Math Review

I. Slope-Intercept Form

A. y = mx + b

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

B. Slope.

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

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 (the troll)
x = -b/m (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 <u>linear</u> 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.

$$WAGE = \alpha + \beta(EXPER)$$

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:

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

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

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

t-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

$$\begin{array}{lcccccc} \text{WAGE} & = & 4.0 & + & 0.24 \times \text{EXPER} & + & 0.47 \times \text{EDUC} \\ & & (0.5) & & (0.1) & & (0.03) \end{array}$$

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

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

experience increases the wage even holding education constant

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

education increases the wage even holding experience constant