

Tying Knots

Objective: Students will find a linear model to fit data.

Students will compare and interpret different slopes and intercepts in a context.

Students will discuss domain and range:

- as discrete points vs. continuous intervals.
- the restrictions implicitly given in a context.

Approximate time: 1-2 days depending on time spent on calculator instructions.

Materials: One piece of rope with taped ends for each group. (The ropes should be of 2 or 3 different diameters and 2 or 3 different lengths so that some ropes have equal length, others have equal diameters, but none match on both attributes.) One meter stick or tape measure per group.

Summary: Students will tie a series of uniform knots in a length of rope. They will record the length of the rope and the number of knots after tying each knot. They will predict the shape of the graph before collecting data, and find a linear function to fit the graph after collecting data. They will interpret the meaning of the slope and the y-intercept of their line and compare them to lines from other ropes.

Also the Domain/Range can be discussed: Is it OK to draw in a line to model the data? Is the modeling line the function? Maybe a dashed line?

How can the function be represented: Graph, numeric, symbolic.

Procedure:

1. Hand out a length of rope and a meter stick or tape measure for each group.
2. Hand out the student activity sheet and have students complete it down to the prediction graph. Check individual groups on their interpretation of dependent and independent variables. Discuss some of the predictions before proceeding. Look for things like "Is the graph going down? Why is the graph going down? Do we know where the graph starts? Is the graph changing at a steady rate?"
3. Have students complete the activity sheet.
4. Compare some of the equations and graphs from related ropes (same length or same diameter) on the overhead calculator.
5. Have groups (or individuals) write their equation and questions on a file card to trade with another group (or individual). Groups (or individuals) should check their solutions with the problem's creator.

Tying the Knot!

Materials: One length of rope, 1 tape measure, and one sheet of graph paper per group.
The first sheet of the activity for each member of the group.
(2nd sheet to be handed out when graph is completed.)

Measure the length of the rope in centimeters. _____

We are going to tie a series of uniform knots in the rope and measure the length of the rope after each new knot. (Do not tie knots until you get to the table below)

What variables should we record? _____ and _____

Identify the variables as dependent and independent.

Dependent variable = _____ Independent Variable = _____

Label the axes on the graph below and draw a prediction of what you think the graph of the data will look like.



Tie the knots, measure the rope, and record your data in the table below. (Label table)

Draw an **appropriate** axis on the graph paper and **carefully** graph the points on your axis.
Be sure to **label** both axis completely.

When you have completed your graph get the 2nd sheet of the activity from your instructor.

Carefully draw in a “trend line” on your graph that models your data.

Find the equation for your “trend line”. _____
Show your work below!

What is the domain of your function? _____
Why?

Write your function as a set of ordered pairs: _____

Write your function as a symbolic formula: _____

What is the y-intercept of your linear model and what does it mean in this situation?

What is the slope of your linear model and what does it mean in this situation?

Find another group with the same original rope length that you had. Compare equations. What do you observe?

Find another group with the same diameter rope that you had and compare equations. What do you observe?

We can also use a graphing calculator to find the BEST FIT “trend line.”

For a TI-83 or 84 follow the following steps:

1. Push the “Stat” key and then “edit”. Enter your input data in L1 and output data in L2.
2. Push the “Y=” key and turn on “Plot1”
3. Push the “graph” key. You may need to reset your window.
4. If you do not get anything push the “2nd, Y=” keys (“Stat plot”) to setup the plot. Put L1 in Xlist and L2 in Ylist and turn on the first graph type.
5. You should now have a graph of the points in your table.
6. Now to get the trend line: Type into Y1: Ax+B
7. Then push the “Stat” key and scroll to “Calc” and scroll down to 4 “LinReg” and push enter.
8. Push enter again to get the coefficients of the line.
9. Store the value of a in A and the value of b in B.
10. Push graph! You should see a line go through near the data points.

Equation of the trend line from your calculator: _____

How do the slope and y-intercept compare to your original trend line? Why are they different?

More Rope Problems? Why not?

Name _____

Consider the following questions!

1. A rope with no knots is 75 cm long. After six knots are tied in the rope the length is 33 cm.
 - a. How much rope is taken up for each knot?

 - b. Write a linear equation that models the length of the rope as a function of the number of knots.

2. A rope with two knots has length 64cm. After three more knots are tied in the rope (for a total of 5 knots) the length is 40 cm.
 - a. How much rope is taken up for each knot?

 - b. Write a linear equation that models the length of the rope as a function of the number of knots.

3. Which of the two ropes above most likely has the larger diameter? **Explain your choices.**

4. Which of the two ropes above is the longest? **Explain your choices.**

