# INITIATE Lesson Plan: *Precision*

***Lesson plan at a glance...***

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| **Name:** | Precision |
| **Course:** | Statistics |
| **Grade Level:** | 11-12 |
| **Prerequisites:** | *Bloxter programming skills* |
| **Time:** | **Preparation: 5 min**<br>**Instruction:** 40min |
| **Standard(s):** | S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. ★<br>a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions, or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.<br>b. Informally assess the fit of a function by discussing residuals.<br>c. Fit a linear function for a scatterplot that suggests a linear association.<br>Interpret linear models.<br>S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.<br>S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. |

***In this lesson plan…***



## Lesson Overview

In this lesson, Students will collect data from inputting a desired distance into the car and measuring the actual driving distance of the car. After making a scatterplot, the students will then come up with the prediction line for what the car actually drives based off of the inputted distance. Students will then use the prediction line to write a program for the car to drive the distance desired.

## Driving Questions

Overarching Driving Questions for Bowsher Wide Project:

- How can we make smart cars safer and more convenient?
- How can we protect them from cyberattacks?

Lesson Specific Question: To make the car safer, can we make the imputed distance to be the same as the actual distance driven after collecting data.

## Materials and Equipment

*Chrome Books*
*Smart Cars*
*Paper*
*Calculators*
*Measuring tapes or large driving paper with 1 in grid*

## Preparation Tasks

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| | • Have several areas cleared for the cars to operate.<br>• The students must check whether their chrome books are working, connected to the smart car, and have sufficient battery life.<br>• To check whether the smart car is working, run it using a single command to make the car move forward for 2 seconds. | *Time 5min* |

## The Lesson

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| **Warm-up Activity:** *Is precision important?* | *Time 5 min* |
| **Activity 1:** *Data Collection* | 10 min |
| **Activity 2:** *Investigation* | 10 min |
| **Activity 3:** *Scatter Plots and Line of Best Fit* | 10 min |
| **Wrap-up Activity:** *Testing the program* | 5 min |

**Warm-up Activity: Is Precision Important?** (5 min)

**Activity Overview:** In this activity, students will…be amazed by the precision of autonomous cars!

**Activity**: https://youtu.be/4CZc3erc_l4 Show this short clip on intersections with smart cars and talk about the importance of precision.

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**Activity 1: Data Collection** (10 min)

**Activity Overview:** In this activity, students will see how precise their car is by collecting data.

**Activity:** Now that students are aware of the importance of being precise, they will test their cars for precision. Students will drive the car for different imputed distances and measure to see what the actual distance driven was. They will put the data into a T table. Depending on the number of cars and students, students should pick different roles, such as programming the car to drive x distance, measuring the actual distance, writing down the actual distance on the chart.

**Teaching Tips:**

- *Print the Chart ahead of time.*

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**Activity 2: Investigation** (10 min)

**Activity Overview:** In this activity, students will try to make their car drive the inputted distance.

**Activity:** Students will explore on their own on how to program the car to drive the inputted distance. I will have all students in the group connect to their car and try to write a program to fix the imprecision. This should lead to several failed attempts as students take turns trying their programs and measuring different distances.

**Teaching Tips:**

- *If someone thinks they have a correct program, try inputting a different distance that is far from the one they checked to see if it truly works since the imprecision is different depending on how far the car is driven.*

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**Activity 3: Scatter Plot and Line of Best Fit** (10 min)

**Activity Overview:** In this activity, students will draw a scatter plot and come up with a line of best fit.

**Activity:** If students are still struggling after 10 minutes, I will suggest that they draw a scatter plot to see if they notice a pattern and see if they can predict the distance driven for any input. Can you then somehow use the predicted distance to adjust the input needed? Let the students then try to program their car using this information.

