LiHC – Class #19

fMRI Article Results Discussion
Linear Regression Review
Linear Regression in SPSS
SPSS Practice

Acknowledgements: Brian MacElree

Types of Analyses

	ANOVA	Regression	χ^2
Dependent Variables	continuous	continuous	discrete
Independent Variables	discrete	continuous and discrete	discrete

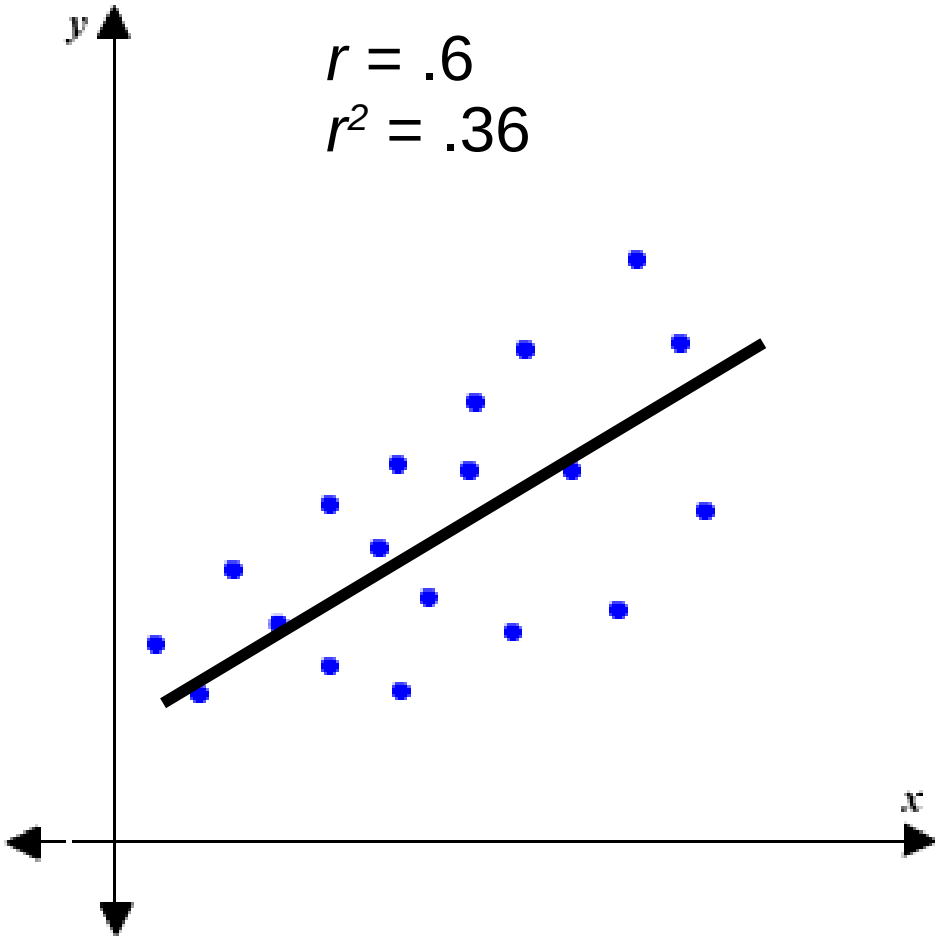
- If goal is to show a *qualitative* effect,
  - use few IV levels that have maximally different effects on DV(s)
  - maximizes *power*
- If goal is to show a *quantitative* relationship
  - use range of IV levels to illustrate consistent pattern
  - maximizes understanding of relationship, at cost of power

Simple and Complex

- One-Way ANOVA
  - One categorical IV
  - One continuous DV
- Two-Way (n-Way) ANOVA
  - Two (n) categorical IVs
  - One continuous DV
- (Multivariate ANOVA)
  - Two or more DVs

- Simple Regression
  - One continuous IV
  - One continuous DV
- Multiple Regression
  - Two or more continuous or categorical IVs
  - One continuous DV
- (Set Correlation)
  - don't ask

