Here are some questions to direct your reading of Excursion 3 Tour I. (I am not collecting these, but some will appear as choices in the next assignment.) We will be splitting this excursion over the next two classes. I will save GTR for Mar 1, so you can skip those pages for now.

Please check the latest syllabus on my blog. It is now the third blogpost on https://errorstatistics.com.

1. Try to outline (not for collection) the key concepts of Fisher and N-P tests: test statistic, P-value, type I and type II errors, uniformly powerful test (UMP) test.


3. Try your hand at the exercises on P-values and severity on the next two pages, computing by hand or using the Morey app (linked on the next page).
Areas under the standard Normal distribution (to the right of z)

<table>
<thead>
<tr>
<th>z</th>
<th>.5</th>
<th>1</th>
<th>1.5</th>
<th>1.65</th>
<th>1.96</th>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pr(Z &gt; z)</td>
<td>.5</td>
<td>.3</td>
<td>.16</td>
<td>.07</td>
<td>.05</td>
<td>.025</td>
<td>.023</td>
<td>.005</td>
<td>.001</td>
</tr>
</tbody>
</table>

$H_0: \mu \leq 150$ 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.

<table>
<thead>
<tr>
<th>$\bar{X}$</th>
<th>152</th>
<th>151</th>
<th>150.5</th>
<th>150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>2</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>P-value</td>
<td>.023</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Negative z-values: What if $\bar{X} < 150$ results in z being a minus number? Say $\bar{X} = 149$, so $z = -1$. $Pr(Z > -z) = 1 - Pr(Z < -z)$, 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
\[ H_0: \mu \leq 151 \text{ vs. } H_1: \mu > 151, \]
the P-value would be .16. Now you do the other two:

(b) For \( \mu \leq 152 \),
\[ z = \frac{\bar{x} - 152}{1} \text{ so the P-value is ______ if you were testing } \]
\[ H_0: \mu \leq 152 \text{ vs. } H_1: \mu > 152, \]

(c) For \( \mu \leq 153 \),
\[ z = \frac{\bar{x} - 153}{1} = ____ \text{ so the P-value is ____ if you were testing } \]
\[ H_0: \mu \leq 153 \text{ vs. } H_1: \mu > 153, \]

**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 \( \mu < \mu' \) with this observed sample mean \( \bar{X} \).