https://richarddmorey.shinyapps.io/severity/?mu0=150&mu1=150&sigma=10&n=100&xbar=152&xmin=145&xmax=155&alpha=0.05&dir=%3E

Areas under the standard Normal distribution (to the right of z)

| z | 0 | .5 | 1 | 1.5 | 1.65 | 1.96 | 2 | 2.5 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pr(Z $\geq$ z) | .5 | .3 | .16 | .07 | .05 | .025 | .023 | .005 | .001 | ~1 |

$H_0: \mu \leq 150$ vs. $H_1: \mu > 150$.

To get the (one-sided) P-value associated with $\mu \leq 150$ for a given value of $\bar{X}$

1. Turn $\bar{X}$ into a standard Normal variable, i.e., a z score: subtract the hypothesized mean (150) from the observed sample mean $\bar{X}$ and divide by the standard deviation of $\bar{X}$, or the standard error SE. The SE is only $\sigma/\sqrt{n} = 10/\sqrt{100} = 1$

So $z = \frac{\bar{X}-150}{1}$

2. Find the area under the standard Normal curve to the right of z.

Example I: Find the P-value associated with $\mu \leq 150$ for different values of $\bar{X}$ (there's no change to the SE). I did the first.

| | | |
|---|---|---|
| $\bar{X}$ = 152 | Z = 2 | P-value = .023 |
| $\bar{X}$ = 151 | Z = ? | P-value = ? |
| $\bar{X}$ = 150.5 | Z = ? | P-value = ? |
| $\bar{X}$ = 150 | Z = ? | P-value = ? |

**Negative z-values**: What if $\bar{X}$ < 150 results in z being a minus number? Say $\bar{X}$ = 149, so z = -1. Pr(Z $\geq$ -z) =1 – Pr(Z < -z), and because of symmetry of the Normal distribution, Pr(Z < -z)= Pr(Z > z). So the P-value is 1 – Pr( Z > z) = 1 -.16 = .84.

Don't worry, you can use the SEV app by Richard Morey.

**The Morey SEV app.** Go to *sampling distribution* (although the *curve selection* is also very informative)
Change the sampling mean to be the observed $\bar{X}$. When asking for the P-value, ignore the *alternative* (it's imagined to be a Fisherian test with just the null for this purpose), and ignore the *alpha level* box which is for power in a N-P test. Then, under *display options* ask for the *P-value*.

It's useful also to go to the *curve selection* to see the P-value. (Keep the arrow choice to >, although you can also use it for < problems.)

**Example II**: Now fix $\bar{X}$ = 152, and find P-values associated with testing 3 different null hypotheses: $\mu \leq 151$, $\mu \leq 152$ , $\mu \leq 153$
For $\mu \leq 151$

$z = \frac{\bar{X}-151}{1} = \frac{152-150}{1}$ = 1

(a) If you were testing

$H_0: \mu \leq 151$ vs. $H_1: \mu > 151$,

the P-value would be .16. Now you do the other two:

(b) For $\mu \leq 152$,

$z = \frac{\bar{X}-152}{1}$ so the P-value is _______ if you were testing

$H_0: \mu \leq 152$ vs. $H_1: \mu > 152$,

© For $\mu \leq 153$,

$z = \frac{\bar{X}-153}{1} =$ ____ so the P-value is ____ if you were testing

$H_0: \mu \leq 153$ vs. $H_1: \mu > 153$,

**Getting these P-values using the Morey app**. The sample mean remains FIXED at $\bar{X}$ = 152, and the *alternative* and the *alpha score* boxes are irrelevant (it can be done in different ways, but let's just stick with one way). The ONLY thing you change is the value for the null $\mu$ . Then under display option click P-value (it's lower case in the app). You can do it by means of the *sampling distribution* display or the *curve selection*. The sampling distribution display also provides the reasoning at the bottom

**Severity**. The severity associated with $\mu > \mu'$. (see SIST p. 143)
Using the Morey app: Set the sample mean $\bar{X}$ and change ***the alternative value for $\mu$ to $\mu'$.***
This alternative will be some discrepancy from the null value under test but, for simplicity, this computation app for severity does not pick up on changes you make to the *null box*—that is assumed fixed. Nor does it pick up on changes to the *alpha-level box,* used in N-P tests.
Then under *display option click severity* using either the *sampling distribution* display or the *curve*. The *sampling distribution* display also provides the reasoning at the bottom. The *curve* supplies SEV values for other discrepancies, so it's especially useful.

Compute the SEV values for the examples in Table 3.1, SIST p. 144. Here $\bar{X}$ = 152
Notice that in each case the SEV value for inferring $\mu > \mu'$ corresponds to 1 – the P-value associated with testing $\underline{\mu < \mu'}$ with this observed sample mean $\bar{X}$.