A Critical Value for a Standard Normal Distribution is a \( z \) value on the \( z \) axis that is the vertical boundary separating the area in one tail of the graph from the remaining area.

The total tail area is denoted by \( \alpha \).

In this chapter the tail areas are normally .10 or less so the tail areas are shown as a smaller proportion of the total area.

**Left Tail (One Tail)**
- The total value of \( \alpha \) is placed in the left tail area.

**Right Tail (One Tail)**
- The total value of \( \alpha \) is placed in the right tail area.

**Two Tail (Left and Right Tails)**
- The total value of \( \alpha \) is split in half and an area of \( \frac{\alpha}{2} \) is placed in both the left tail and the right tail.

\[
\text{left tail area} = \frac{\alpha}{2} \\
\text{right tail area} = \frac{\alpha}{2}
\]
Finding the Left Tail (One Tail) Critical Value
for a Standard Normal Distribution
with a left tail area of \( \alpha \)

In the case of a Left Tail (One Tail) example the entire value of \( \alpha \) is placed in the left tail. There is no right tail critical area. **The total area denoted by \( \alpha \) is in the left tail.**

We call the \( z \) value that separates a left tail area of \( \alpha \) from the rest of the area under the curve a **Left Tail Critical Value.** The left tail has a Negative Critical \( Z \) Value that has an area of \( \alpha \) to the left. The **Left Tail Critical Value for a left tail area of \( \alpha \) is written** \( -z_\alpha \).
### Negative Z Scores Table

The numbers in the body of the table (in yellow) represents an area to the LEFT of a given z score.

The z score is the 2 digit z value from the left column (in red) with an additional decimal place from the row on top (in red).

A number in yellow that is at the intersection of the left column z value (in red) and top row z value (in red) stands for the area to the LEFT of that given z score.

The Negative Z Scores Table is used to find the Left Tail Critical Value if the area denoted by $\alpha$ is in the left tail. The number in YELLOW at the intersection of the left column (in red) and top row (in red) stands for the area to the LEFT of that given z score.

Find a number in yellow in the body of the table as close to $\alpha$ as possible. The left tail critical z value is the 2 digit z value from the left column (in red) with an additional decimal place from the row on top (in red).

<table>
<thead>
<tr>
<th>Z</th>
<th>0.00</th>
<th>0.01</th>
<th>0.02</th>
<th>0.03</th>
<th>0.04</th>
<th>0.05</th>
<th>0.06</th>
<th>0.07</th>
<th>0.08</th>
<th>0.09</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3.4</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003</td>
<td>0.002</td>
</tr>
<tr>
<td>-3.3</td>
<td>0.005</td>
<td>0.005</td>
<td>0.005</td>
<td>0.004</td>
<td>0.004</td>
<td>0.004</td>
<td>0.004</td>
<td>0.004</td>
<td>0.004</td>
<td>0.003</td>
</tr>
<tr>
<td>-3.2</td>
<td>0.007</td>
<td>0.007</td>
<td>0.006</td>
<td>0.006</td>
<td>0.006</td>
<td>0.006</td>
<td>0.006</td>
<td>0.006</td>
<td>0.005</td>
<td>0.005</td>
</tr>
<tr>
<td>-3.1</td>
<td>0.010</td>
<td>0.009</td>
<td>0.009</td>
<td>0.009</td>
<td>0.008</td>
<td>0.008</td>
<td>0.008</td>
<td>0.008</td>
<td>0.007</td>
<td>0.007</td>
</tr>
<tr>
<td>-3.0</td>
<td>0.013</td>
<td>0.013</td>
<td>0.013</td>
<td>0.012</td>
<td>0.012</td>
<td>0.011</td>
<td>0.011</td>
<td>0.011</td>
<td>0.010</td>
<td>0.010</td>
</tr>
<tr>
<td>-2.9</td>
<td>0.019</td>
<td>0.018</td>
<td>0.018</td>
<td>0.017</td>
<td>0.016</td>
<td>0.016</td>
<td>0.015</td>
<td>0.015</td>
<td>0.014</td>
<td>0.014</td>
</tr>
<tr>
<td>-2.8</td>
<td>0.026</td>
<td>0.025</td>
<td>0.024</td>
<td>0.023</td>
<td>0.023</td>
<td>0.022</td>
<td>0.021</td>
<td>0.021</td>
<td>0.020</td>
<td>0.019</td>
</tr>
<tr>
<td>-2.7</td>
<td>0.035</td>
<td>0.034</td>
<td>0.033</td>
<td>0.032</td>
<td>0.031</td>
<td>0.030</td>
<td>0.029</td>
<td>0.028</td>
<td>0.027</td>
<td>0.026</td>
</tr>
<tr>
<td>-2.6</td>
<td>0.047</td>
<td>0.045</td>
<td>0.044</td>
<td>0.043</td>
<td>0.041</td>
<td>0.040</td>
<td>0.039</td>
<td>0.038</td>
<td>0.037</td>
<td>0.036</td>
</tr>
<tr>
<td>-2.5</td>
<td>0.062</td>
<td>0.060</td>
<td>0.059</td>
<td>0.057</td>
<td>0.055</td>
<td>0.054</td>
<td>0.052</td>
<td>0.051</td>
<td>0.049</td>
<td>0.048</td>
</tr>
<tr>
<td>-2.4</td>
<td>0.082</td>
<td>0.080</td>
<td>0.078</td>
<td>0.075</td>
<td>0.073</td>
<td>0.071</td>
<td>0.069</td>
<td>0.068</td>
<td>0.066</td>
<td>0.064</td>
</tr>
<tr>
<td>-2.3</td>
<td>0.107</td>
<td>0.104</td>
<td>0.102</td>
<td>0.099</td>
<td>0.096</td>
<td>0.094</td>
<td>0.091</td>
<td>0.089</td>
<td>0.087</td>
<td>0.084</td>
</tr>
<tr>
<td>-2.2</td>
<td>0.139</td>
<td>0.136</td>
<td>0.132</td>
<td>0.129</td>
<td>0.125</td>
<td>0.122</td>
<td>0.119</td>
<td>0.116</td>
<td>0.113</td>
<td>0.110</td>
</tr>
</tbody>
</table>

