Lumber Pricing

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Task Overview

Description
Students will look at lumber prices over time and design and calculate the area of a deck. The cost of the deck and the impact of borrowing money will be determined in relation to the construction of the deck. The task focuses on connecting different strands of math together (data, measurement, proportional reasoning, finance) and could be used at any point in the course.

Big Ideas
Data can reflect what is going on in the world

Decision making and mathematical reasoning is needed when creating & building

Planning before construction can inform when and what you buy and will result in informed financial decisions

Duration
2 lessons (or more, depending upon the scope and depth of discussions and extensions)

Materials needed
Printed or computerised student sheets, Chromebooks (or other devices that can access Google sheets or similar), paper, VNPS, chart paper, writing and drawing tools tools, calculators, rulers, protractors, compasses, scissors, PRINTED MATERIALS (if required). Maybe provide examples of decking lumber.

Learning Goals
- Students will reflect on the effects of a global event on local activities
- Students will look at data and determine whether or not a curve of best fit is appropriate
- Students will calculate area of a composite shape and use this to decide how much lumber they need
- Students will consider the impact of borrowing money
- Students will make connections between different math strands and global events

Sample Success Criteria
- I can see trends in data
- I can calculate the area of a composite figure and apply this knowledge to a real world situation
- I can perform unit conversions
- I can determine the cost of borrowing money and use this knowledge to make an informed decision

Overall Expectations

AA1. Social-Emotional Learning Skills
develop and explore a variety of social-emotional learning skills in a context that supports and reflects this learning in connection with the expectations across all other strands

A1. Mathematical Processes
apply the mathematical processes to develop a conceptual understanding of, and procedural fluency with, the mathematics they are learning

B3. Number Sense and Operations
apply an understanding of rational numbers, ratios, rates, percentages, and proportions, in various mathematical contexts, and to solve problems

D1. Collection, Representation, and Analysis of Data
describe the collection and use of data, and represent and analyse data involving one and two variables

E1. Geometric and Measurement Relationships
demonstrate an understanding of the development and use of geometric and measurement relationships, and apply these relationships to solve problems, including problems involving real-life situations

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F1. Financial Decisions
demonstrate the knowledge and skills needed to make informed financial decisions

Social-Emotional Learning (SEL) Skills
- Recognizing and identifying emotions that support mathematical learning;
- Identifying resources and supports that aid perseverance in mathematical learning;
- Building healthy relationships and communicating effectively in mathematics;
- Developing critical and creative mathematical thinking.

Mathematical Processes
- Communication
- Critical thinking and problem solving
- Global citizenship and sustainability
- Self-directed learning
- Representing

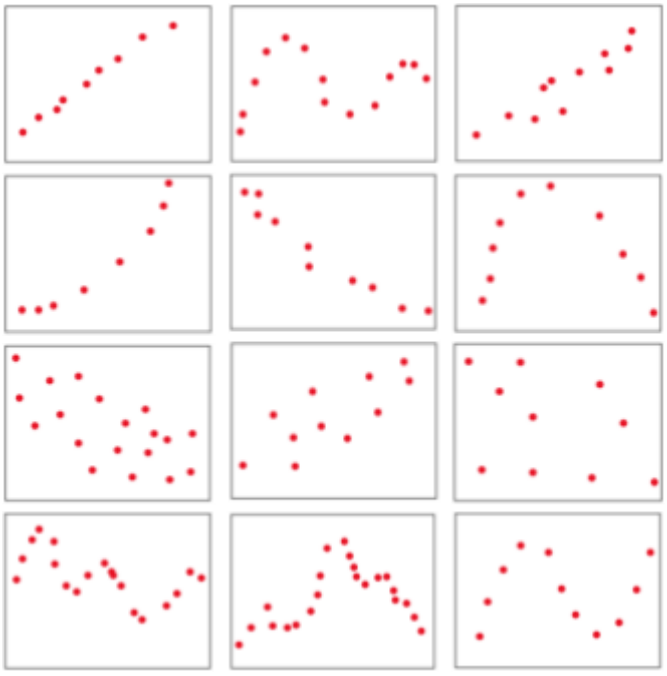
Prior Learning and Placement of Task during Semester

- Understanding of creating scatter plots and regression lines
- Correlation terminology (weak/strong, linear/non-linear, etc.)
- Calculating areas of composite shapes
- Converting between units of measure and currencies
- Exposure to effects of borrowing money, including compound interest

Diagnostic Task & Look fors

- Which of the following scatterplots would be appropriate to use a line of best fit, a curve of best fit and which would not?
- For those that show linear correlation, rank the scatter plots from weakest to strongest correlation.

In your groups, discuss and compare your choices.



Look fors
- Understands that a often a 'line' of best fit may not be appropriate
- Use of vocabulary: correlation, strong/weak, linear/non-linear
- Can select appropriate regression type
- Can evaluate strength of regression
- Communication of idea

Educator Notes:
- Teachers can decide whether to let students have individual think time first or jump straight into group discussion
- In class student copy - option to cut and physically manipulate

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- Jamboard option for online learning - Please have students drag and drop the frames into the order they decide to rank the images. Alternative option: Educator may choose to put into a cardsort in Desmos

The Task

Hook

What do you notice?

