

Math Review

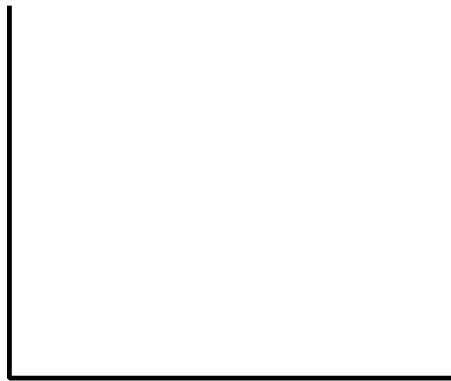
I. Slope-Intercept Form

A. $y = mx + b$

1. dependent variable
2. independent variable
3. slope.

B. Slope.

$$\frac{RISE}{RUN} = \frac{\Delta VERTICAL}{\Delta HORIZONTAL} = \frac{\Delta Y}{\Delta X} = \frac{\Delta LFTHANDSIDE}{\Delta RGHTHANDSIDE} = M$$



C. Y and X intercept

1. y-intercept - value of y when $x=0$; "b"
2. x-intercept - value of x when $y=0$

$$0 = mx + b$$

$$-mx = b \quad (\text{the troll})$$

$$x = -b/m \quad (\text{anti matter})$$

II. Application: The Budget Constraint

$$A. 100 = 5Q_A + 10Q_B$$

1. Intuitive Approach

How much A could I buy if I bought only A

How much B could I buy if I bought only B

2. Draw graph - What is the y-intercept

$$5Q_A = 100 - 10Q_B$$

$$Q_A = (100 - 10Q_B)(1/5)$$

$$Q_A = 20 - 2Q_B$$

3. Slope - how much A must give up to get unit of B

$$\frac{\Delta Q_A}{\Delta Q_B} = -2$$

Graph of Budget Constraint



III. Nonlinear Relationships

A. Zero versus Infinity

Graph 1. ZERO SLOPE



$$SLOPE = \frac{RISE}{RUN} = \frac{0}{\infty}$$

Graph 2. INFINITE SLOPE



$$SLOPE = \frac{RISE}{RUN} = \frac{\infty}{0}$$

B. Tangency - linear function touches non-linear function at one point.

Graph 1. Indifference curve



Graph 2. Profit function



V. Regression Analysis

A. Economics is an empirical science - good theories lead to predictions that can be tested empirically.

1. most common technique used to answer empirical questions is "regression analysis".
2. focus on linear regressions - extension of linear functions
3. focus on results of regression - not how regression is done.

B. Univariate-Regression Example: regression of the hourly wage in dollars (WAGE) on years of experience (EXPER)

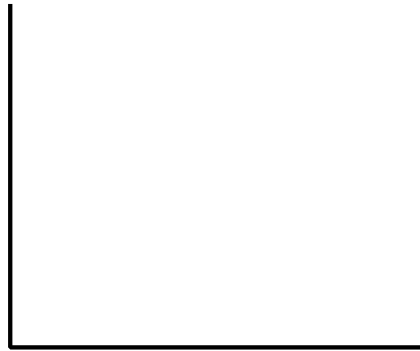
1. Suppose we thought that a persons wage depended linearly on their experience.

$$\text{WAGE} = \alpha + \beta(\text{EXPER})$$

this is just an equation of a line.

2. regression analysis is a technique to trace out a line using data on wages and experience to solve for α and β .

graph of wages and experience



3. We know that:

- a. α is just the y-intercept (value of wage when $EXPER=0$)
- b. β is just the slope

4. I took data for the city of Cincinnati in 1980 and ran the following regression

$$WAGE = 4.0 + 0.25 \times EXPER$$

- a. predicts $WAGE=4$ when $EXPER=0$.
- b. predicts wage increases by 0.25 a year of experience

$$(\Delta WAGE / \Delta EXPER) = 0.25$$

5. Margin for Error - Statistical Significance

- a. statistical techniques never give you "exact" answers - they give you **estimates**; in other words there is a margin of error.
- b. The standard error is an estimate of the margin for error. In our example the standard errors were:
 - 1. for the constant: 0.5
 - 2. for the slope coefficient: 0.1

c. rule of thumb - the "true" value of the response of wages and experience is highly likely to fall within + or - 2*(standard error)

example: a person with 0 years of experience is expected to earn between:

$$4-2(0.5) < \text{wage} < 4+2(0.5) \text{ or } 3 < \text{wage} < 5$$

d. t statistic: an alternative means of telling margin of error - reported in all statistical packages

$$t\text{-stat} = \frac{\text{absolute value of regression coefficient}}{\text{standard error of regression}}$$

$$t\text{-stat for slope: } (0.25)/.1 = 2.5$$

e. statistically significant: if t-stat equals "2" then regression coefficient is "significantly greater than 0" - t-stat is greater than 2 then interval calculated above will not include 0.

6. multiple regression - more than one independent variable

$$\text{WAGE} = 4.0 + 0.24 \times \text{EXPER} + 0.47 \times \text{EDUC}$$

(0.5) (0.1) (0.03)

a. interpretation of slope coefficients is now done in the context of "all else equal":

$$\frac{\Delta \text{WAGE}}{\Delta \text{EXPER}} \Big|_{\text{EDUC}} = 0.24$$

experience increases the wage even holding education constant

$$\frac{\Delta \text{WAGE}}{\Delta \text{EDUC}} \Big|_{\text{EXPER}} = 0.47$$

education increases the wage even holding experience constant