

**Regression Models Along the Layers of Communication**

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| **6-12th Grade** |  |
| **Topic:** What Regression model will best fit for the data sent along the line of communication over the network layers? | **Materials:*** 2 COSMOS Toolkits
* Ethernet Cable (wired)
* One toolkit (WiFi access point)
* One toolkit (WiFi client)
* Pencil (colored)
* Rulers
* Clip board
* Post-it Chart Paper
* Markers
* Graph Papers
* Graphing Calculators
* Graphic Organizers
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| **Science & Engineering Practices (SEPs)****Planning and Carrying Out Investigations**Planning and carrying out investigations to answer questions or test solutionsto problems in 6–8 builds on K–5 experiences and progresses to includeinvestigations that use multiple variables and provide evidence to supportexplanations or design solutions. Plan an investigation individually and collaboratively, and in the design:identify independent and dependent variables and controls, what toolsare needed to do the gathering, how measurements will be recorded, andhow many data are needed to support a claim. (MS-PS3-4)**Analyzing and Interpreting Data**Analyzing data in 6–8 builds on K–5 and progresses to extending quantitativeanalysis to investigations, distinguishing between correlation and causation,and basic statistical techniques of data and error analysis.Construct and interpret graphical displays of data to identify linear andnonlinear relationships. (MS-PS3-1)**Constructing Explanations and** **Designing Solutions**Constructing explanations and designing solutions in 6–8 builds on K–5experiences and progresses to include constructing explanations anddesigning solutions supported by multiple sources of evidence consistent withscientific ideas, principles, and theories.Apply scientific ideas or principles to design, construct, and test a designof an object, tool, process or system. (MS-PS3-3) | **Disciplinary Core Ideas (DCIs)****PS3.B: Conservation of Energy and Energy Transfer**When the motion energy of an object changes, thereis inevitably some other change in energy at the sametime. (MS-PS3-5)The amount of energy transfer needed to change thetemperature of a matter sample by a given amountdepends on the nature of the matter, the size of thesample, and the environment. (MS-PS3-4)Energy is spontaneously transferred out of hotterregions or objects and into colder ones. (MS-PS3-3)**PS3.C: Relationship Between Energy and Forces**When two objects interact, each one exerts a force onthe other that can cause energy to be transferred to orfrom the object. (MS-PS3-2)**ETS1.A: Defining and Delimiting an Engineering****Problem**The more precisely a design task’s criteria andconstraints can be defined, the more likely it is thatthe designed solution will be successful. Specificationof constraints includes consideration of scientificprinciples and other relevant knowledge that is likelyto limit possible solutions. (secondary to MS-PS3-3) | **Crosscutting Concepts (CCs)****Scale, Proportion, and Quantity**Proportional relationships (e.g. speedas the ratio of distance traveled totime taken) among different types ofquantities provide information aboutthe magnitude of properties andprocesses. (MS-PS3-1),(MS-PS3-4)**Systems and System Models**Models can be used to representsystems and their interactions – suchas inputs, processes, and outputs –and energy and matter flows withinsystems. (MS-PS3-2)**Energy and Matter**Energy may take different forms(e.g. energy in fields, thermalenergy, energy of motion). (MS-PS3-5)The transfer of energy can betracked as energy flows through adesigned or natural system. (MS-PS3-3) |