What do you wonder?

Who would be most affected by this?

During the Pandemic, a lot of home and business owners decided to expand their outdoor spaces by building decks and patios. You are going to investigate how pandemic pricing affected the cost of such a project.

Image to project for students

Part One

The table below shows the retail price of lumber on certain dates over the course of the pandemic.
Make a scatter plot of the data. Discuss the trends that you see and the effect that the pandemic had on the price of lumber.

Add a line of best fit to your scatter plot. Consider if the line of best fit is a good representation of the data. Consider other available regression models. Do any fit better?

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Date	Days since February 1, 2020	Price (USD/1000 board feet)
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April 18, 2021	442	2750.06
May 5, 2021	459	3526.74
June 3, 2021	488	2353.26
July 8, 2021	523	1618.79

Data source: https://tradingeconomics.com/commodity/lumber

Did you know...
In the lumber industry in North America the amount of wood is measured using 'board feet' and equals the volume of wood that is 1 foot long, by 1 foot wide by 1 inch thick. So if you use deck boards that are 1 inch thick, this means that you can use the conversion:
1 board foot = 1 square foot of area

Teacher Notes
Suggestion is to use google sheets for this graph - click here for a guide
Note: The original data has been converted from market value to retail price. Click here for more details, should you wish to add additional more recent points.
Extension: Can discuss outliers and blips like the pandemic not having a long term effect and how using data over a longer period of time would minimize the impact of the pandemic on the data.

Part Two
Take a look at the examples of decks and patios provided - **Patio and Deck ideas**.

Given the outdoor space below, design a deck layout of your choice that will fit in the outdoor space. The deck must be a composite shape and include a variety of shapes.
(For the purposes of this task, we are just going to focus on the flat deck boards and not worry about the other construction aspects. However, you are more than welcome to extend your own work to include these extra elements if you wish)

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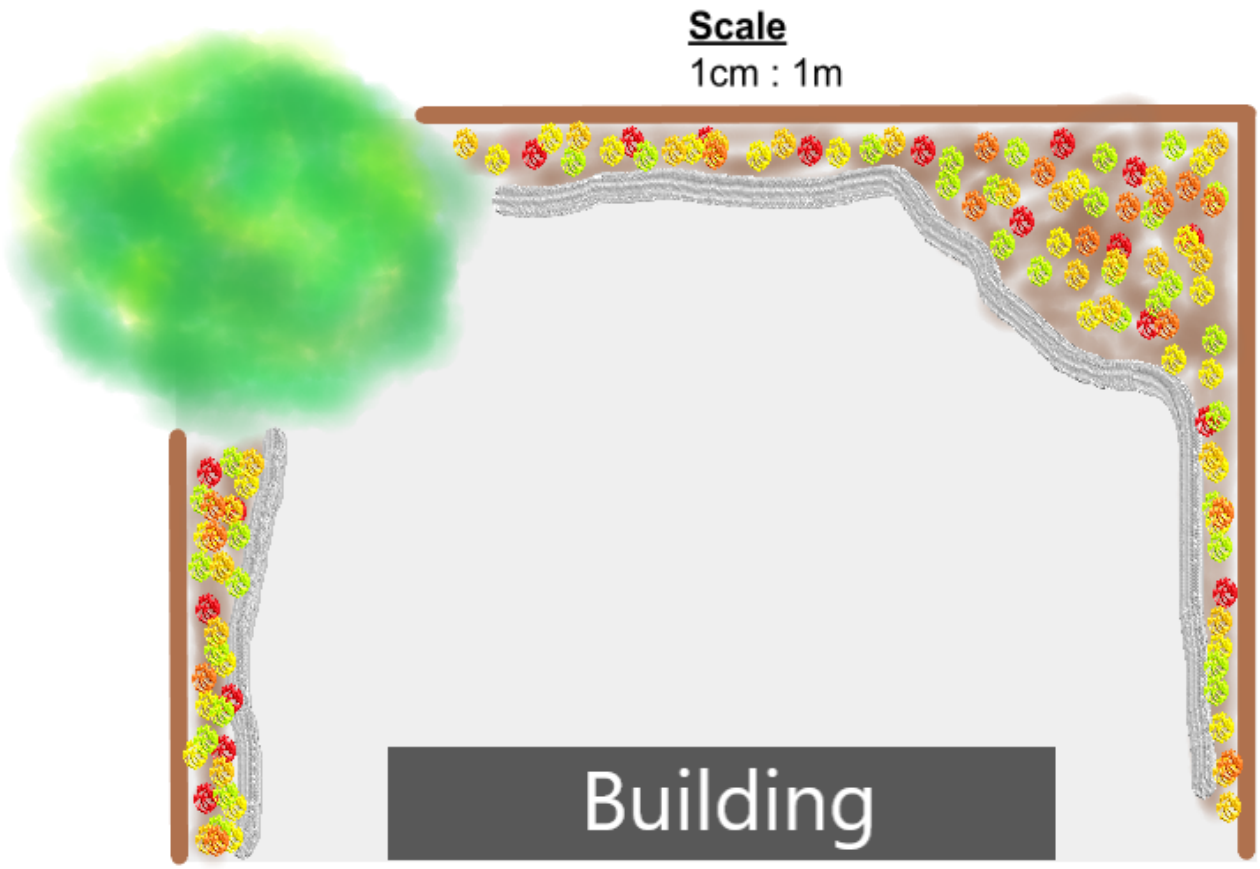

Using the scale provided, determine the area of your deck and convert this into *board feet*.

