9/10/2024

Regression
Algebra of Functions (Operations, Composition, Domain/Range)

In Excel… see the example file for the points and the solution.

Linear Regression Equation (ex. 2.5.1 in online textbook)

y = 1.2871x - 2473.9

slope: coefficient of x, 1.2871
y-intercept: constant, -2473.9

what does the slope mean: rate of change: as x gets bigger (by 1) by how much does y change?
X is in years, and y is in quads
For each year (as it increases) the number of quads of energy usage goes up by 1.2871 quads

For the y-intercept: happens when x=0, here x is years… so in year 0 AD, energy usage was -2473.9 quads.
We can't go back in time to year 0… there was not electric energy consumption at all 2000 years ago.
Energy can't be measured as a negative, so as soon as you get to negative values, the equation can no longer be valid.

Sometimes, the problem will tell you to measure time from a particular year (for example, starting in 1950).

Algebra of functions

Recall from an earlier section:
We can add, subtract, multiply and divide functions.

The new operation is composition

$$f(g(x)) = (f \circ g)(x)$$

$$f(x) = x^2 + x, g(x) = 3x + 2$$

$$f(g(x)) = (3x+2)^2 + (3x+2) = 9x^2 + 12x + 4 + 3x + 2 = 9x^2 + 15x + 6$$

$$f(f(x)) = (x^2+x)^2 + (x^2+x) = x^4 + 2x^3 + x^2 + x^2 + x = x^4 + 2x^3 + 2x^2 + x$$

Domain the of division and composition of functions.

$$\left(\frac{f}{g}\right)(x) = \frac{x^2 + x}{3x + 2}$$

What is the domain of $\frac{f}{g}$?

$$3x + 2 = 0$$
$$x = -\frac{2}{3}$$

$$\left(-\infty, -\frac{2}{3}\right) \cup \left(-\frac{2}{3}, \infty\right)$$

$$f(x) = \sqrt{x}, g(x) = \frac{1}{x-2}$$

$$\left(\frac{f}{g}\right)(x) = \frac{\sqrt{x}}{\left(\frac{1}{(x-2)}\right)} = (x-2)\sqrt{x}$$

$$D: [0,2) \cup (2, \infty)$$

When you do domains and ranges of composition:
Even if restrictions on individual functions appear to disappear in combination, they still remain in the domain restrictions of the composition.

$$f(x) = \sqrt{x}, g(x) = x^2$$

$$g(f(x)) = \left(\sqrt{x}\right)^2 = |x|$$

$$D: [0, \infty)$$

Positive numbers only remains even after simplifying.