Internet of Things (IoT) at UCF

UNIVERSITY OF CENTRAL FLORIDA

UCF RET Site: Collaborative Multidisciplinary Engineering Design Experiences for Teachers

AP Statistics (#1210320)

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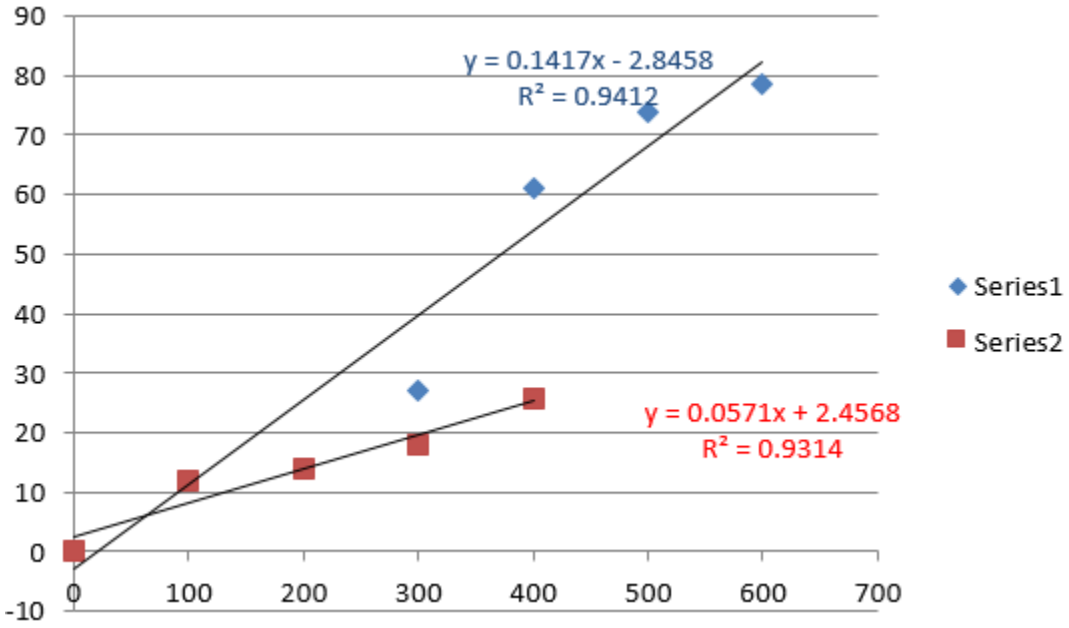
In today's world computing devices are continually designed with the capability to interconnect with each other to send and receive information. This is referred to as the Internet of Things (IoT) and it is a growing field of research and development in private industry and academia. The COMET program at the University of Central Florida program is particularly interested in how IoT devices are utilized in the field of environmental sensors.

The purpose of the AP Statistics course is to make students fluent in the process of collecting and analyzing data and drawing relevant conclusions from said data. The process of calibrating and using environmental sensors requires the use of linear regression and correlation analysis. During the program I, and my group of teachers, created the following calibration scatterplot with accompanying least squares regression lines of the concentration of lead in parts per billion (x-axis) with the current measured through the sensor in µA (y-axis).



From these regression equations, we could then use our sensors in the field and determine the concentration of the target chemical in our samples. The goal for my students is to do just that. Using the procedures described below students will create their own regression equations and then use their calibrated sensors to detect a target chemical. Due to the limitations of equipment available at the middle and high school level, the research activity has been modified in this lesson to use pH sensors with acidic and basic solutions.

RET Site: CoMET Lesson/Unit Plan

Course(s): AP Statistics 1210320
Grade Level: High School
Suggested Length of Lesson: 3 Days

Materials/Technology Needed
- **pH Sensors**
- **Beakers**
- **Pipettes**
- **Chemical Solutions (one acidic and one basic)**
- **Data software (Excel or graphing calculator)**

Where this Fits
- This lesson is used to augment the unit on exploring bivariate data and to provide real-world example of the applications of linear regression and correlation

Lesson Objective(s)/Learning Goal(s)
- Students will be able to collect data on the calibration process of an environmental sensor
- Students will create regression equations and calculate linear correlation based on collected data
- Students will then use their equations to measure concentration values in a field setting

Standard(s)/Benchmark(s) Addressed
- *Standards:*
  - *Correlation*
  - *Linear Regression*
  - *Slope*
  - *Scatterplots*

Standards for Mathematical Practice
- AP Statistics does not have standards listed on CPALMS, however a course description can be found at: https://apcentral.collegeboard.org/

Instructional Strategies
- Cooperative Learning
- Inquiry Based Learning
- Field Experience
- Hands-on Learning
- Project Based Learning
- Modeling

Evidence of Learning (Assessment Plan)
- **Formal Assessment on Correlation and Linear regression**
- **Readings of concentration of a target chemical in a field setting**

Description of Lesson Activity/Experiences

1. Students begin the lesson with directed reading on calibration of environmental sensors to be read prior to the start of the lesson.
2. Students take a pre-test on environmental sensors, linear regression, and correlation.
3. Students are given a worksheet on important vocabulary they will use.
4. Lab Safety Procedures (partnering with a science teacher in Chemistry or a related field is recommended)
5. Students will be given pH sensors, beakers with solutions, and accompanying lab worksheet
6. Data collection begins and is recorded on lab worksheet
7. Using technology (Excel, Google Sheets, graphing calculators) students will calculate and graph least squares regression line along with correlation coefficient and coefficient of determination
8. Students will then take readings on samples of prepared concentrations (unknown to them) and predict the concentrations based on their models.

List of Materials/Resources Used
- pH Sensors
- Beakers
- Pipettes

- Chemical Solutions (one acidic and one basic)
- Data software (Excel or graphing calculator)

Important Vocabulary

Term	Definition
Correlation	Value, r, measuring the linear strength and interconnectivity between two variables.
Coefficient of Determination	Value, r^2, measuring the variation of the dependent variable predicted by changes in the independent variable
Linear Regression	Method for measuring the linear relationship between an independent and dependent variable
Independent Variable	The variable being manipulated in an experiment
Dependent Variable	The variable responding to the changes in the independent variable
Chemical Sensor	A device that detects or measures the chemical properties of a target chemical
Concentration	The relative abundance of a substance in relationship to its environment
Slope	The variation in the dependent variable for every change in the independent variable
Intercept	The predicted value of the dependent variable when the independent variable is set to 0
Voltage	The potential difference measured in Volts
Current	The flow of an electrical charge measured in Amps
pH	Measure for the presence of hydrogen ion concentration; values close to 0 are acidic, values close to 14 are basic

Attachments

1. Pre-test/Post-test
2. Answer key
3. Lab Worksheet
4. Vocabulary Exercise

References

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