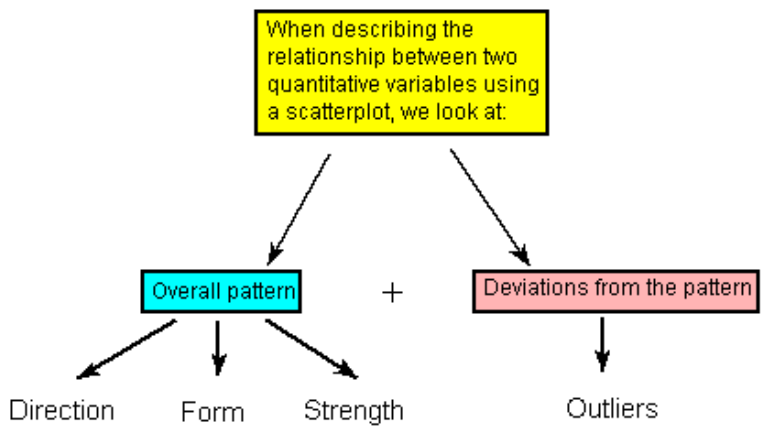
Scatterplot: Interpretation

Learning Objective: Graphically display the relationship between two quantitative variables and describe: a) the overall pattern, and b) striking deviations from the pattern.

Interpreting the Scatterplot

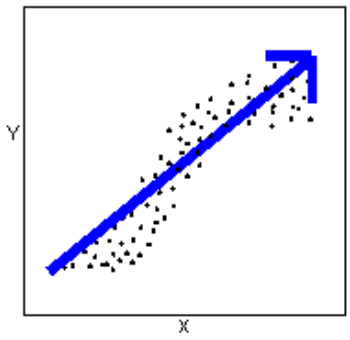
How do we explore the relationship between two quantitative variables using the scatterplot? What should we look at, or pay attention to?

Recall that when we described the distribution of a single quantitative variable with a histogram, we described the overall pattern of the distribution (shape, center, spread) and any deviations from that pattern (outliers). **We do the same thing with the scatterplot.** The following figure summarizes this point:

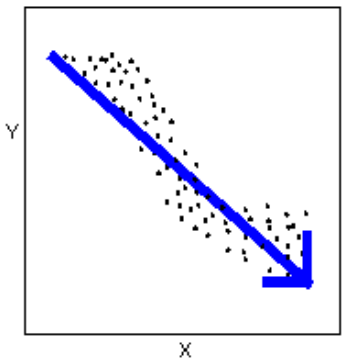


As the figure explains, when describing the **overall pattern** of the relationship we look at its direction, form and strength.

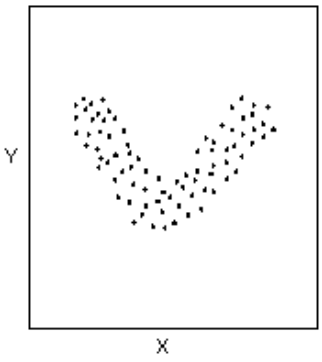
- The **direction** of the relationship can be positive, negative, or neither:



Positive relationship



Negative relationship



Neither positive nor negative

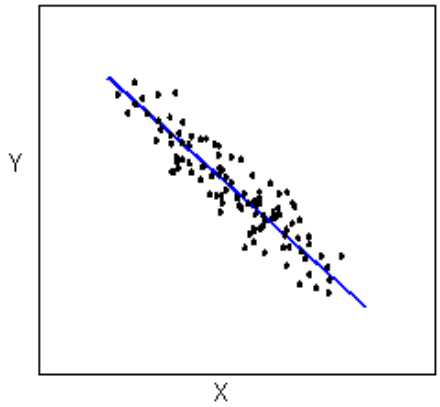
A **positive (or increasing) relationship** means that an increase in one of the variables is associated with an increase in the other.

A **negative (or decreasing) relationship** means that an increase in one of the variables is associated with a decrease in the other.

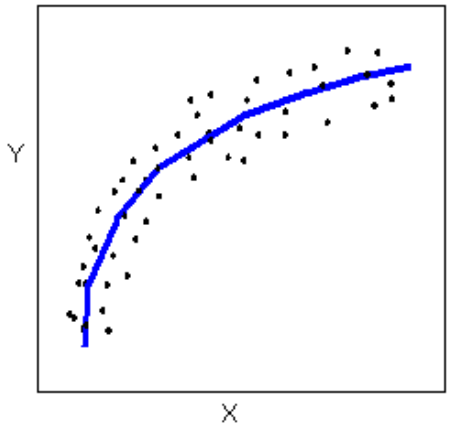
Not all relationships can be classified as either positive or negative.

