The Distribution

The  *distribution*, also called the *standard normal distribution*, is a normal distribution with a mean of zero and a standard deviation of one. It is used to standardize values in order to determine their probability. Probability in a distribution is represented as the area between the curve and the horizontal axis – often called the area under the curve. (This is actually true of all probability distributions – they all use area under the curve to measure probability).

Let’s draw a distribution and label some of its important features:

values are in units of standard deviations, so they express how many standard deviations away from the mean a particular value is. For example, a value that standardizes to a of is two standard deviations above the mean, while a value that standardizes to a of is standard deviations below the mean.

The *table* is used to look up probabilities for different values of . The probability of a value falling at or above a given is called the upper tail probability, or *upper tail p-value.* The probability of a value falling at or below a given is called the lower tail probability, or *lower tail p-value*. The probability of a value falling a given distance away from the mean in either tail is called the *two-tailed p-value* (don’t worry – there will be more on this one later). These p-values will be very important in hypothesis testing, where they will be the evidence in the *p-value approach to rejecting the null hypothesis.*

*Example 1*. What is the probability that a randomly drawn z value would be greater than or equal to 1.24? This is what is called the **upper tail p-value** of

*Example 2.* What is the probability that a randomly drawn z value would be less than or equal to ? This is what is called the **lower tail p-value** of

*Example 3.* What is the probability that a randomly drawn z value would be at least standard deviations away from the mean? This is what is called a **two-tailed p-value**.

Now it is your turn! Try the three exercises below.

*Exercise 1.* What is the UT p-value of ?

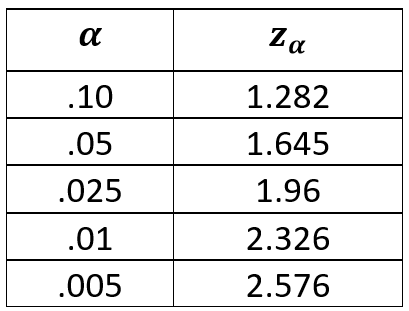
*Exercise 2.* What is the LT p-value of ?

*Exercise 3.* What is the 2T p-value of ?

**Critical Values of Z**

Critical Values (CVs) are values of with given tail probabilities. In notation, Critical Values are always subscripted with a probability. In general, is the CV of with probability in the upper tail, and is the CV of with probability in the lower tail.

Some common CVs of are given in the inset table on the first page of the z table, reproduced here:



where the tail probability

and the Critical Value of with probability in the tail

*Example 4.* Look up the **upper tail CV** of at Draw and fully label the distribution showing the CV and shading in the tail probability.

*Example 5.* Look up the **lower tail CV** of at Draw and fully label the distribution showing the CV and shading in the tail probability.

*Example 6.* Look up the **two-tailed Critical Values** of at Draw and fully label the distribution. Here are the steps to look up the 2T CVs:

1. Split between the two tails by dividing by 2
2. Look up the LT CV of at and the UT CV of at . These are your 2T CVs.

**Why do we need Critical Values?**

Critical Values can give us information about the p-value (the probability) of other values of . This use of CVs will be very important in hypothesis testing, where they will be the evidence in the *Critical Value approach to rejecting the null hypothesis.*

What is the UT CV of at Draw and fully label the distribution. What can this picture tell us about the UT p-value of