**Teaching Tips:**

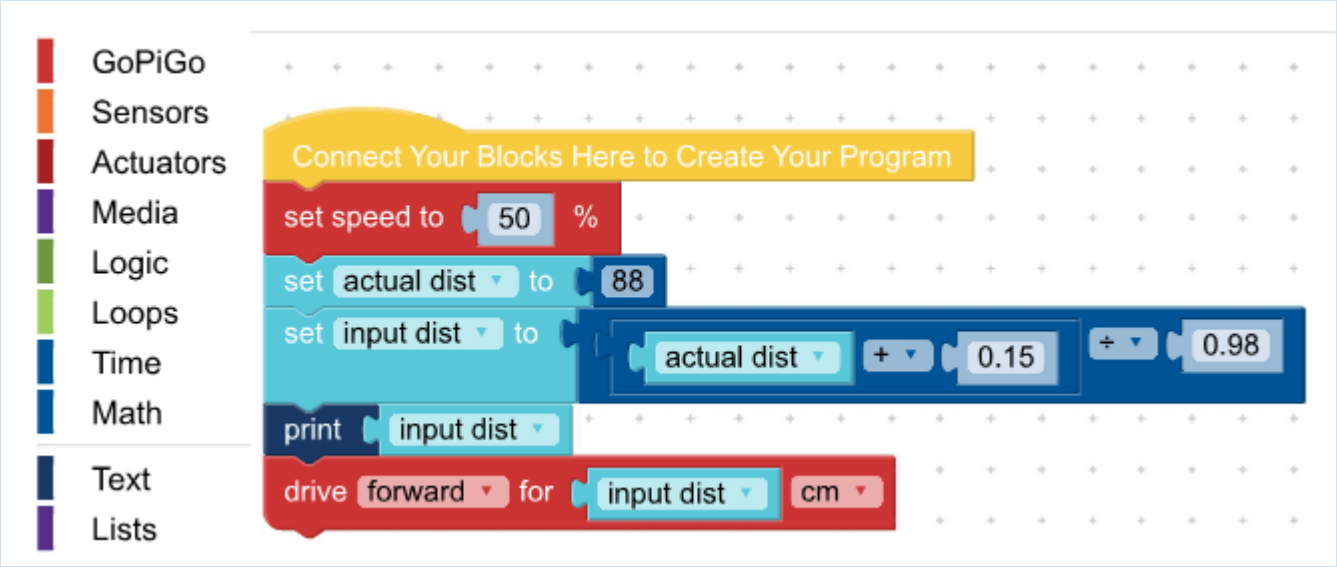
- Provide students adequate time, and assistance if required.

**Wrap-up Activity: Analysis and reflection** (20 minutes)

**Activity Overview:** In this activity, students will correct the cars imprecision.

**Activity:**

1. Demonstrate the car driving the desired distance with different distances. Here is an example of the program I wrote with my data. Each car will need a different equation depending on the precision of their car.




**Assessment:** Did the car drive the desired distance?

## Learning Objectives and Standards

| Learning Objectives | Standards |
|---|---|
| Make a scatter plot and come up with a relationship mathematically. | S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. ★<br>a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions, or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.<br>b. Informally assess the fit of a function by discussing residuals.<br>c. Fit a linear function for a scatterplot that suggests a linear association. |
| Use the relationship found to write a program. | S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.<br>S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. |

## Additional Information and Resources

### Project-based Learning Features

| Feature | Where does this occur in the lesson? |
|---|---|
| ***Driving Question*** | *At the beginning of this lesson. The question was how to make smart cars more convenient and safer. To make it safer, the smart car should be able to navigate precisely. In this lesson plan, the students have learned what mathematical calculations and programing could be done to make a smart car correct for imprecisions.* |
| ***Making Sense of Data*** | *In activities 2 and 3, students are using scatter plots and the line of best fit to figure out the relationship between the inputted distance and the actual distance driven.* |
| ***Investigation and Problem Solving*** | *In activity 2, students will try different ways to program the car to dive the inputted distance. This will take several attempts and investigating what the problem is with what program they tried didn't work*. |
| ***Technology Incorporation*** | *The students are using graphing calculators, Chrome books, StatCrunch (website), and Smart Cars.* |
| ***Collaborative Opportunities*** | *The students are paired up in groups with the limited smart cars. The students will work together to find out why their programs don't work if the cars doesn't do what they wanted.* |
| ***Assessment Techniques*** | *The students get immediate feedback on if the program they designed works by inputting in different distances and seeing if it matches the actual distance driven.* |

### Computational Thinking Concepts

| Concept | Where does this occur in the lesson? |
|---|---|
| ***Pattern Recognition*** | *Students are looking for a pattern in the data they collect to find a mathematical relationship between two variables.* |
| ***Algorithm Design*** | *Programing the car requires the student to come up with step by step instructions.* |

### Administrative Details

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**Sources:**

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**Template adapted from:** https://edu.google.com/resources/programs/exploring-computational-thinking/