

P-values with the Ti83/Ti84

Note: The majority of the commands used in this handout can be found under the DISTR menu which you can access by pressing [2nd] [VARS]. You should see the following:

```
DISTR DRAW
1:normalPdf(
2:normalcdf(
3:invNorm(
4:invT(
5:tPdf(
6:tcdf(
7↓X²Pdf(
```

NOTE: The calculator does not have a key for infinity (∞). In some cases when finding a p-value we need to use infinity as a lower or upper bound. Because the calculator does not have such a key we must use a number that acts as infinity. Usually it will be a number that would be “off the chart” if we were to use one of the tables. Please note this in the following examples.

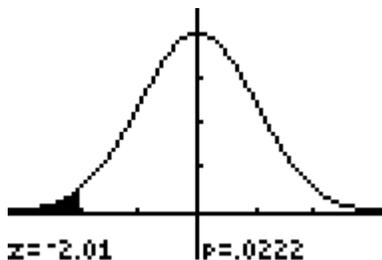
1. Z-table p-values: use choice 2: normalcdf(

NOTE: Recall for the standard normal table (the z-table) the z-scores on the table are between -3.59 and 3.59 . In essence for this table a z-score of 10 is off the charts, we could use 10 to “act like” infinity.

a. Left-tailed test ($H_1: \mu < \text{some number}$).

The p-value would be the area to the left of the test statistic.

Let our test statistics be $z = -2.01$. The p-value would be $P(z < -2.01)$ or the area under the standard normal curve to the left of $z = -2.01$.



Notice that the p-value is .0222.

We can find this value using the Normalcdf feature of the calculator found by pressing [2nd] [VARS] as noted above.

The calculator will expect the following: Normalcdf(lowerbound, upperbound). Try typing in: Normalcdf(-10, -2.01) , after pressing [ENTER] you should get the same p-value as above. It will look like the following on the calculator:

```
normalcdf(-10, -2
.01)
.0222155248
```

Notice the p-value matches the one under the normal curve given earlier. It also matches the p-value you would get if you used the standard normal table.

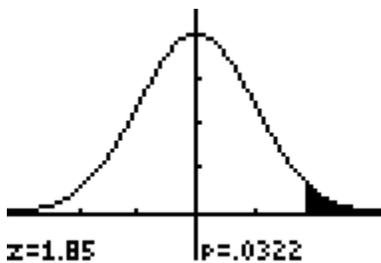
Note: For the p-value in our example we need the area from $z = -\infty$ to $z = -2.01$. The calculator does not have a key for $-\infty$, so we need to chose a value that will act like $-\infty$. If we type in Normalcdf(-10, -2.01) the -10 is acting as “ $-\infty$ ”.

b. Right tailed test ($H_1: \mu > \text{some number}$):

The p-value would be the area to the right of the test statistic.

Let our test statistics be $z = 1.85$. The p-value would be $P(z > 1.85)$ or the area under the standard normal curve to the right of $z = 1.85$.

The p-value would be the area to the right of 1.85 on the z-table.



Notice that the p-value is .0322, or $P(z > 1.85) = .0322$.

We could find this value directly using Normalcdf(1.85,10). Again, the 10 is being used to act like infinity. We could use a larger value, anything that is large enough to be off the standard normal curve would suffice.

On the calculator this would look like the following:

```
normalcdf(2.45,1  
0)  
.0071428147
```

Notice that the p-value is the same as would be found using the standard normal table.

c. **Two-tailed test ($H_1: \mu \neq \text{some number}$):**

Do the same as with a right-tailed or left-tailed test but multiply your answer by 2. Just recall that for a two-tailed test that:

- The p-value is the area to the left of the test statistic if the test statistic is on the left.
- The p-value is the area to the right of the test statistic if the test statistic is on the right.

