# §12.2: Re-Expressing Data

Skills

- Model non-linear patterns
- Make predictions using non-linear models

# Think with points, not equations.

Think $(x, x^2)$ instead of $y = x^2$
Think $(x, 2x + 1)$ instead of $y = 2x + 1$

With that in mind, what does the simplest line look like?

# Same kind of function = linear graph (*mostly*)

$(x\ ,\ x)$

$(x^2,\ x^2)$

$(\ln(x),\ \ln(x))$

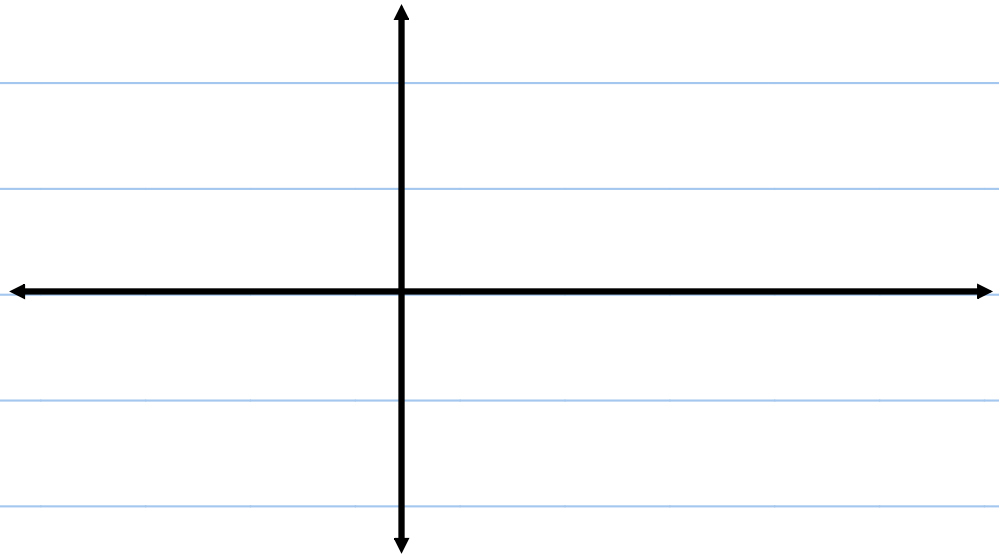
# Two Function Types

Power ($x$, $x^n$)
Exponential ($x$, $n^x$)

In both cases, it's the exponent that creates some problems.
What function from Algebra 2 allows you to move exponents down to become coefficients?

# Curve #1: Exponential

Typical Graph:



Features:

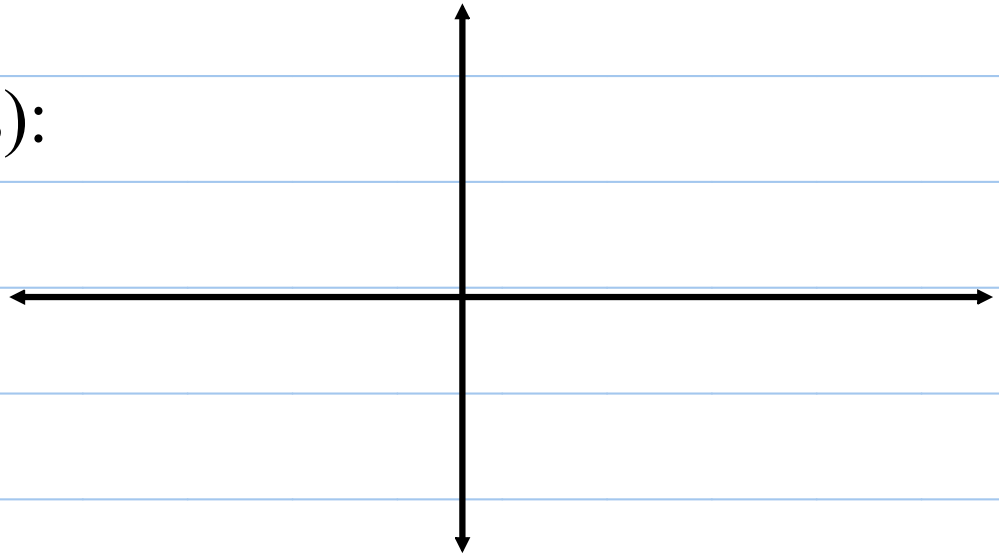
# The Transformation:

# Example

| | |
|---|---|
| 1 | 1 |
| 2 | 3 |
| 3 | 10 |
| 4 | 15 |
| 5 | 33 |
| 6 | 60 |
| 7 | 140 |
| 8 | 275 |
| 9 | 500 |

# Curve #2: Power Function

Typical Graph(s):



Features:

# The Transformation:

# Example

```
1   1
2   3
3  11
4  15
5  26
6  34
7  49
8  64
9  81
```

# Summary

Looks like an Exponential Function =
take the log of $y$-coordinates

Looks like a Power Function =
take the log of both coordinates

Once the graph looks linear, then you can do everything that we did before!

# A Caveat

These are not the only possible transformations...

# In the Calculator...

Changing the graph

Changing the Least Squares Command

# Writing the Least Squares Equation

Changes:

$x$ : $\ln(x)$

$y$ : $\ln(y)$

# Example

You did a power transformation, and the calculator reports

$y = a + bx$
$a = 2.3$
$b = -1.8$

# Example

You did an exponential transformation, and the calculator reports

$y = a + bx$
$a = -4$
$b = 3.85$

# Example

You're told that the following equation models a data set: $\sqrt{\hat{y}} = 5 - 2x$

...and you are to make a prediction for $x$ = -3

# Example

You're told that the following equation models a data set: $\log(\hat{y}) = 4 + 3x^2$

...and you are to make a prediction for $x = 2$

# Example: Frying Tortilla Chips

- Who wants a moist, limp chip?
- Researchers want to be able to predict the moisture content (%) based on the frying time (seconds).

| sec | % |
|---|---|
| 5 | 16.30 |
| 10 | 9.70 |
| 15 | 8.10 |
| 20 | 4.20 |
| 25 | 3.40 |
| 30 | 2.90 |
| 45 | 1.90 |
| 60 | 1.30 |

# Example: River Flow

- Rivers flow more slowly close to the banks, and more swiftly towards the center of the river.
- The speed of the current (cm/sec) was measured at various distances (m) from the bank of a river.
- We want to predict the current based on distance.

| m | cm/sec |
|---|---|
| 0.5 | 22 |
| 1.5 | 23.18 |
| 2.5 | 25.48 |
| 3.5 | 25.25 |
| 4.5 | 27.15 |
| 5.5 | 27.83 |
| 6.5 | 28.49 |
| 7.5 | 28.18 |
| 8.5 | 28.5 |
| 9.5 | 28.63 |