Did you know...
In the lumber industry in North America the amount of wood is measured using 'board feet' and equals the volume of wood that is 1 foot long, by 1 foot wide by 1 inch thick. So if you use deck boards that are 1 inch thick, this means that you can use the conversion:
1 board foot = 1 square foot of area

Teacher Notes:
The situation can be varied by the teacher to suit the needs of the school's population (backyard, restaurant patio, outdoor classroom space, etc.).

The degree of difficulty can be varied by altering the number of conversions, e.g. providing the scale in feet.
If a student is struggling, the educator can offer a scaffold. An example is found here: Deck Design Scaffold, and can be edited as needed.

There is an opportunity to build scale models and link in with tech teachers.

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Part Three

Look up the current exchange rate for US dollars to Canadian dollars.

Today's Conversion Rate
1 USD = _____CAD

Now that you have the area of your deck let's compare the cost of lumber before and at the height of the pandemic.

- Calculate the cost to purchase the required amount of lumber to build the deck using one value before the pandemic started and one value in the middle of the pandemic (refer to the table given in part 1).

If you had the choice, would you rather:

- borrow the money for one year at 4% interest compounded monthly and buy the lumber on your pre-pandemic date

or

- buy the lumber without borrowing any money on your mid-pandemic date?

Justify your decision.

Teacher Notes: Students should do financial calculations using technology. One possibility is the TVM solver on geogebra which works like the TVM solver on graphing calculators.

Extension: Don't forget to add tax. Construction projects usually require an additional 10% material for wastage.

Assessment

Observations during the lesson focusing on the process expectations and success criteria

Exit card: How are the math strands in this task connected to each other?

This task can be included in the **Student Portfolio of Process Expectations** (Google Slides)

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Possible Solutions

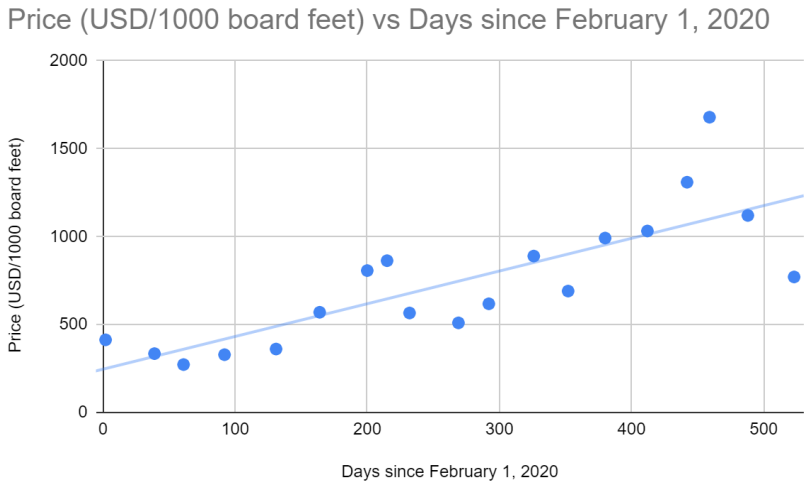
Part 1:

Some examples of how the graphs may turn out with different regression models applied.

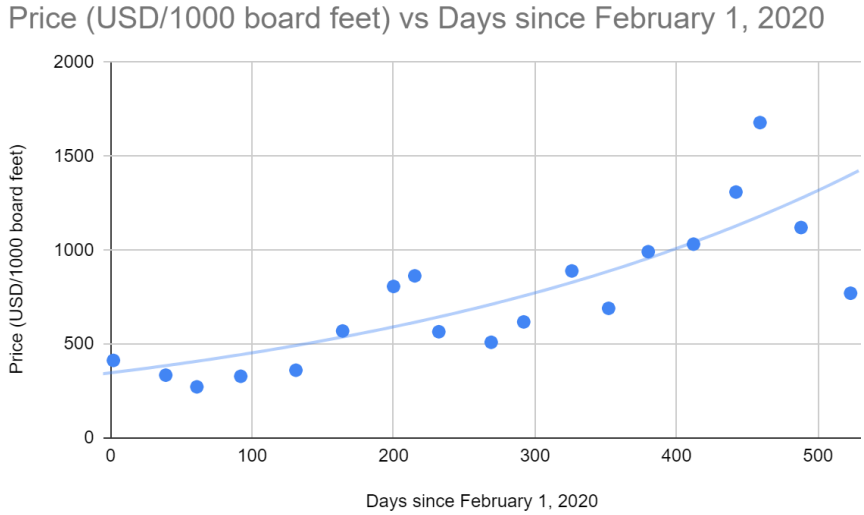
Look fors:

- ❏ Students try different regression models looking for a good fit
- ❏ Students recognize that due to the spike in cost a trend line gives a better representation of the situation