Questions to ask



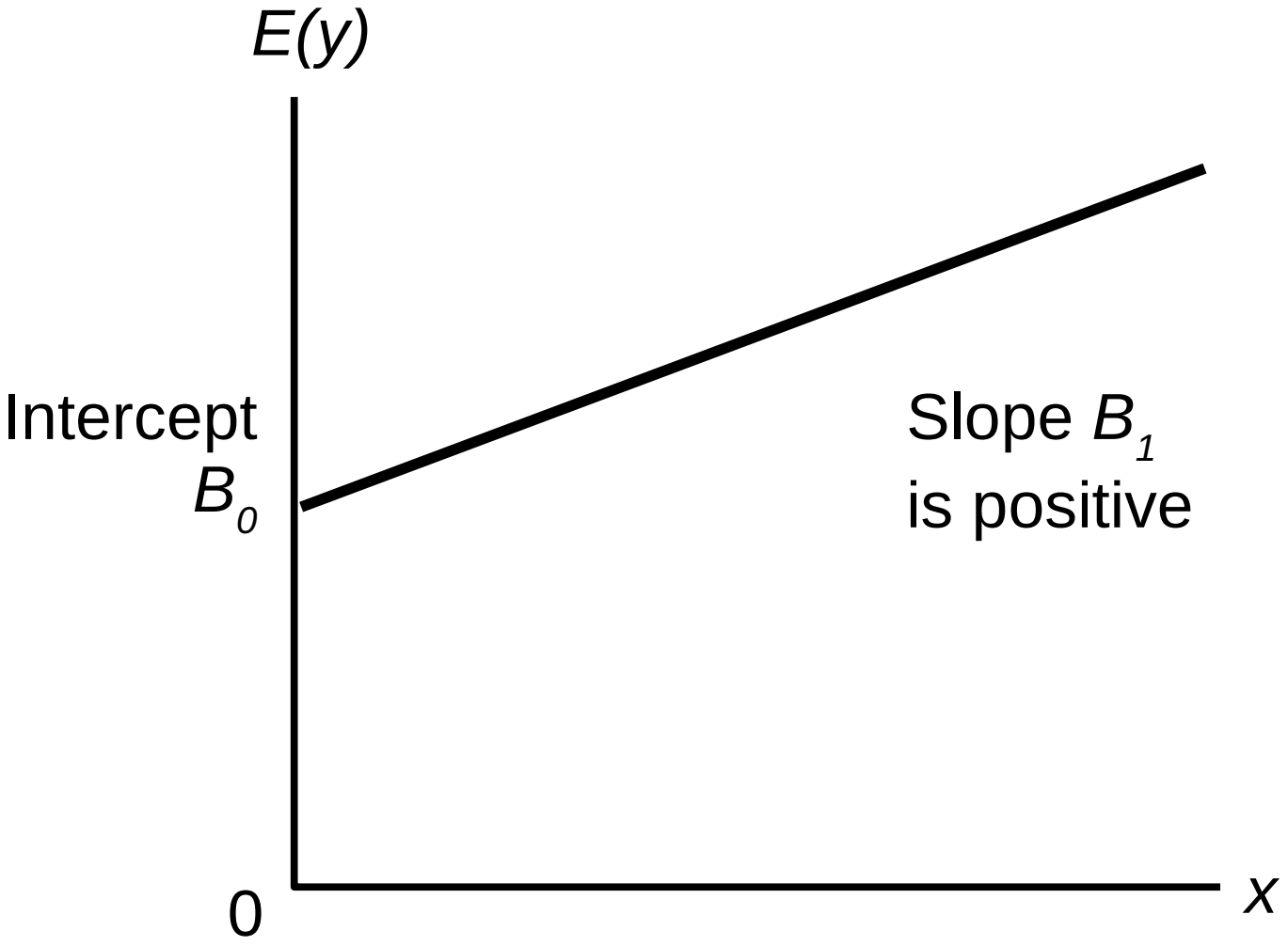
- How well can you predict *y*, given *x*?
  - correlation (*r*, r^2)
- How much does *y* change as *x* changes?
  - regression
  - equation that describes the relationship
    $y = mx + b$
- Can you be confident?
  - statistical tests of *m*, *b*