- The **form** of the relationship is its general shape. When identifying the form, we try to find the simplest way to describe the shape of the scatterplot. There are many possible forms. Here are a couple that are quite common:

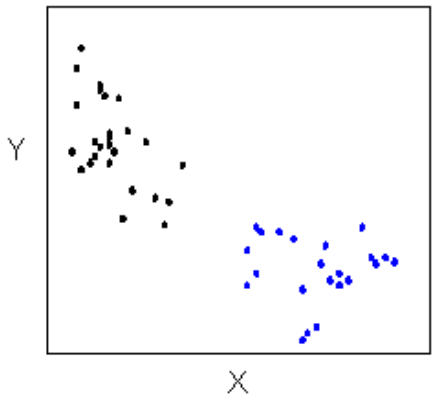
  Relationships with a **linear** form are most simply described as points scattered about a line:



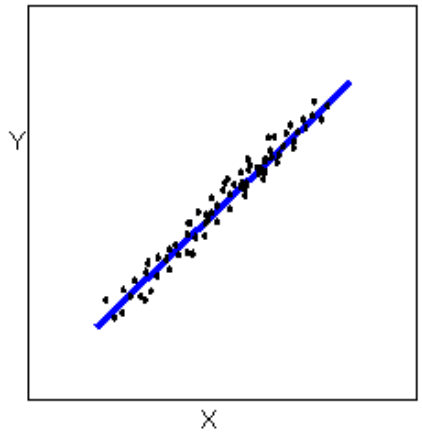
Relationships with a **curvilinear** form are most simply described as points dispersed around the same curved line:



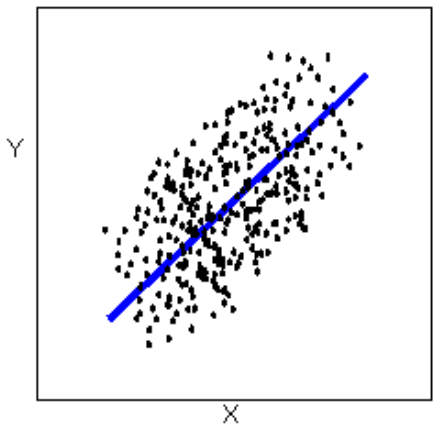
There are many other possible forms for the relationship between two quantitative variables, but linear and curvilinear forms are quite common and easy to identify. Another form-related pattern that we should be aware of is clusters in the data:



- The **strength** of the relationship is determined by how closely the data follow the form of the relationship. Let's look, for example, at the following two scatterplots displaying positive, linear relationships:



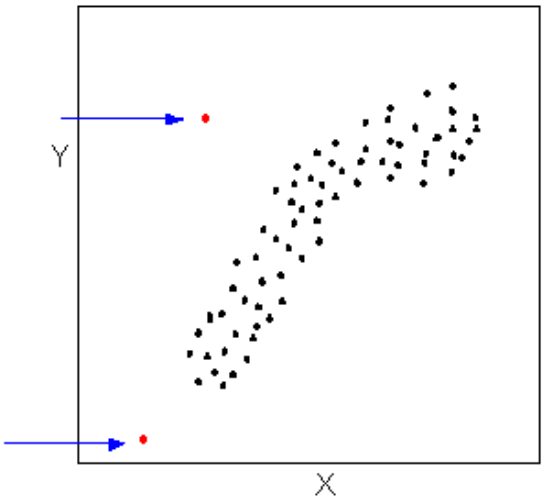
strong relationship



weaker relationship

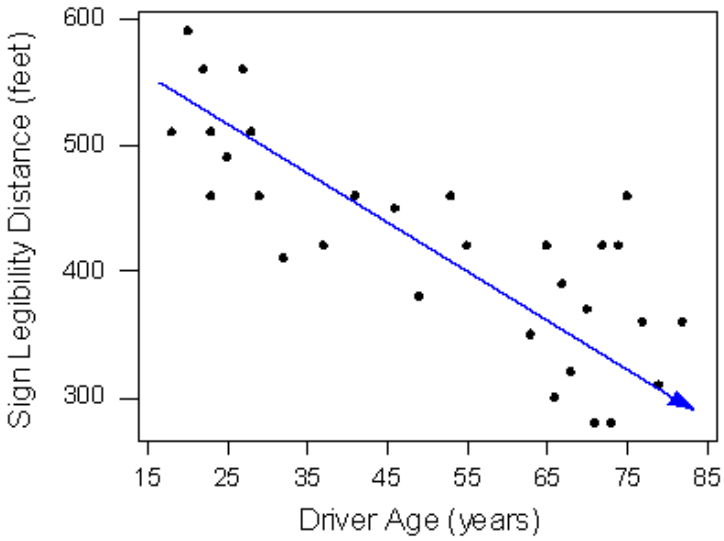
The strength of the relationship is determined by how closely the data points follow the form. We can see that in the top scatterplot the data points follow the linear pattern quite closely. This is an example of a strong relationship. In the bottom scatterplot, the points also follow the linear pattern, but much less closely, and therefore we can say that the relationship is weaker. In general, though, assessing the strength of a relationship just by looking at the scatterplot is quite problematic, and we need a numerical measure to help us with that. We will discuss that later in this section.

Data points that **deviate from the pattern** of the relationship are called **outliers**. We will see several examples of outliers during this section. Two outliers are illustrated in the scatterplot below:



Let's go back now to our example, and use the scatterplot to examine the relationship between the age of the driver and the maximum sign legibility distance. Here is the scatterplot:

The direction of the relationship is **negative**, which makes sense in context, since as you get older your eyesight weakens, and in particular older drivers tend to be able to read signs only at lesser distances. An arrow drawn over the scatterplot illustrates the negative direction of this relationship:



The form of the relationship seems to be **linear**. Notice how the points tend to be scattered about the line. Although, as we mentioned earlier, it is problematic to assess the strength without a numerical measure, the relationship appears to be **moderately strong**, as the data is fairly tightly scattered about the line. Finally, all the data points seem to "obey" the pattern—there **do not appear to be any outliers**.