Linear



Exponential



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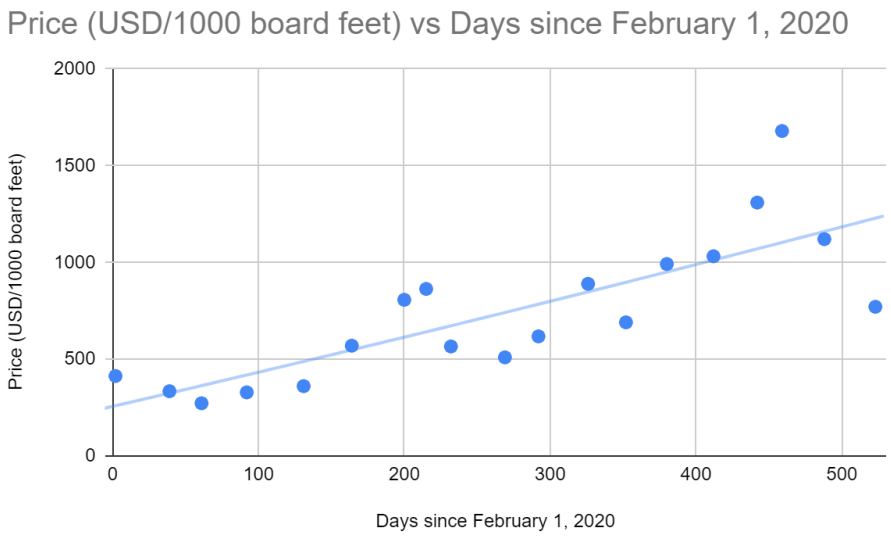
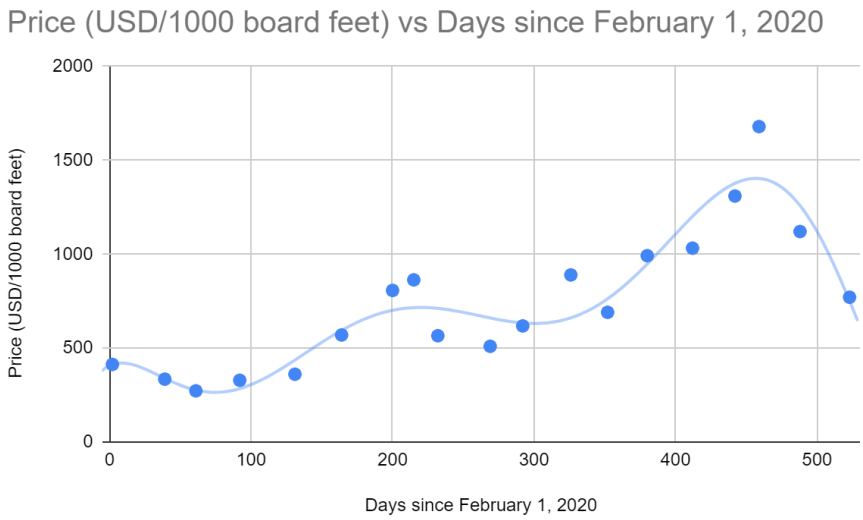
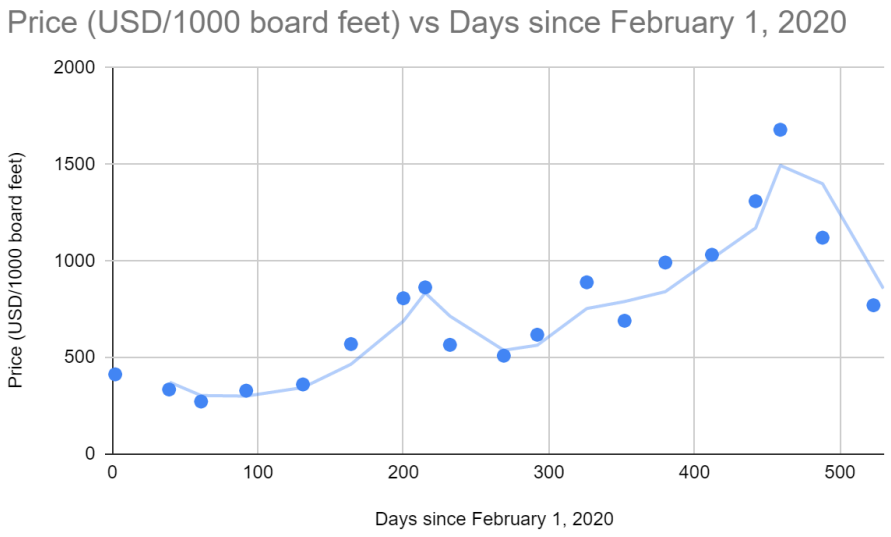
Polynomial degree 2