Simple Linear Regression Equation

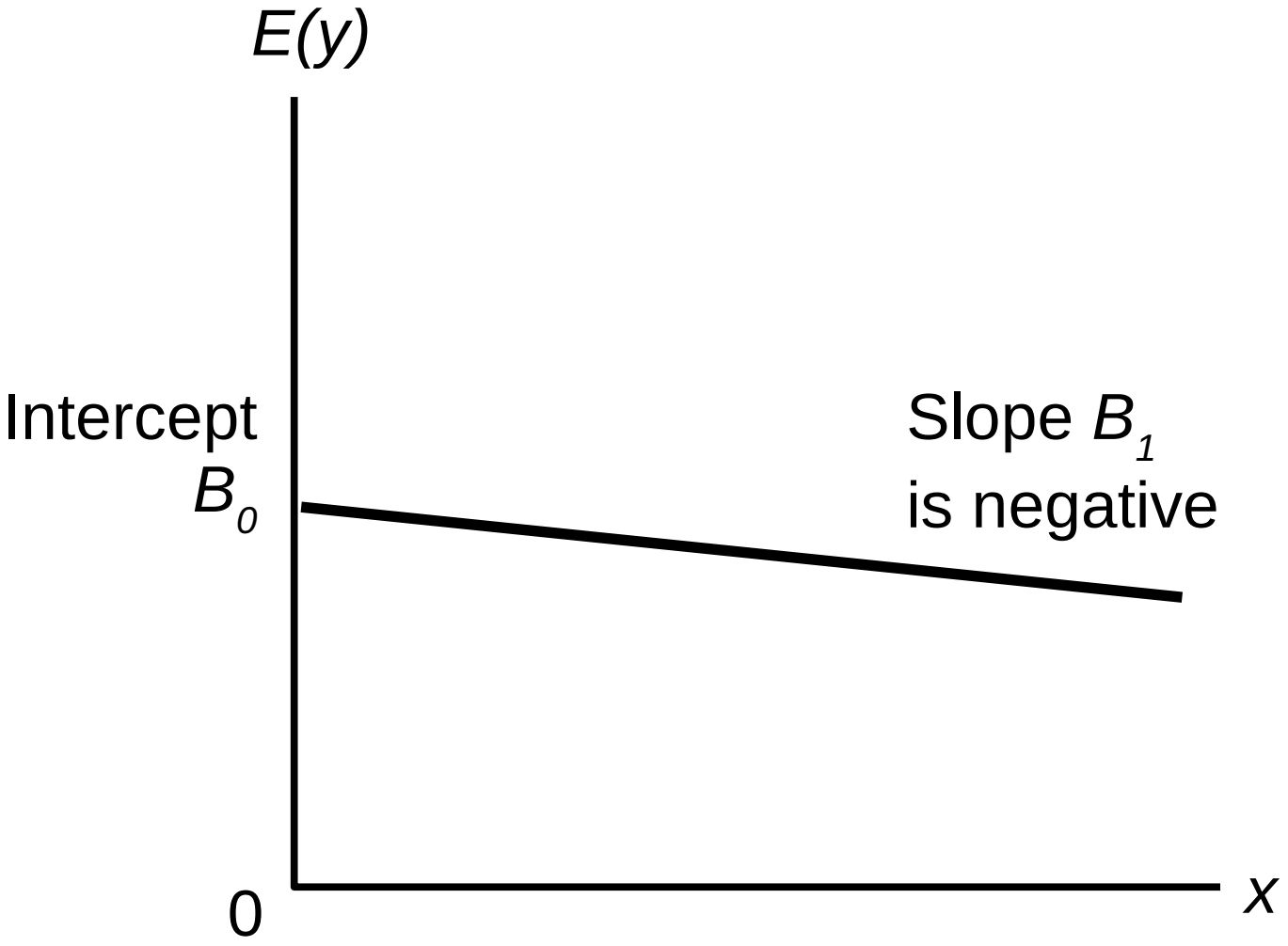
$$E(y) = B_0 + B_1 x$$

- x is the (single) predictor (IV)
- B_0 is the y intercept of the regression line
- B_1 is the slope of the regression line
- $E(y)$ is the expected value of y for a given x value
  - Noise: $y = B_0 + B_1 x + e$