2. **T-table p-values:** use choice 6: tcdf(

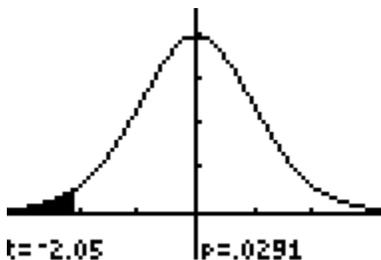
The p-values for the t-table are found in a similar manner as with the z-table, except we must include the degrees of freedom.

The calculator will expect tcdf(lowerbound, upperbound, df).

a. **Left-tailed test ($H_1: \mu < \text{some number}$)**

Let our test statistics be -2.05 and $n=16$, so $df=15$.

The p-value would be the area to the left of -2.05 or $P(t < -2.05)$



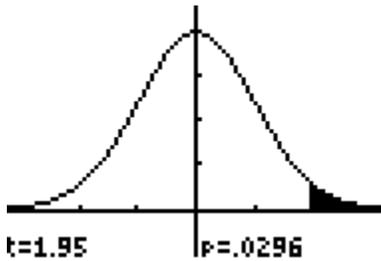
Notice the p-value is .0291, we would type in tcdf(-10, -2.05, 15) to get the same p-value. It should look like the following:

```
tcdf(-10, -2.05, 15)
.0291338715
```

Note: We are again using -10 to act like $-\infty$. Also, finding p-values using the t-distribution table is limited, you will be able to get a much more accurate answer using the calculator.

b. **Right tailed test ($H_1: \mu > \text{some number}$):**

Let our test statistic be $t = 1.95$ and $n = 36$, so $df = 35$.
The value would be the area to the right of $t = 1.95$.



Notice the p-value is $.0296$. We can find this directly by typing in $tcdf(1.95, 10, 35)$
On the calculator this should look like the following:

```
tcdf(1.95, 10, 35)
.0296111722
```

c. **Two – tailed test ($H_1: \mu \neq \text{some number}$):**

Do the same as with a right tailed or left-tailed test but multiply your answer by 2. Just recall that for a two-tailed test that:

- The p-value is the area to the left of the test statistic if the test statistics is on the left .
- The p-value is the area to the right of the test statistic if the test statistic is on the right.

3. **Chi-Square table p-values**: use choice 8: $\chi^2cdf($

The p-values for the χ^2 -table are found in a similar manner as with the t-table. The calculator will expect $\chi^2cdf(\text{lowerbound}, \text{upperbound}, \text{df})$.

a. **Left-tailed test (H1: $\sigma < \text{some number}$)**

Let our test statistic be $\chi^2 = 9.34$ with $n = 27$ so $df = 26$.

The p-value would be the area to the left of the test statistic or to the left of $\chi^2 = 9.34$. To find this with the calculator type in $\chi^2cdf(0, 9.34, 26)$, on the calculator this should look like the following:

```
χ²cdf(0,9.34,26)
.001118475
```

So the p-value is .00118475, or $P(\chi^2 < 9.34) = .0011$

Note: recall that χ^2 values are always positive, so using -10 as a lower bound does not make sense, the smallest possible χ^2 value is 0, so we use 0 as a lower bound.

b. **Right – tailed test (H1: $\sigma > \text{some number}$)**

Let our test statistic be $\chi^2 = 85.3$ with $n = 61$ and $df = 60$.

The p-value would be the area to the right of the test statistic or the right of $\chi^2 = 85.3$. To find this with the calculator type in $\chi^2cdf(85.3, 200, 60)$, on the calculator this should look like the following:

```
χ²cdf(85.3,200,60)
.0176017573
```

So the p-value is .0176 or $P(\chi^2 < 85.3) = .0176$

Note: χ^2 values can be much larger than z or t values, so our upper bound in this example was 200. You can always look at the χ^2 to get an idea of how large to pick your upper bound.

c. **Two-tailed tests $H_1: \sigma \neq \text{some number}$:**

Do the same as with a right tailed or left-tailed test but multiply your answer by 2.

Just recall that for a two-tailed test that:

- The p-value is the area to the left of the test statistic if the test statistics is on the left .
- The p-value is the area to the right of the test statistic if the test statistic is on the right.