Lecture 26

Produced by Dr. Worldwide

Welcome to the 305

Probability

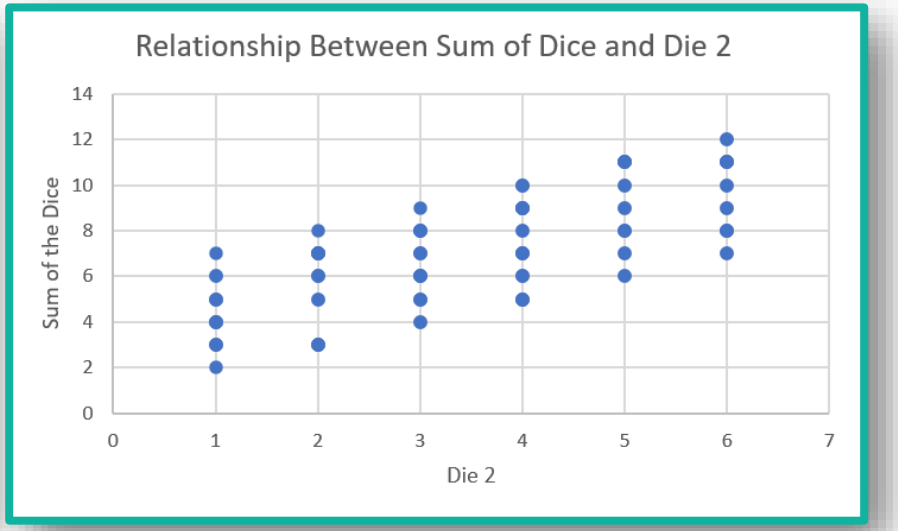
- Current methods are appropriate for univariate data
- Bivariate data contains observations from a pair of variables
- For bivariate data, the focus shifts to understanding the relationship between the two variables
- Descriptive statistics for bivariate data
  - Scatterplot
  - Covariance
  - Correlation
- Since the most widely used method for modeling relationships is linear regression, the scatterplot is often use to inspect if a linear relationship exists

Ex: Sum of Dice

- Q: What kind of relationship exists between the outcomes of the two dice?
- Q: What kind of relationship exists between the outcome of the second die and the sum of the two dice?
- Download SumDice-2.xlsx from link Sheet 1 on course website
- In Excel, create a scatterplot by using the Insert menu
- Optionally, use Recommended Charts to help you select Scatter
- Examine plots in tab named "50" and "100" for examples
- Investigate the plots to determine if your hypotheses were true

Ex: Sum of Dice

- Plots based on 100 observations from the population

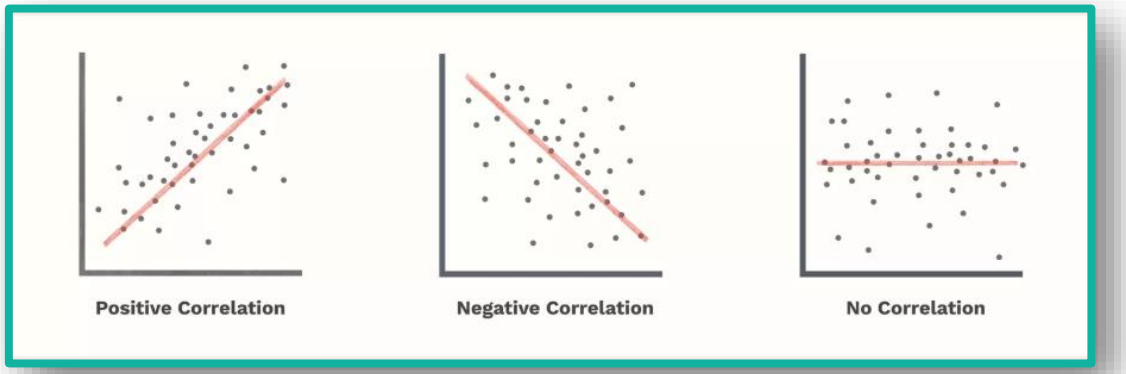


- Q: How would we quantify the difference between these relationships?

