A green chalkboard with two pieces of pink chalk and some faint white chalk drawings. The chalkboard is the background for the text. The text is in a dark teal color. The chalk is in the bottom left corner. The drawings are faint and scattered across the board.

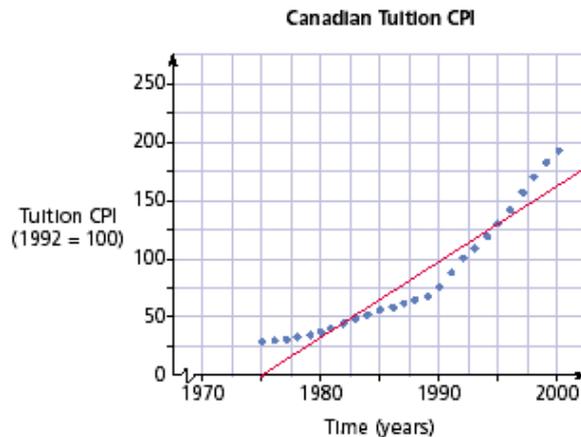
Statistics of Two Variables

Day 6
Non-Linear Regression

Non – Linear Regression

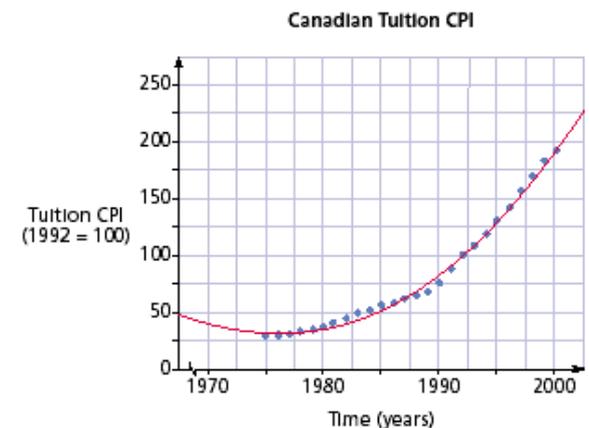
- Many relationships between two variables are not linear
- **Non-Linear Regression** is the process of finding a curve of best fit for a set of data
- Technology can be used to perform this type of regression to obtain the equation of the curve of best fit

Linear Regression



Source: Statistics Canada

Quadratic Regression

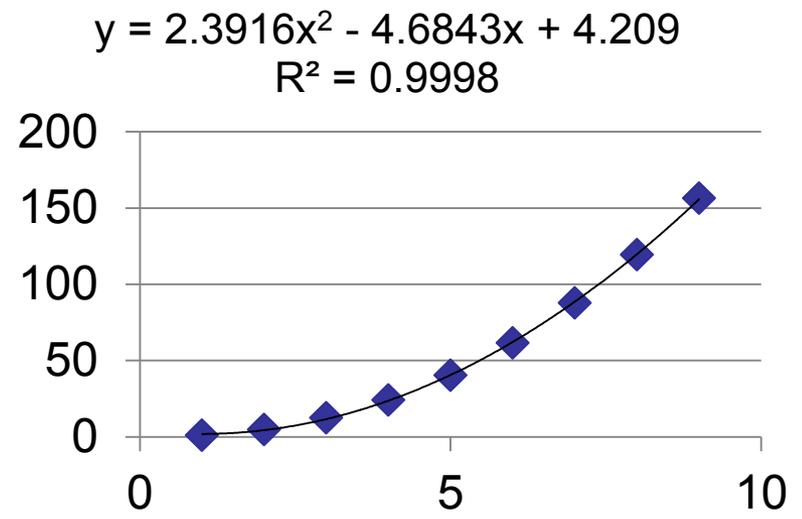
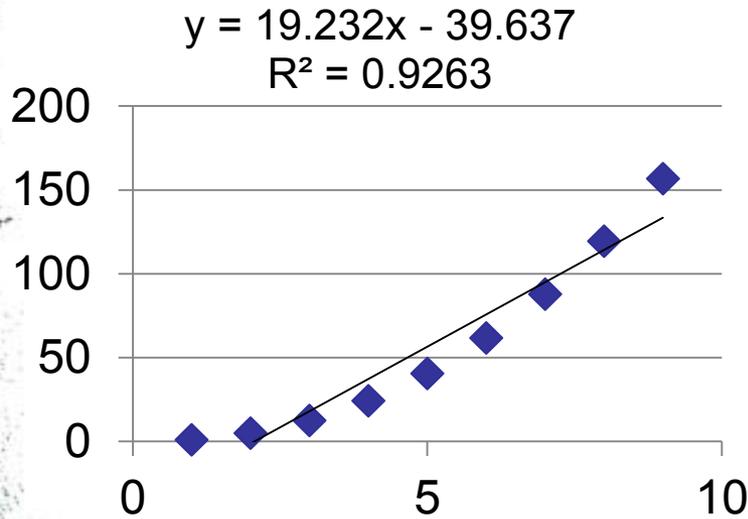