Polynomial degree 8



Moving Average



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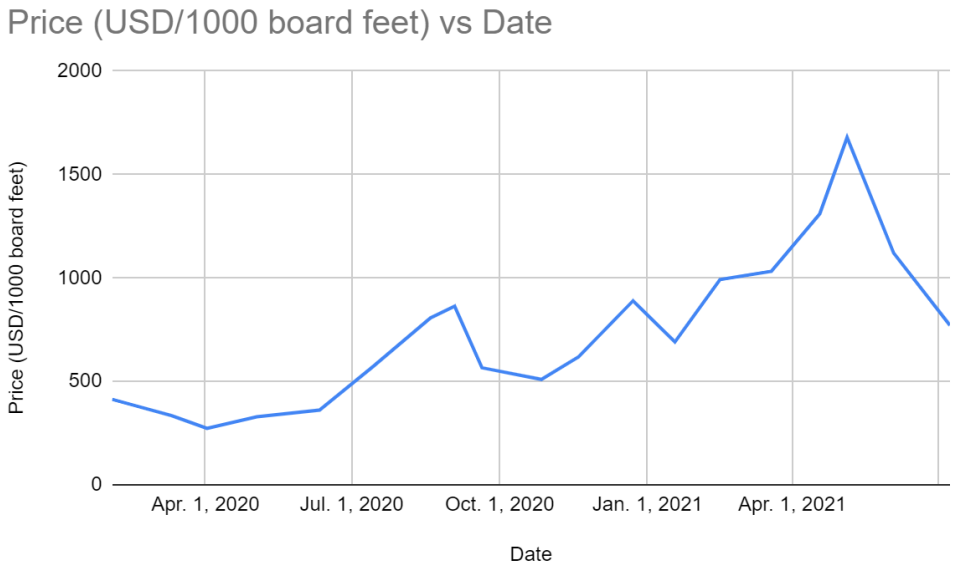
Date vs Price line graph

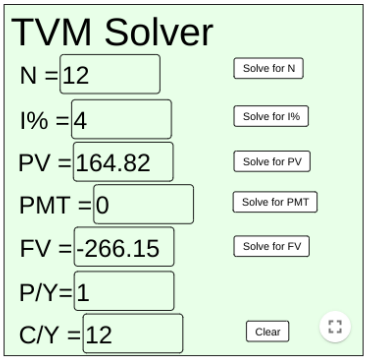


Part 3:

For a deck which is 190 square feet.

Feb 3, 2020:

$$190 \cdot (\frac{867.45}{1000}) = 164.82$$



Look fors:

- ❑ Student calculates the effect of the interest on the pre-pandemic amount
- ❑ Student accounts for the price being per 1000 board feet
- ❑ Student makes a valid comparison between values.

May 5, 2021:

$$190 \cdot (\frac{3526.74}{1000}) = 670.08$$

Even with paying interest it would two and a half times the price to buy the lumber on May 5th, 2021 than on Feb. 3rd 2020.

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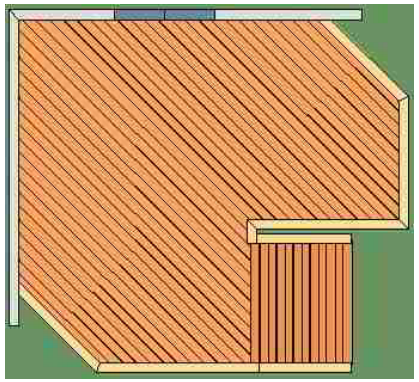
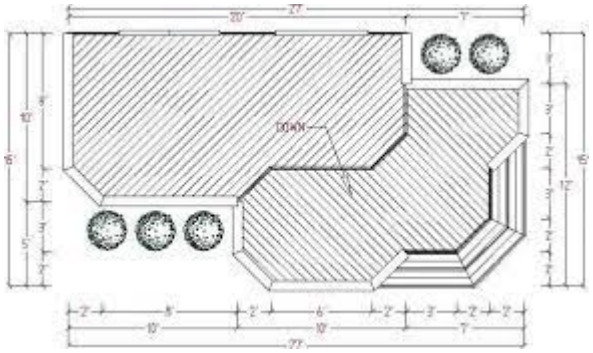
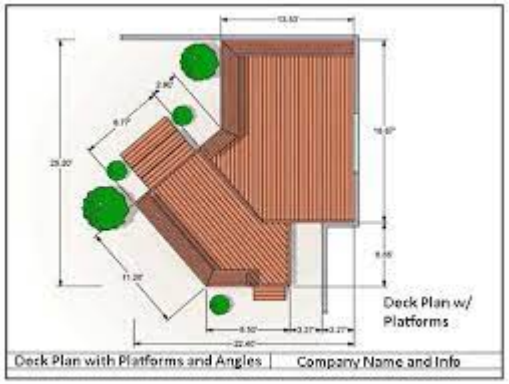
Patio and deck ideas







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Original Data

Source - https://tradingeconomics.com/commodity/lumber
Our original source data was generated from the graphs on the above website. This gave us the market value of the unprocessed lumber. The information provided goes up to the date the task was created. Should you wish to update the information to include more recent data, the following was how the data was created.

In Google sheets we used the code `=datevalue(A2)-43862` to generate the days since February 1, 2020 column.

We wanted to provide students with data that reflected the retail price that they may actually pay and so we decided to convert the prices. However, to provide the students with opportunities to perform conversion, we decided to still provide the information in USD/1000 board feet. To do this conversion we took the cost on July 8, 2021 of a 1”x4”x8’ deck board at Lowes and scaled this to a price in USD/1000 board feet. Comparing this to the market value of lumber in USD/1000 board feet on the same day we established that there was a x2.1 markup, which we then applied to the other dates to provide a rough estimate of the retail price. This doesn’t take into account any time lag effect on the price caused by the processing time, but does provide a usable estimated retail price.

