Means, Modes and Medians

Subject Area(s)	Data analysis & probability
Associated Unit	None
Associated Lesson	None
Activity Title	Means, Modes and Medians
Header	Insert Image 1 here, right justified to wrap

Image 1

ADA Description: An ultrasonic NXT sensor measuring the distance to the white platform

Caption: none

Image file name: spring_mass_setup.jpg

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Grade Level	7 (6-9)
Activity Dependency	None
Time Required	45 min
Group Size	4
Expendable Cost per Group	US$ 0

Summary

During this activity students will collect the data of the spring deflection using LEGO equipment. They will use their measurements to calculate the mean, median, mode, range, percent difference and learn how to represent their data in excel.

Engineering Connection

One of the preliminary skills in science and engineering fields is the data acquisition and analysis. At some point in their project most engineers and scientists need to collect data and understand the accuracy of gathered data and the experimental set up. By understanding statistical properties and the quality of data measurements the experimenter can decide if the device and experiments need adjustments and if the data confirms theoretical predictions. This lesson provides

Engineering Category

Category 1: Relates science concept to engineering,

Category 2: Relates math concept to engineering.

Keywords

Data analysis, average, mean, median, mode, range, Lego Mindstorms NXT, RobotC spring constant, force

Educational Standards

NY, math, 2005, A.CN.7 Recognize and apply mathematical ideas to problem situations that develop outside of mathematics
NY, math, 2005, A.R.1 Use physical objects, diagrams, charts, tables, graphs, symbols, equations, or objects created using technology as representations of mathematical concepts
NY, math, 2005, A.S.1 Categorize data as qualitative or quantitative
NY, math, 2005, A.S.4 Compare and contrast the appropriateness of different measures of central tendency for a given data set

Pre-Requisite Knowledge

A basic understanding of spring-mass system, data collection, data analysis and excel plotting

Learning Objectives

After this activity, students should be able to:

- Differentiate between mean, median, and mode.
- Collect data from an oscillating object
- Estimate the mean, median, mode and range, percent difference of the measurements
- Present the data using Excel software

Materials List

Each group needs:

- LEGO Mindstorms Education NXT Base set (www.legoeducation.com)
- LEGO ultrasonic and touch sensors
- Computer (PC or MAC), RobotC or LEGO Mindstorms software
- Spiral spring or bungee cord
- Weight
- Clamp-stand
- Cardboard platform

Introduction / Motivation

If you were a teacher - how would you fairly give a grade to your students? In general teachers use the arithmetic average to evaluate students' overall grade; however, what if I told you that there is a different way to evaluate the grades. Let's recall what are the mean, median and mode quantities. The mean or the arithmetic average of exam grades received over the semester is the summation of all of the grades divided by the number of exams taken. In other words, the mean of the set of values is the summation of values divided by the number of values. The median of the exam grades is the obtained by organizing all the grades in ascending or descending order and denoting the middle number as the median grade. The method

of evaluation of median of the grades depends on number of exams that you've taken. The mode grade can be obtained by finding the most frequently received grade. In addition, out of the curiosity, one can find the gap between the lowest and highest grades over entire semester. Now, what if I told you that these same quantities, mean, median, mode and range are frequently being used not only by teachers but also by scientists, engineers and all the professions that are out there. These quantities that I just listed are the statistical measures for sets of data. Scientists use them to analyze, present their data to others and sometimes even predict how the data will behave in the future. For example, let's look at a very simple spring-mass experiment. When we take a bungee cord and hang it high enough from the floor – we will record an equilibrium distance of the bungee cord. When we hang the mass on a bungee cord, we expect that the mass will oscillate due to the elastic property of a bungee. After some time the mass will stop oscillating and will be stretching the spring from its equilibrium position. Now, can you determine the mean, median, mode distance of the mass in respect to the equilibrium position from the time it was put in motion to the time it came to rest? What is the range of values the distance can take? You can predict it just by observing the motion of the spring-mass or you could measure and calculate it using sensors. And that is what we are about to do.

(Show the students the oscillating motion of the spring under the mass and with different springs. Ask students how the motion changes when we change the springs and what they predict the motion to be when the spring is changed to more elastic or stiffer one. Ask or explain what the equilibrium position of the spring is and where the minimum/maximum of the mass displacement can be. Ask what they observe the mean, median, mode to be.)

Vocabulary / Definitions

Word	Definition
Mean	An arithmetic average of the set of data
Median	The middle value of the ordered set of data
Mode	The most frequent value in the set of data
Range	The difference between and lowest and highest value in the data set.
Spring	An device, such as a coil of wire, that regains its original shape after being compressed or extended

Procedure

Background

A teacher needs to make sure that the students understand the mathematical calculations of the range, mean, mode and median prior to the activity. They need to know the formulas or the methods of finding these quantities.

Before the Activity

- Set up the clamp-stand, spring – mass set-up and LEGO equipment for each team.
- Make sure that the device is working and is connected to the computer for data collection

With the Students

1. Explain the set up of the experiment and the objective of collecting data.
2. Explain how to properly and safely attach the mass to the spring.
3. Show how the students can obtain the data from the NXT Mindstorms or RobotC software.
4. Distribute the worksheet among the students and go over what is the expected of them to finish by the end of the activity.

Image 2

ADA Description: Students from Bedford Academy High School collecting statistical data

Caption: None

Image file name: MMM_BAHS.jpg

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Attachments

MMM_Preevaluation.docx

MMM_Postevaluation.docx

MMM_Worksheet.docx

Safety Issues

The weight should be tightly attached to the bungee cord or a spiral spring to prevent its crashing on the floor during oscillations.

Troubleshooting Tips

Collect the data using Lego set up. Run several trials and check collected data for outliers due to sensor measurements to the floor instead of cardboard platform.

Investigating Questions

What aspect of oscillation does mean, median and mode quantities describe?
What is an underdamped oscillator? Give an example.
Why is statistical analysis important in engineering?

Assessment

Pre-Activity Assessment

Brainstorming: Involve students to work in teams of 4 to discuss where they have encountered mean, median, mode, range quantities. Ask them to discuss where the springs and masses can be used or where they have seen them being used. In addition see MMM_Preevaluation.docx

Activity Embedded Assessment

Analysis: Let students do exercise on the worksheet and fill out the data collection and calculation. See MMM_Worksheet.docx

Post-Activity Assessment

See MMM_Postevaluation.docx

Activity Extensions
None

Activity Scaling
- For younger students
- For upper grades

Additional Multimedia Support
None

References
http://www.thefreedictionary.com/

Redirect URL
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