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| **Math Common Core Standards:**Represent and analyze quantitative relationships between dependent and independent variables.**6.EE.9** Use variables to represent two quantities in a real-world problem that change in relationship toone another; write an equation to express one quantity, thought of as the dependent variable, interms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.**7.RP.2** Recognize and represent proportional relationships between quantities.a. Decide whether two quantities are in a proportional relationship, e.g., by testing forequivalent ratios in a table or graphing on a coordinate plane and observing whether thegraph is a straight line through the origin.b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams,and verbal descriptions of proportional relationships.c. Represent proportional relationships by equations. For example, if total cost is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.**7.EE.3**Solve multi-step real-life and mathematical problems posed with positive and negative rationalnumbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms asappropriate; and assess the reasonableness of answers using mental computation andestimation strategies.**8.EE.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Comparetwo different proportional relationships represented in different ways. For example, compare adistance-time graph to a distance-time equation to determine which of two moving objects hasgreater speed.**8.EE.6** Use similar triangles to explain why the slope m is the same between any two distinct points on anon-vertical line in the coordinate plane; derive the equation y = mx for a line through the originand the equation y = mx + b for a line intercepting the vertical axis at b.**F-IF.8**Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.**F-IF.9 34**Use the process of factoring and completing the square in a quadratic function to showzeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.Compare properties of two functions each represented in a different way (algebraically,graphically, numerically in tables, or by verbal descriptions). For example, given a graph of onequadratic function and an algebraic expression for another, say which has the larger maximum.**A-REI.6 59** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairsof linear equations in two variables.**F-IF.6 71** Calculate and interpret the average rate of change of a function (presented symbolically or as atable) over a specified interval. Estimate the rate of change from a graph. **Build a function that models a relationship between two quantities****F-BF.1 40**Write a function that describes a relationship between two quantities.1. Determine an explicit expression, a recursive process, or steps for calculation from a context.

**S-ID.6 62**Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. Fit a function to the data; use functions fitted to data to solve problems in the context of thedata. Use given functions or choose a function suggested by the context. Emphasize linear,quadratic, and exponential models.**Interpret functions that arise in applications in terms of the context****F-IF.4 38** For a function that models a relationship between two quantities, interpret key features ofgraphs and tables in terms of the quantities, and sketch graphs showing key features given averbal description of the relationship. Key features include: intercepts; intervals where thefunction is increasing, decreasing, positive, or negative; relative maximums and minimums;symmetries; end behavior; and periodicity. **F-IF.5** Relate the domain of a function to its graph and, where applicable, to the quantitativerelationship it describes. For example, if the function h(n) gives the number of person-hours ittakes to assemble n engines in a factory, then the positive integers would be an appropriate |
| **Essential Question:** What relationship best describes the rate of data upload and download along the different communication lines over the network layers? |
| **Learning Target** | I can observe the data rate when uploading or downloading a message over the different medium of the network layers.I will describe the difference of their speed and the regression model that will best fit the data as I analyze the trend of the different medium. ( wifi, cable or optical fibers) |
| **Engage** | 1. Teacher and student will perform the experiment on the rate at which data is transferred over the different medium of the communication layers using the COSMOS Toolkit and complete a See, Think, Wonder ( graphic organizer )
2. Students engage in a see, think, wonder of different airplane routes as shown on the Smartboard or Promethean Board.
	1. See: What do you notice?
	2. Think: What do you think your noticing mean?
	3. Wonder: Create a question that you would like to explore further based on your noticings and conjectures?
3. Discuss with the students their conjectures and wonderings.
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| **Explore** | A student (transmitter-Host A ) will send a message/text/email/data to someone and find out how fast the data travelled over the layers of communication before it arrived to the receiver (Host B)**Host A and Host B will be of different teams**.They will compare this phenomenon with the data sent via wireless network versus using cable wires versus optical.Students will explore the different types of internet connections such as Satellite, Fiber Optics, WiFi, DSL and Cable. They will record the data on a table and see the relationship of these types of connections to their speed and discuss what regression models will best fit the given data. |
| **Explain** | 1. In small groups, the students will discuss their observations, their findings, questions, multiple representations of the results and trends based on the data.
2. In a gallery walk, students will present all of their data and make connections across the different groups. They can use this space to discuss results and trends across the groups. \*Peer evaluations\*
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| **Extend**  | Discuss possible connections of this experiment to science concepts by studying the different factors behind and/or chemical compositions of the different types of internet connections such as cables or fiber optics that promote fast energy transfer over the communication line.Powerpoint, Prezzi or Powtoons can be used for creative presentations of the Project. |
| **Evaluate** | Find out if the students were able to accomplish the main goal/learning target/essential questions posted before the experiment started. Let students present their findings and let them discuss among their classmates and entertain questions regarding the results. Students and teacher will evaluate the success of the experiment of the other groups by asking relevant questions based on their presentations. A rubric will be used to give specific feedback to the work of their peers. |
| **Differentiation** | Students will be grouped heterogeneously. Each group will be expected to meet the same standards. Graphic organizers and vocabulary sheets will be available to students to use.  |