Descriptive Statistics

- The sample correlation coefficient measures the strength of linear relationship between two variables on a scale between -1 and +1
  - Close to 1 implies strong positive correlation
  - Close to -1 implies strong negative correlation
  - Close to 0 indicates no correlation
  - Formula

$$r = \frac{1}{n}\sum\left(\frac{x_i - \overline{x(n)}}{s_x}\right)\left(\frac{y_i - \overline{y(n)}}{s_y}\right)$$



Ex: Sum of Dice

- Calculation of correlation using CORREL(variable 1, variable 2)
  - When n=50

Sample correlation (W,X)	0.675188473
Sample correlation (Y,W)	-0.110785404

  - When n=100

Sample correlation (W,X)	0.73263405
Sample correlation (Y,W)	0.06826615

  - When n=200

Sample correlation (W,X)	0.67376759
Sample correlation (Y,W)	-0.0530525

Descriptive Statistics

- Previous statistic is often called Pearson's correlation coefficient

- Assumptions for Pearson's correlation coefficient
  - Both variables are normally distributed (approximately bell-shaped)
  - Relationship can be expressed by a line
  - Data is equally distributed around the best-fitted line

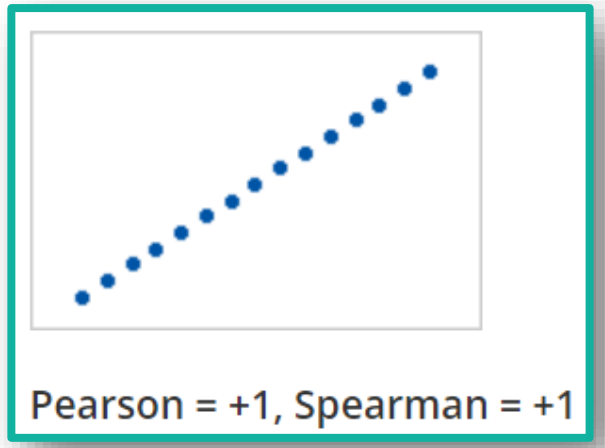
- Spearman's correlation coefficient is the nonparametric version of the latter and evaluates the monotonic relationship between the ranked values

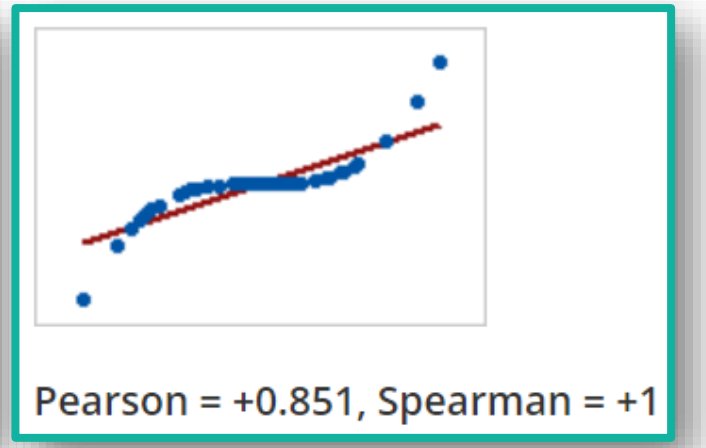
- Monotonic implies that variables change together but not at a constant rate

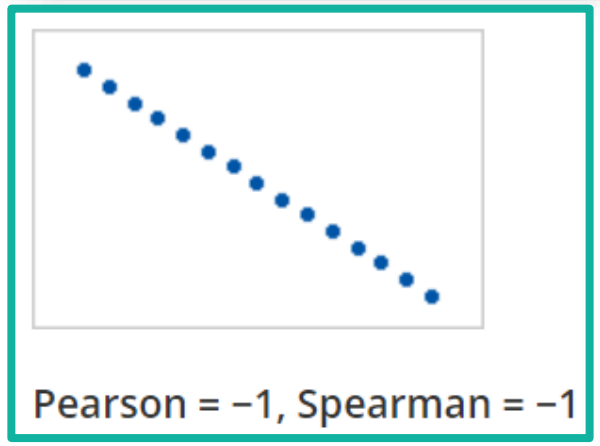
- Both correlation coefficients are between -1 and 1

