Section 2.1

Chapter 2 - Relationships b/t Variables

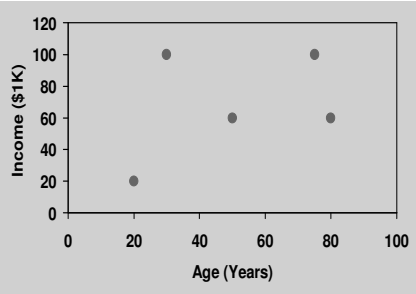
	1 Variable (Ch. 1)	**2 Variables (Ch.2)**
Graphical Summaries	histograms, etc.	scatterplots
Numerical Summaries	center, spread	correlation
Models	density curve	regression

Exploring the Relationship b/t Two Variables

- We label the two variables as "x" and "y."
- **Question:** Is there an **association** between the two variables? That is, do they tend to vary together?
- **Graphical Solution: Scatterplot**
  A scatterplot is the most common way of graphically exploring the relationship between two **quantitative** variables.

Example

Name	Age	Income ($ 1K)
Anna	20	20
Bert	50	60
Chad	80	60
Dave	30	100
Erin	75	100



Purpose

1. **Explore the nature of the relationship between two variables**
2. **Show that one variable can explain the variation in the other variable**

Response (Dependent) Variable - measures an outcome of a study

Explanatory (Independent) Variable - explains or causes changes in the response variable.

In a response/explanatory setting, **always** plot the explanatory (x) variable on the horizontal axis.

Response/Explanatory Variables

In the following situations, indicate if a response-explanatory relationship exists. If so, which variable is the response variable and which variable is the explanatory variable?

- The amount of time spent studying for an exam and the grade on the exam.

  Response: Grade on the Exam

  Explanatory: Time spent studying

- The height of husband and the height of wife.

  No response/explanatory relationship

- The crop yield and the amount of yearly rainfall.

  Response: Crop Yield

  Explanatory: Rainfall

Note: Calling one variable explanatory and the other response doesn't necessarily mean that changes in one *causes* changes in the other.

Examining a Scatterplot

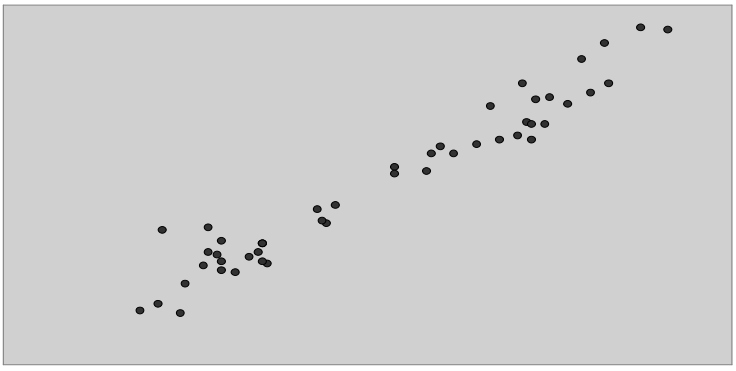
When examining a scatterplot we want to look for an overall pattern and observations that noticeably deviate from this pattern. Overall patterns are described by:

1. Form
2. Direction
3. Strength

An **outlier** is an individual value that falls outside the overall pattern of the relationship.