Date	Days since February 1, 2020	Price - Market value (USD/1000 board feet)	Converted retail price (USD/1000 board feet)
Feb. 3, 2020	2	413.07	867.45
March 11, 2020	39	334.67	702.81
April 2, 2020	61	272.36	571.96
May 3, 2020	92	328.64	690.14
June 11, 2020	131	360.8	757.68
July 14, 2020	164	569.85	1196.69
Aug. 19, 2020	200	807.04	1694.78
Sep. 3, 2020	215	863.32	1812.97
Sep. 20, 2020	232	565.83	1188.24
Oct. 27, 2020	269	509.55	1070.06
Nov. 19, 2020	292	618.09	1297.99
Dec. 23, 2020	326	889.5	1867.95
Jan. 18, 2021	352	690.45	1449.95
Feb. 15, 2021	380	991.96	2083.12
March 19, 2021	412	1032.16	2167.54
April 18, 2021	442	1309.55	2750.06
May 5, 2021	459	1679.4	3526.74
June 3, 2021	488	1120.6	2353.26
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Additional Resources - Printed Materials

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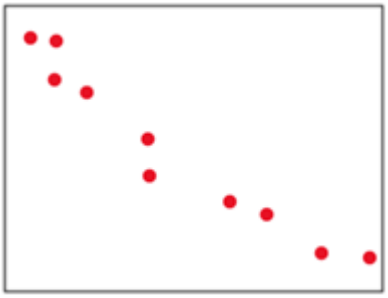

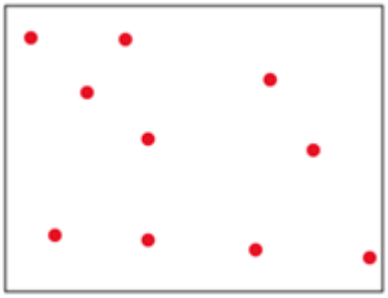

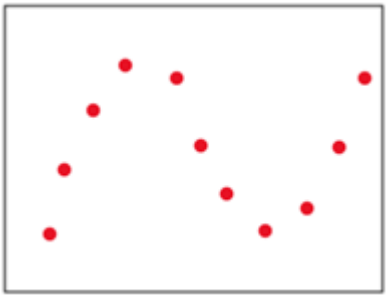

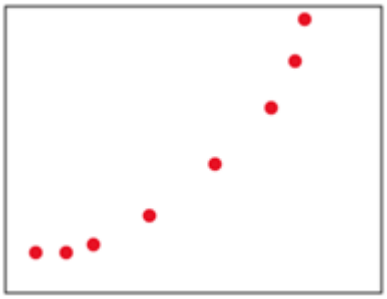

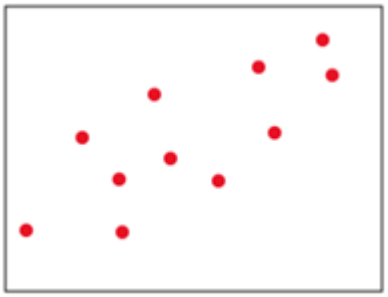

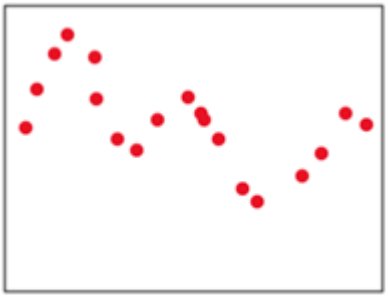

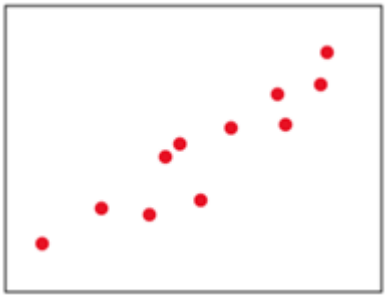

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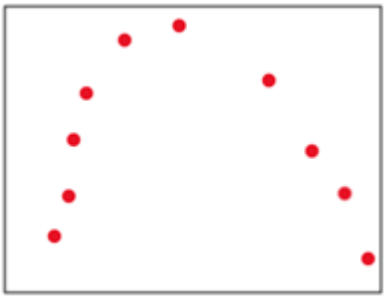

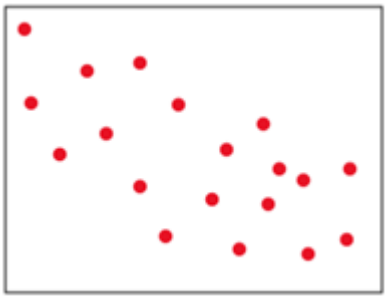

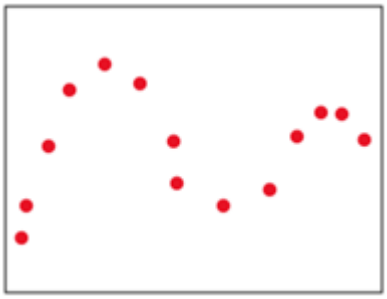

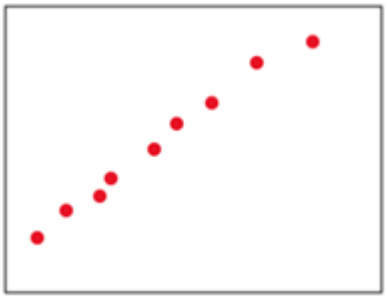

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What do you notice?