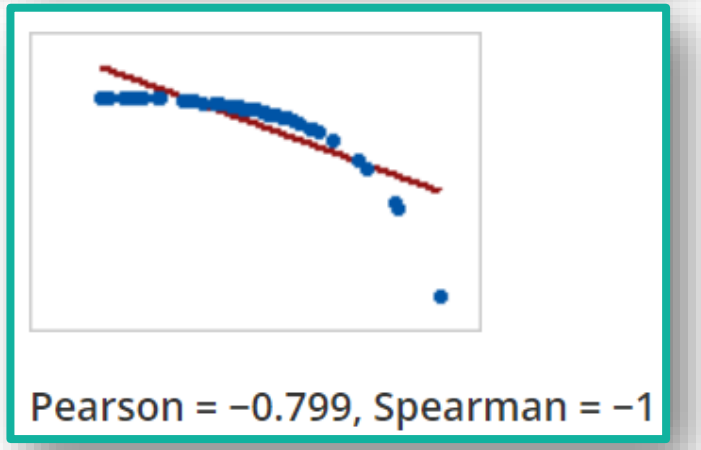
Descriptive Statistics

- Visual difference between Pearson and Spearman


Pearson = +1, Spearman = +1


Pearson = +0.851, Spearman = +1


Pearson = −1, Spearman = −1


Pearson = −0.799, Spearman = −1

Descriptive Statistics

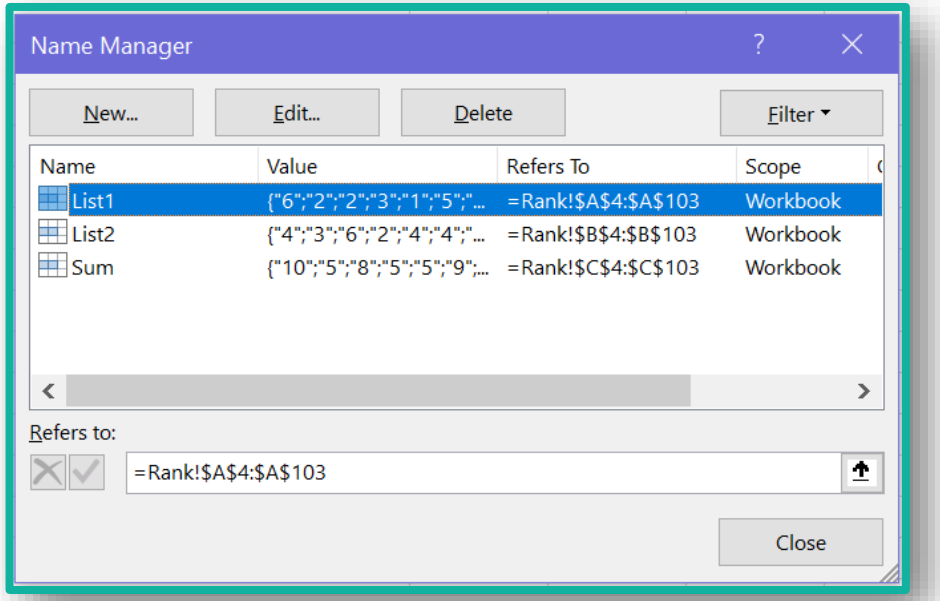
- Advantage of Spearman's is that it can be applied to discrete numeric and ordinal categorical data
- Formulation is based on ranking the observations for each of the variables and computing the Pearson correlation coefficient for the ranks
- When ranking, we handle ties by computing the average

  =RANK.AVG(observation, variable, 0=descending)
- Evaluation of Spearman's correlation coefficient

  =CORREL(RANK.AVG(variable 1),RANK.AVG(variable 2))

Ex: Sum of Dice

- Calculation of Spearman's correlation in tab named "Rank"
  - Create variables for first die roll, second die roll, and sum of dice



  - Create columns of ranks using RANK.AVG
  - Use CORREL function on ranked columns

Spearman's Correlation (W,X)	0.730623
Spearman's Correlation (Y,W)	0.070636

PivotTables

- The PivotTable is a powerful tool to calculate, summarize, and analyze data
- The purpose is to organize and summarize the data in a way that can be used to answer questions or visualize patterns
- Two tutorials provided on the course website
  - Tutorial from Excel Easy is found in Link 1 on course website
  - Tutorial from Microsoft Support is found in Link 2 on course website
- Many YouTube videos in addition to these two tutorials
- Companies use Excel's PivotTables as their main tool for summarizing data making competency in this area extremely marketable

