We have learned how to find areas (probabilities) under any normal curve on a specified interval by converting the variable $x$ to the standardized variable $z$. Today we will go the other direction.

- How to find a $z$-score given the area under the normal curve
- How to transform a $z$-score to an $x$-value
- How to find a specific data value of a normal distribution given the probability (or percent)

### Finding $z$-scores

We are given a probability (or percent or area) and wish to determine the relevant $z$-scores.

**Remarks**

- Generally the given area will not be in the table, so just use the entry closest to it. If the area is halfway between two area entries then use a $z$-score halfway between the corresponding $z$-scores.
- Don’t confuse $z$-scores and areas. A $z$-score is a distance along the horizontal axis, but areas are the region under the normal curve.
- Areas are positive or (approximately) zero, but never negative.
- Be careful to choose the correct (left/right) side of the graph.
  - A value separating the top 10% from the other values will be located on the right side of the graph, but a value separating the bottom 10% will be located on the left side of the graph.
  - A $z$-score must be negative whenever it is located in the left half of the normal distribution.

### Transforming a $z$-Score to an $x$-Value

To transform a standard $z$-score to a data value $x$ in a given population, use

$$x = \mu + z\sigma$$

**Remark**

This is the same formula we have been using.