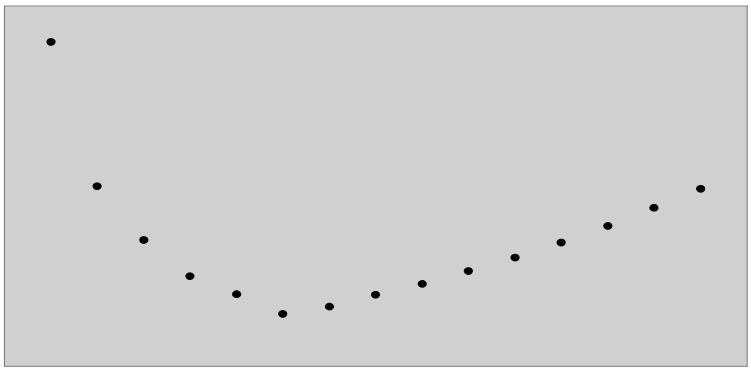
Form

Linear



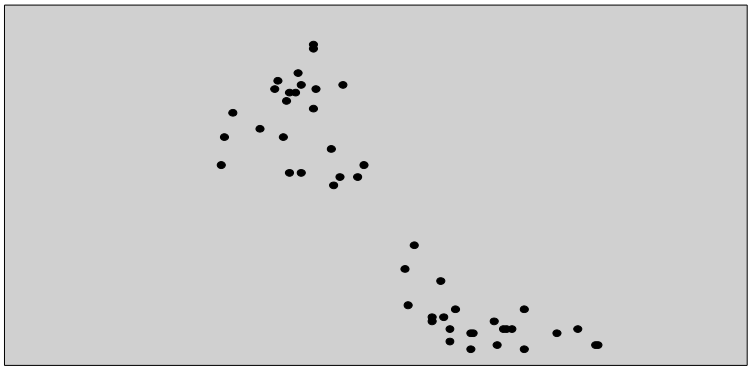
Form

Curved



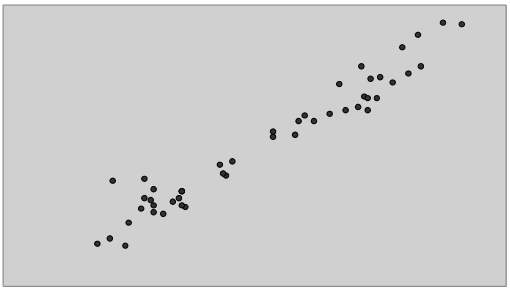
Form

Clustered



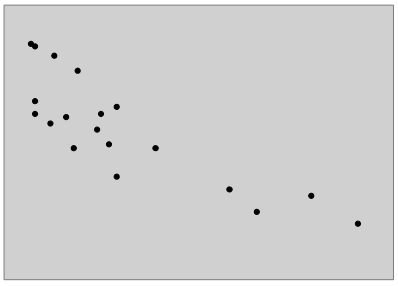
Direction

Positive Association – As values of the x variable increase, values of the y variable increase.



Direction

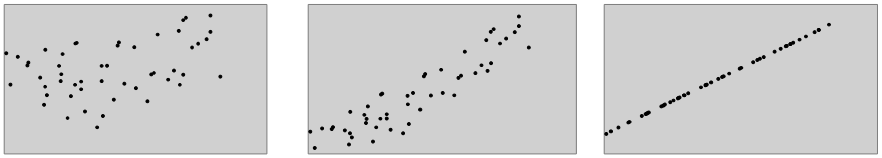
Negative Association – As values of the x variable increase, values of the y variable decrease.



Strength

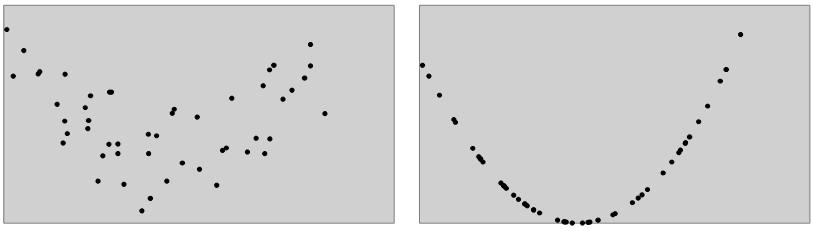
Strength refers to how scattered the points are about a line or curve.

WEAK **MODERATE** **STRONG**



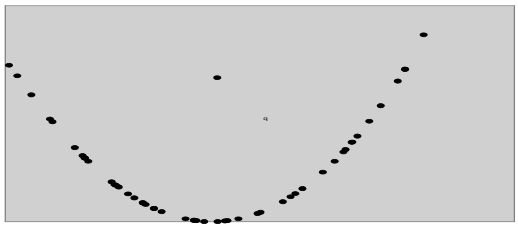
Strength

WEAK CURVE **STRONG CURVE**



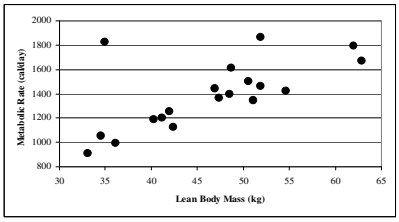
Outliers

An individual is an **outlier** if it falls outside the overall pattern of the relationship.



Example

The plot shown below is a scatterplot of the lean body mass of some individuals and their metabolic rate.



Lean body mass – body weight excluding fat
Metabolic rate – rate body consumes energy

- What is the form of this relationship?
  - The form is linear; the points follow a straight line.
- Is there a positive or negative association? Why?
  - Positive Association: As lean body mass increases, metabolic rate increases.
- How strong is the relationship?
  - The relationship is fairly weak.
- Do there appear to be any outliers? If so, which point? Does it strengthen or weaken the linear relationship?
  - There is one outlier - someone with a low body mass and high metabolism. It weakens the linear relationship..

Adding a Categorical Variable

Use different colors or symbols to plot points when you want to add a categorical variable to a scatterplot. Below is the plot of the lean body mass data with women marked as triangles and men as circles.