What do you wonder?

Who would be most affected by this?

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Part One

The table below shows the retail price of lumber on certain dates over the course of the pandemic. Make a scatter plot of the data. Discuss the trends that you see and the effect that the pandemic had on the price of lumber.
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In the lumber industry in North America the amount of wood is measured using 'board feet' and equals the volume of wood that is 1 foot long, by 1 foot wide by 1 inch thick. So if you use deck boards that are 1 inch thick, this means that you can use the conversion:
1 board foot = 1 square foot of area

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Part Two

Take a look at the examples of decks and patios provided - **Patio and Deck ideas**.

Given the outdoor space below, design a deck layout of your choice that will fit in the outdoor space. The deck must be a composite shape and include a variety of shapes.
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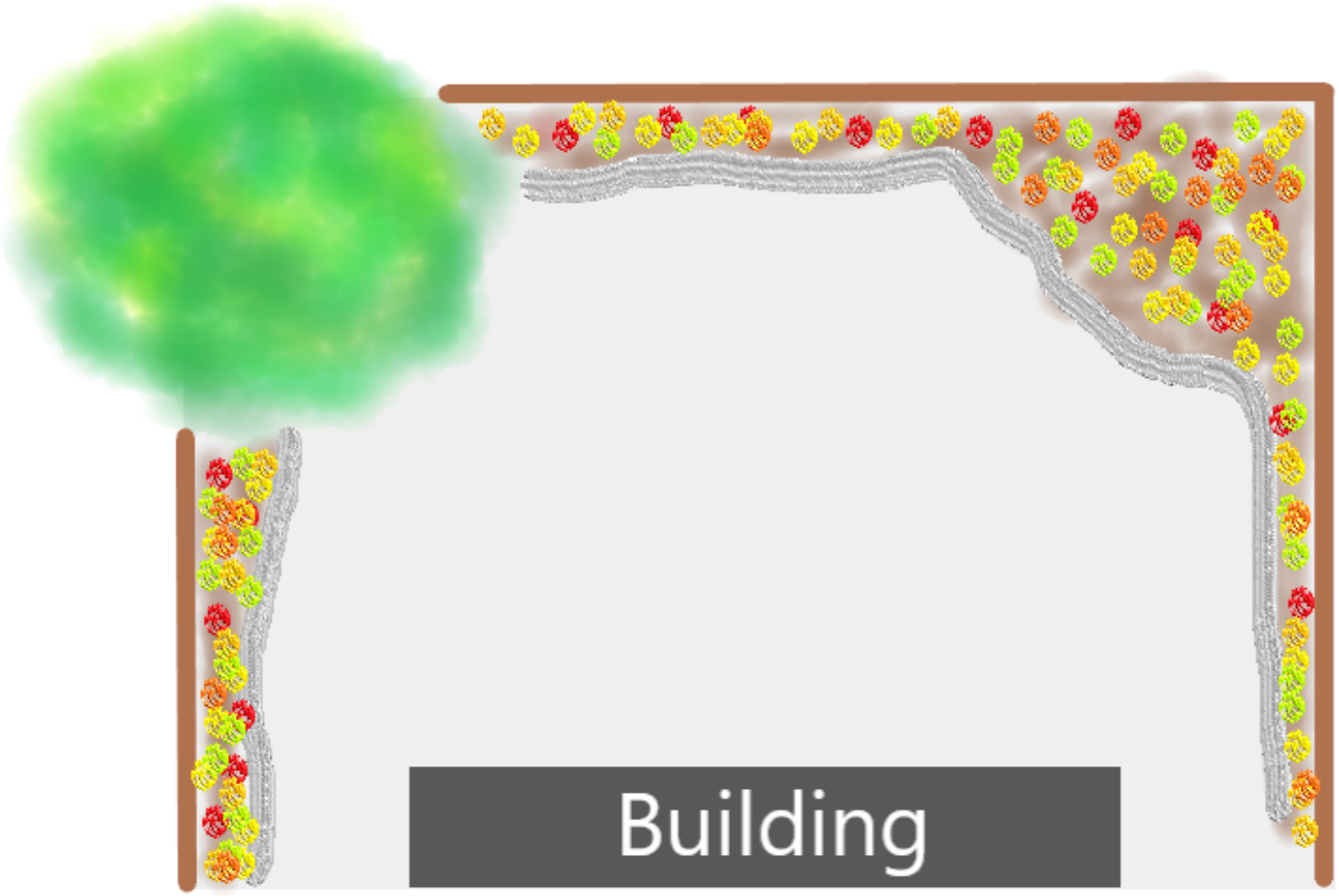

Using the scale provided, determine the area of your deck and convert this into *board feet*.

