals.	