Source: Statistics Canada



How do you know what type of regression to use?

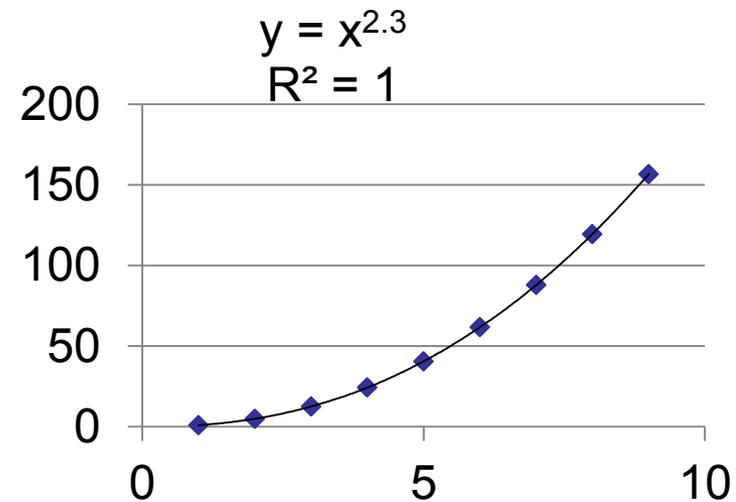
- Recall that the correlation coefficient (r) is a measure of how closely a straight line fits the data
- The **coefficient of determination (r^2)** can be used to determine which type of regression is most appropriate for the data
- The coefficient of determination can have values from 0 to 1
- It is a measure of how much variation in the x variable accounts for the variation in the y variable
- The best type of regression for a particular set of data will be the one with the highest value for r^2



Three types of regression have been performed on the same data (linear, quadratic, exponential)

Notice how the value of r^2 changes

To be an effective model, the curve must be useful for extrapolation



Example 1

A lab monitors the growth of a bacterial culture by scanning it every hour and estimating the number of bacteria.

Time (h)	Population
8	630
9	775
10	830
11	980
12	1105
13	1215
14	1410

Determine the best type of regression for this data.

Example 2

In a physics project students drop a ball from the top of a 4m high ladder and measure the distance the ball travelled every tenth of a second.

Time (s)	Distance (m)
0.1	0.005
0.2	0.2
0.3	0.4
0.4	0.8
0.5	1.2
0.6	1.7
0.7	2.4
0.8	3.1
0.9	3.9
1	4.9

- Determine the best model for the data
- Predict how far the ball will fall in 5s



a. Determine the best model for the data

The quadratic model is best

$$y = 4.8977x^2 - 0.0084x - 0.0205$$

b. Predict how far the ball will fall in 5s

$$\begin{aligned}y &= 4.8977x^2 - 0.0084x - 0.0205 \\y &= 4.8977(5)^2 - 0.0084(5) - 0.0205 \\y &= 117.42\text{m}\end{aligned}$$