Did you know…
In the lumber industry in North America the amount of wood is measured using 'board feet' and equals the volume of wood that is 1 foot long, by 1 foot wide by 1 inch thick. So if you use deck boards that are 1 inch thick, this means that you can use the conversion:
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Part Three

Look up the current exchange rate for US dollars to Canadian dollars.

Today's Conversion Rate
1 USD = _____CAD

Now that you have the area of your deck let's compare the cost of lumber before and at the height of the pandemic.

Calculate the cost to purchase the required amount of lumber to build the deck using one value before the pandemic started and one value in the middle of the pandemic (refer to the table given in part 1)

If you had the choice, would you rather:

- borrow the money for one year at 4% interest compounded monthly and buy the lumber on your pre-pandemic date

or

- buy the lumber without borrowing any money on your mid-pandemic date?

Justify your decision.

Extension: Don't forget to add tax. Construction projects usually require an additional 10% material for wastage.

Exit Card: How are the math strands in this task connected to each other?

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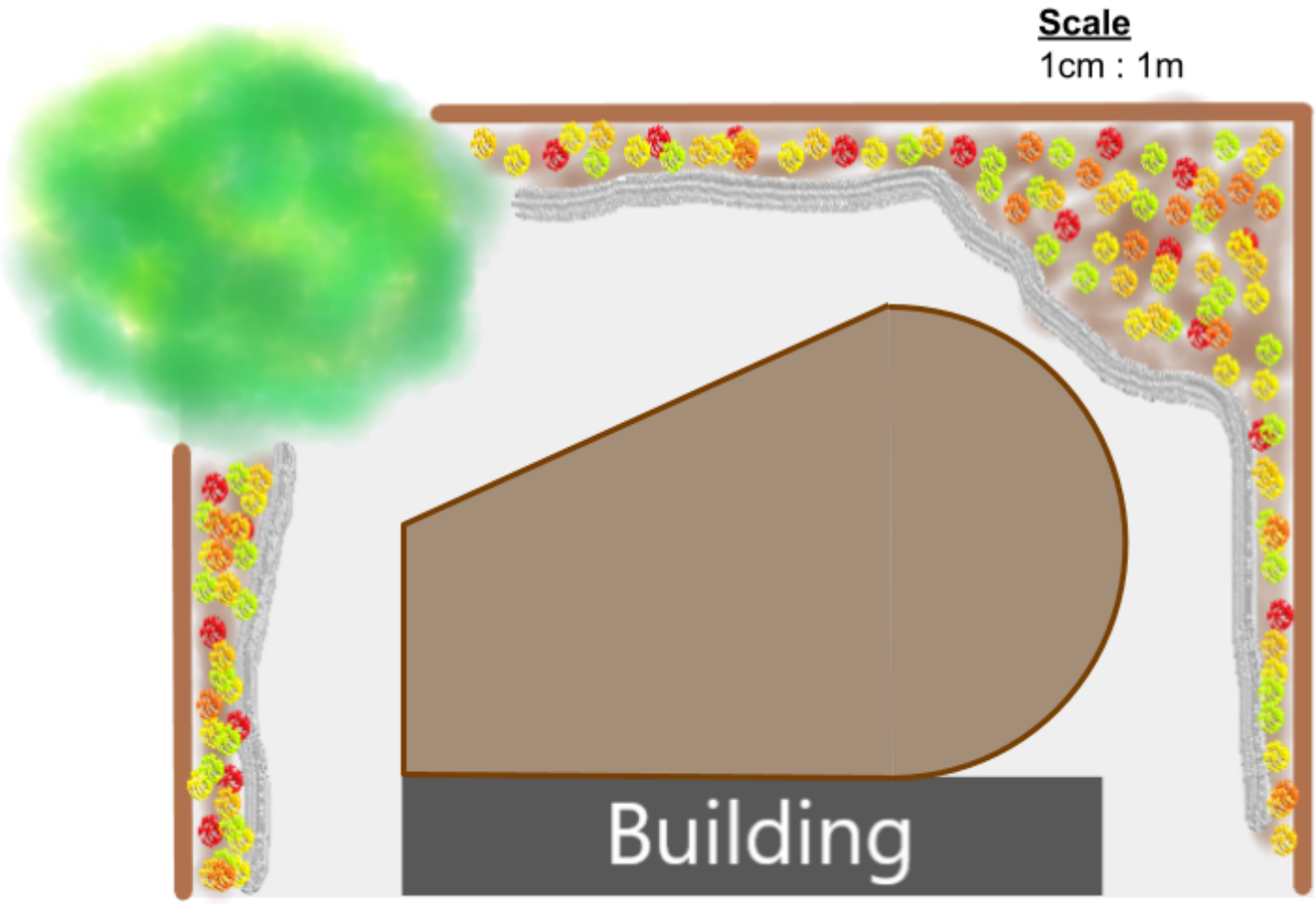
Deck Design Scaffold



Given the deck design above, what shapes can you find? Draw them on the diagram and measure each dimension in centimetres.

The scale is 1cm : 1m, convert each of the measurements into metres.

Calculate the area of each shape and the total area of the deck in square metres.

1 square metre = 10.76 square feet, convert the deck area into square feet.

1 square foot = 1 board foot, how many board feet of lumber do you need to build this deck?