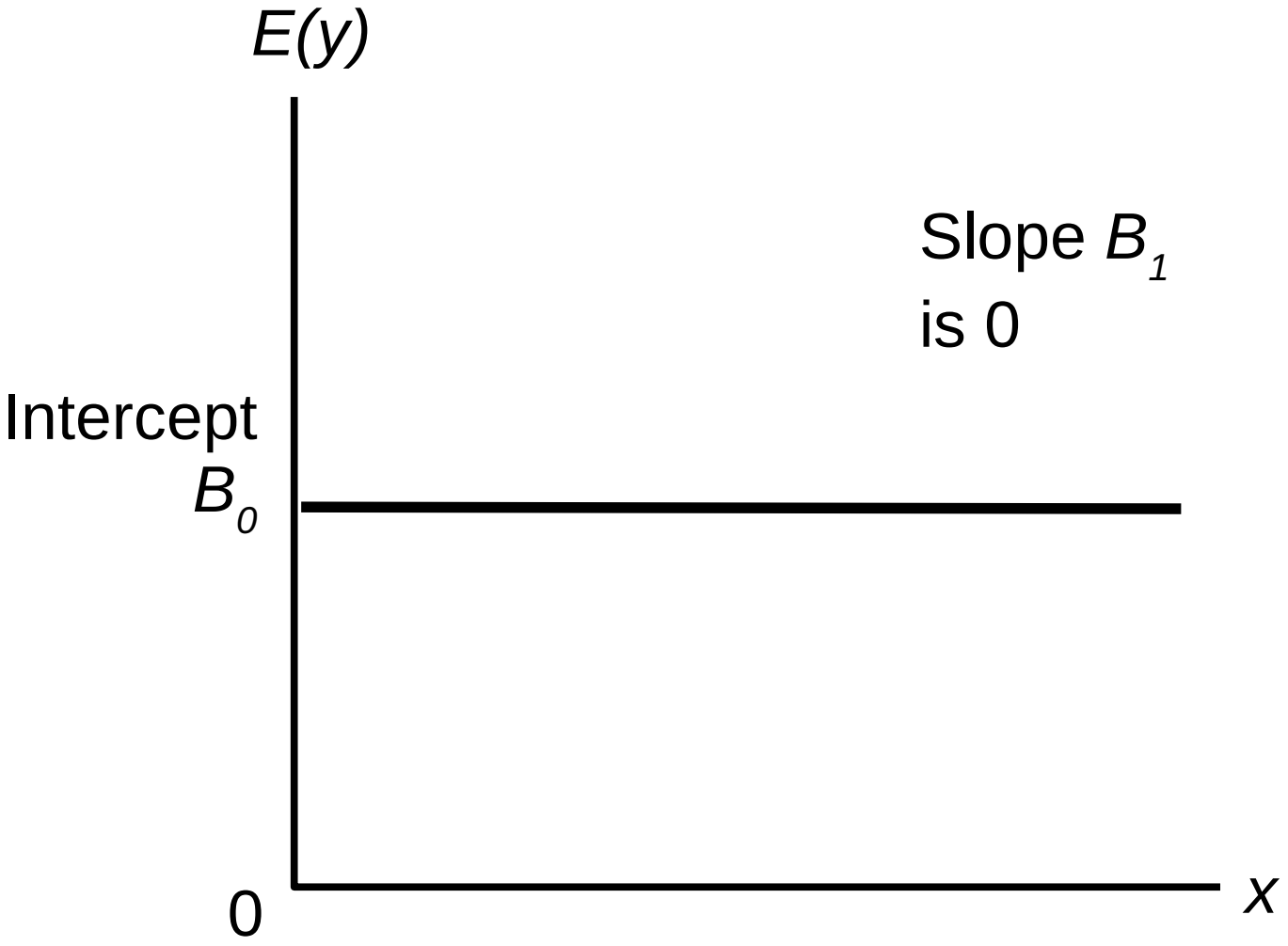
Positive Linear Relationship



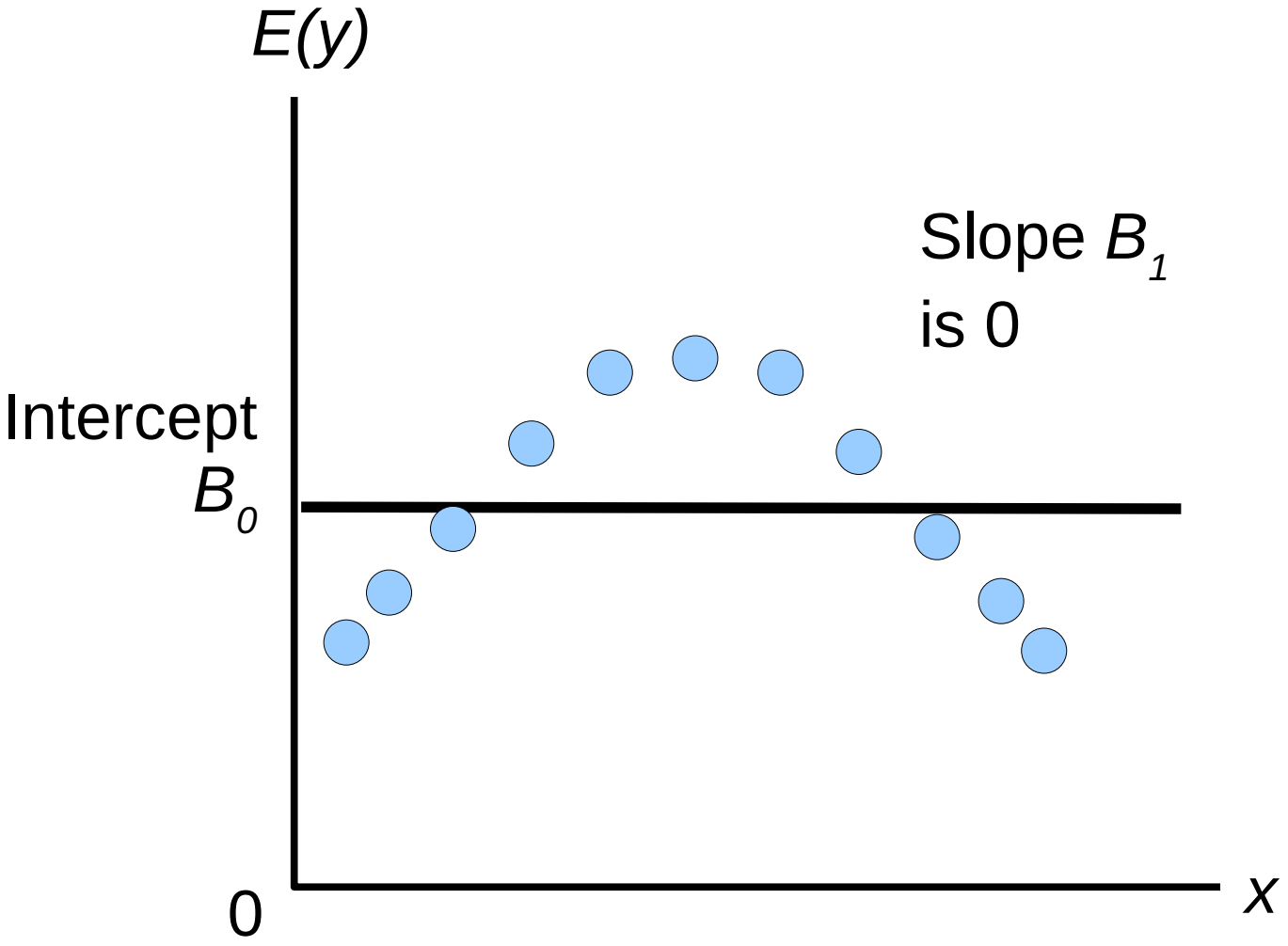
Negative Linear Relationship



No Relationship

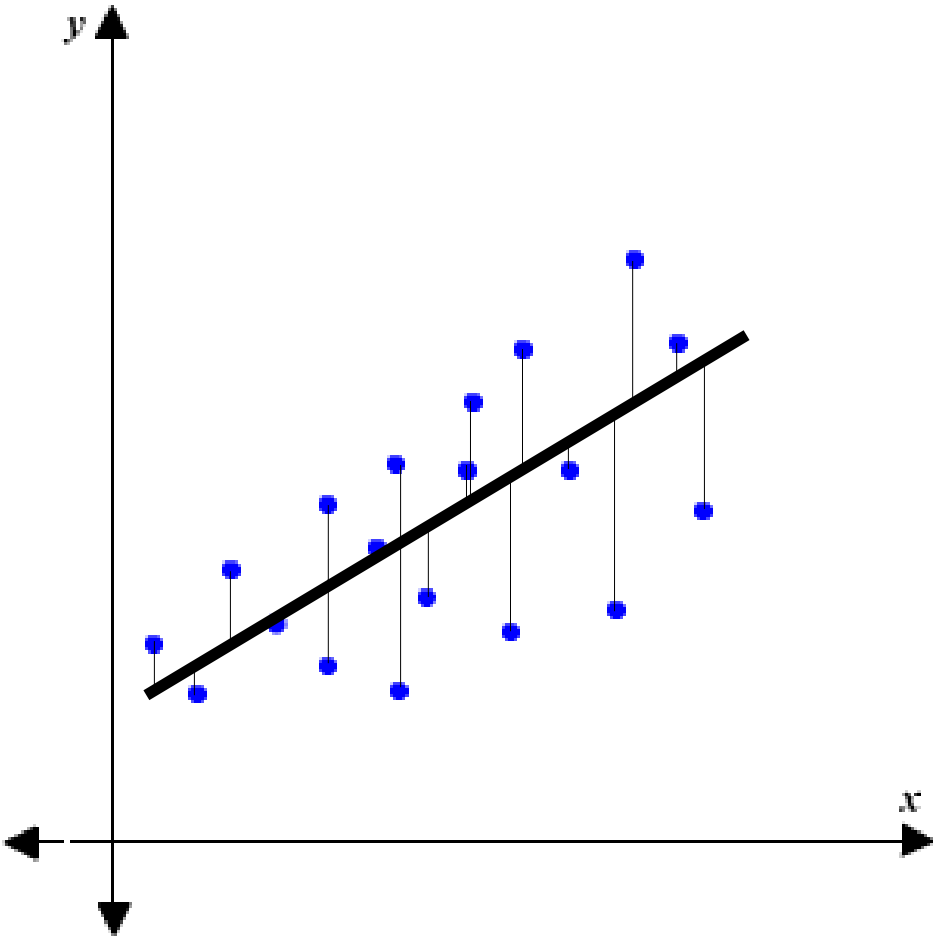


No *Linear* Relationship



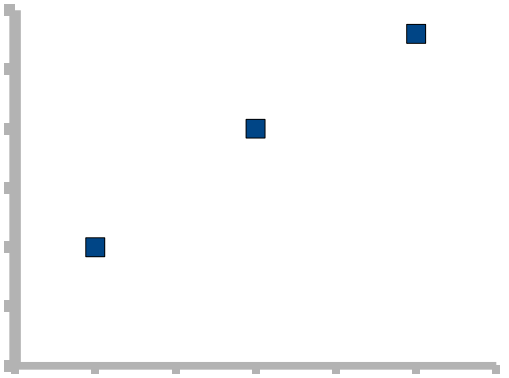
How does regression work?

- $y = B_0 + B_1 x + e$
- Given a set of data points: (x_1, y_1), (x_2, y_2), ... , (x_n, y_n),
