What does it mean to scale my data, versus log transform my data?

log simply takes the logarithm (base e, by default) of each element of the vector.  
scale, with default settings, will calculate the mean and standard deviation of the entire vector, then "scale" each element by those values by subtracting the mean and dividing by the sd.

But what is the significance of scale()? What could my reasoning be for using it

scale make more sense when you have multiple variables that you are considering across different scales. eg, one var is of order of magnitude 100 while another is of order of magnitude 1000000

ie hp vs. mpg

Another (very lose) way to think about it: when using scale, you are not changing the data, rather you are changing the scale (the axis values when plotting). Think of grabbing the axis at the two ends and stretching or compressing it. That is scale. In contrast, log actually changes the data. The impact of log is "stronger" for larger values and more minimal for smaller values

It provides nothing else but a *standardization* of the data