Ex: Cancer Research

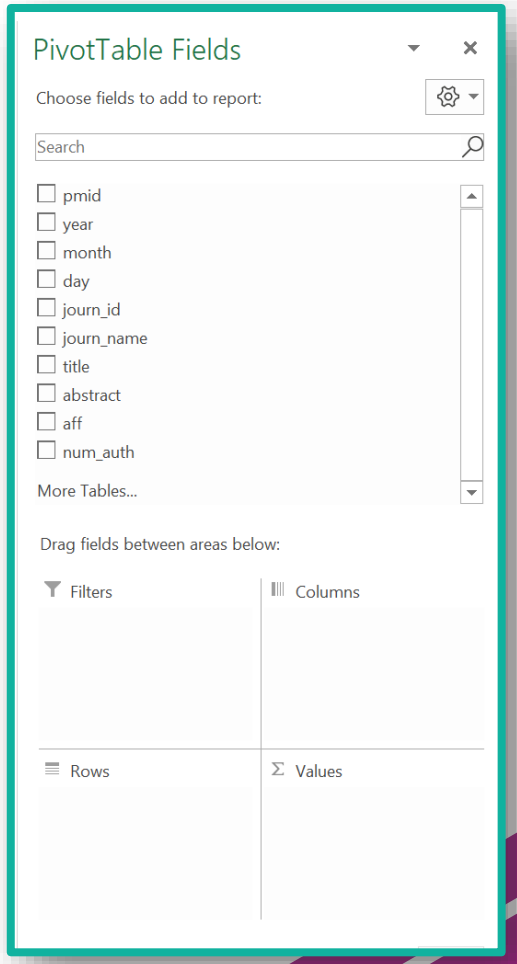
- Download CancerResearch.xlsx from link Sheet 2 on course website

- Results form a PubMed search on the topic "Non-small lung cancer"

- Dataset contains 10 fields
  - Article ID number (*pmid*)
  - Year of publication (*year*)
  - Month of publication (*month*)
  - Day of publication (*day*)
  - Journal ID number (*journ_id*)
  - Journal title (*journ_name*)
  - Article title (*title*)
  - Article abstract (*abstract*)
  - Author's affiliations (*aff*)
  - Number of authors (*num_auth*)

Ex: Cancer Research

- Select all data: Select cell A1 (top-left) and use the shortcut Ctrl+Shift+Down+Right to automatically select all the data
- When selecting the data include column names in selection
- Go to Insert menu to find PivotTable in the far left
- By default, this operation will generate a new tab
- Menu bar is used to customize the PivotTable



Ex: Cancer Research

- Aspects of the menu bar
  - PivotTable Fields: Box containing all the variables from selection
  - Filters: Box where you can select fields to filter the rows
  - Columns: Field(s) used to define the columns of the table
  - Rows: Field(s) used to define the rows of the table
  - Values: Type of summary statistic that the table should display

- Possible summary statistics
  - Sum
  - Count
  - Average
  - Max
  - Min
  - Product
  - StdDev
  - Var

Ex: Cancer Research

- Q: When was the research on non-small cell lung cancer most active?
- Q: What journals published more papers on that topic?
- Q: What institutions have conducted the most research in this area?
- Q: What was the average number of authors for each journal?
- Q: What other questions could we explore in this dataset?
- Go to tab named "Pivot Table" and play around with the example or create your own tab and start from scratch

PivotCharts

- PivotCharts are visual representations of the PivotTable
- Create PivotCharts through the Insert menu after selecting data
- Different options in menu bar
  - PivotChart Fields: Box containing all the variables from selection
  - Filters: A box where you can select fields to filter the axis labels
  - Legend(Series): Field(s) that will be used to create legends
  - Axis (Categories): Field(s) used to define axis labels
  - Values: Type of summary statistic that the chart should summarize
- The default PivotChart is a barplot but many other options exist
- When chart is selected, go through the Design menu to find Change Chart Type

The End

Dale