- find the values of B_0 and B_1 that *minimize* total (squared) error.



Statistics

- Correlation (*r*)
- Estimates for B_i
  - Standard error for each B_i
  - Tells you slope of relationship between *x* and *y*
- Statistical test: is B_i significantly different from 0?
  - *t*-test!



SPSS Example

- (RegressionExamples to show data, Regression-demo1 in SPSS)

Multiple Regression

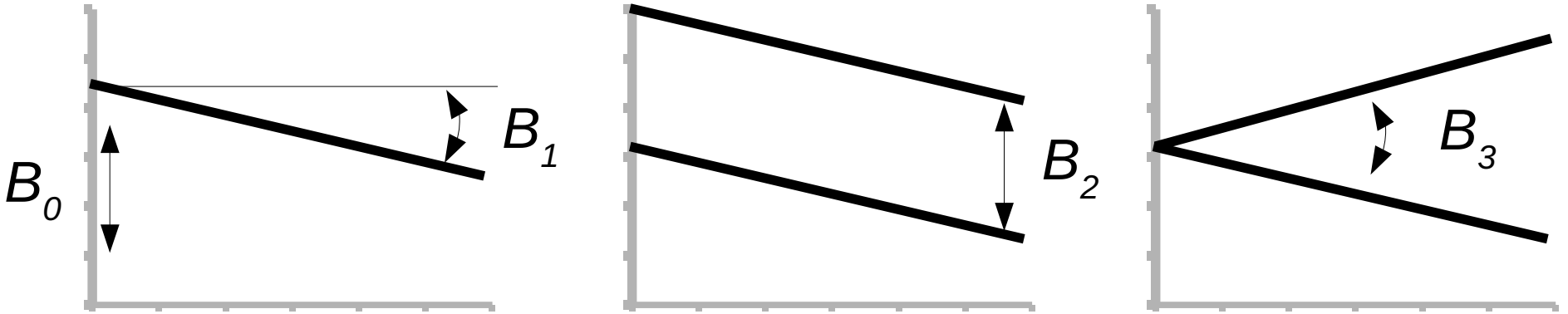
- Obvious extension: add more predictors
- $y = B_0 + B_1x_1 + B_2x_2 + B_3x_3 + e$
- If several x_i are continuous, line becomes curve in space
  - hard/impossible to visualize
- In designed experiments, one continuous predictor, plus additional categorical factors
  - Ex: predictors are set size (continuous) and probe presence (categorical)

SPSS Example 2

- (RegressionExamples to show data, Regression-demo2 in SPSS)

Interactions in Regression

- Two predictors: $y = B_0 + B_1x_1 + B_2x_2 + e$
- Add interaction: $y = B_0 + B_1x_1 + B_2x_2 + B_3x_1x_2 + e$
- In SPSS, create a new column (“x1x2”) by hand
  - x1x2 = x1 * x2
- What this means:



Tip of the iceberg

- Regression is more flexible and complicated than ANOVA!
  - add regressors one-by-one to see if they add explanatory power
  - use non-linear functions
  - test assumptions of independent regressors
  - relate to causality
  - etc., etc.