Bivariate Relationships Between Variables

ECO 230: Business and Economics Research

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Goals

- Detect *relationships* between variables.
- Be able to prescribe appropriate statistical methods for measuring relationship based on scale of measurement.

2 Correlation

2.1 Linear and Monotonic Relationships

Correlation

Correlation
Correlation: when two variables move together in some fashion.

Correlations measure *monotonic relationships*.

- Positive: When one variable increases, the other tends to increase.
- Negative: When one variable increases, the other tends to decrease.

Common Focus: Linear Relationships
Linear relationships: Visually illustrated with a straight line

Common monotonic relationships, but not linear:

- Employment experience and income
- Employment experience and productivity
- Wealth and consumer spending

2.2 Pearson vs Spearman Correlation

Pearson vs Spearman Correlation

Pearson linear correlation coefficient

- Measure of the strength of the **linear relationship**
- Parametric test for interval or ratio data
- Null hypothesis: zero linear correlation between two variables.

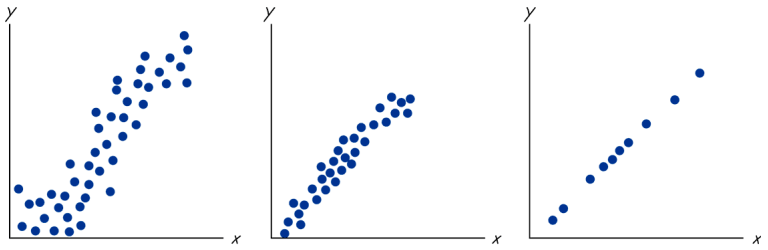
- Alternative hypothesis: linear correlation exists (either positive or negative) between two variables.

Spearman linear correlation coefficient

- Measure of the strength of a **monotonic relationship**
- Non-parametric test for ordinal, interval, and ratio data
- Pearson computation with *ranks* instead of actual data
- Same hypotheses.

2.3 Strength of Correlation

Positive linear correlation



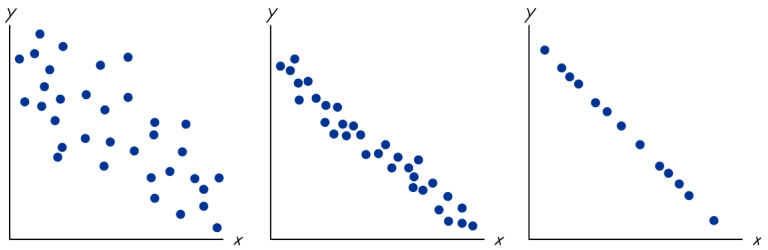
(a) Positive correlation between x and y

(b) Strong positive correlation between x and y

(c) Perfect positive correlation between x and y

- Positive correlation: move in the same direction.
- Stronger correlation: closer to 1.0
- Perfect positive correlation: $\rho = 1.0$

Negative linear correlation



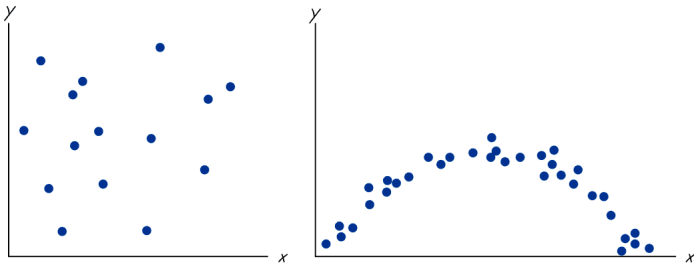
(d) Negative correlation between x and y

(e) Strong negative correlation between x and y

(f) Perfect negative correlation between x and y

- Negative correlation: move in opposite directions.
- Stronger correlation: closer to -1.0
- Perfect negative correlation: $\rho = -1.0$

No linear correlation



(g) No correlation between x and y

(h) Nonlinear relationship between x and y

- Panel (g): no relationship at all.
- Panel (h): strong relationship, but not a *linear* relationship.
  - Cannot use regular correlation to detect this.

3 Chi-Square Test of Independence

3.1 Definition and Example

Chi-Square Test for Independence

- Used to determine if two categorical variables (eg: nominal) are related.
- Example: Suppose a hotel manager surveys guest who indicate they will not return:

	Reason for Not Returning		
Reason for Stay	Price	Location	Amenities
Personal/Vacation	56	49	0
Business	20	47	27

- Data in the table are always frequencies that fall into individual categories.
- Could use this table to test if two variables are independent.

3.2 Hypothesis Test

Chi-Square Test of independence

- **Null hypothesis**: there is no relationship between the row variable and the column variable (independent)
- **Alternative hypothesis**: There is a relationship between the row variable and the column variable (dependent).