Choosing the Right Model

When finding a mathematical model to represent the trend in data (curve of best fit), how do you know whether to use a linear, quadratic, or exponential model?

Answer: Look for patterns in the table of values.

Example: Determine what model would best represent the data in each table: linear, quadratic, or exponential.

a.

X	-3	-2	-1	0	1	2
Y	10	7	4	1	-2	-5

b.

X	-2	-1	0	1	2	3
Y	6	3	2	3	5	9

c.

X	0	1	2	3	4	5
Y	4	8	16	32	64	128

Sometimes it is difficult to tell from a scatter plot whether a trend is linear, quadratic, or exponential.

To determine which model is the best fit in these cases, use the **correlation coefficient, r**. Remember, the closer this value is to 1/-1, the better the model fits the data.

Example:

In 1990, the total debris in orbit around the Earth was approximately 1800 tonnes (t). The table shows the accumulated mass of debris for the following five years.

Year	Mass of Debris (t)
1990	1800
1991	2710
1992	3710
1993	4800
1994	5980
1995	7250

a. Enter the data into a table on Desmos **but instead of entering the years themselves, make the first column "years since 1990". So for 1990, enter 0, for 1991, enter 1 and so on.**

ie. The table you will enter is:

X	Y
0	1800
1	2710
2	3710
3	4800
4	5980
5	7250

b. Click on the wrench (tool) in the top right corner and adjust your window settings as follows:

$0 \leq x \leq 7$ and $0 \leq y \leq 8000$

c. Determine a linear, quadratic, and exponential model for the data **and record the correlation coefficient beside each equation.**

LINEAR (formula: $y_1 \sim mx_1 + b$)

QUADRATIC (formula: $y_1 \sim ax_1{}^2 + bx_1 + c$)

EXPONENTIAL (formula: $y_1 \sim ab^{x_1}$)

d. Use each model to predict the mass of space debris in 2005.

LINEAR:

QUADRATIC:

EXPONENTIAL:

e. Which model is most optimistic?

f. Which is most pessimistic?

g. Which model fits the data best? Explain how you know.