This is only a portion of the entire Negative z Score Table.
Finding The Left Tail (One Tail) Critical Value for the z Distribution with a left tail area of $\alpha$

**Example 1**

Find the Left Tail (One Tail) Critical Value for an area of $\alpha = .10$ in the left tail

The number at the intersection of the left column (in red) and top row (in red) stands for the area to the LEFT of that given z score. **Find a number in YELLOW in the body of the table as close to .10 as possible.** The Left Tail critical z value is the 2 digit z value from the left column (in red) with an additional decimal place from the row on top (in red).

**Find a number in yellow in the body of the table as close to .10 as possible**

The number at the intersection of the **−1.2** row and the **0.08** column is **0.1003** which is as close to .10 as possible.

This means that the Z score with a left tail area of .10 is $Z = −1.28$

<table>
<thead>
<tr>
<th>Negative Z Scores</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Normal (Z) Distribution:</strong> Cumulative Area to the LEFT of Z</td>
<td><strong>Z</strong></td>
<td>.00</td>
<td>.01</td>
<td>.02</td>
<td>.03</td>
<td>.04</td>
<td>.05</td>
<td>.06</td>
<td>.07</td>
<td>.08</td>
</tr>
<tr>
<td><strong>−1.2</strong></td>
<td>0.1151</td>
<td>0.1131</td>
<td>0.1112</td>
<td>0.1093</td>
<td>0.1075</td>
<td>0.1056</td>
<td>0.1038</td>
<td>0.1020</td>
<td>0.1003</td>
<td>0.0985</td>
</tr>
</tbody>
</table>

The area to the left of $z$ is .10

**left tail area $\alpha = .10$**

$z = −1.28$

*negative critical value*

©2013 Eitel
Finding The Left Tail (One Tail) Critical Value for the z Distribution
with a left tail area of $\alpha$

Example 2

Find the Critical Value for an area of $\alpha = .04$ in the left tail

Find a number in YELLOW in the body of the table as close to .04 as possible

The number at the intersection of the -1.7 row and the 0.05 column is 0.0401

which is as close to .04 as possible

This means that the Z score with a left tail area of .04 is $Z = -1.75$

<table>
<thead>
<tr>
<th>Negative Z Scores</th>
<th>0.00</th>
<th>0.01</th>
<th>0.02</th>
<th>0.03</th>
<th>0.04</th>
<th>0.05</th>
<th>0.06</th>
<th>0.07</th>
<th>0.08</th>
<th>0.09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Normal (Z) Distribution: Cumulative Area to the LEFT of Z</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-1.7</td>
<td>0.0446</td>
<td>0.0436</td>
<td>0.0427</td>
<td>0.0418</td>
<td>0.0409</td>
<td><strong>0.0401</strong></td>
<td>0.0392</td>
<td>0.0384</td>
<td>0.0375</td>
<td>0.0367</td>
</tr>
</tbody>
</table>

the area to the left of $z$ is .04

left tail area $\alpha = .04$

$z = -1.75$

negative critical value
Finding The Left Tail (One Tail) Critical Value for the z Distribution
with a left tail area of \( \alpha \)

Example 3

Find the Critical Value for an area of \( \alpha = .05 \) in the left tail

Find a number in YELLOW in the body of the table as close to .05 as possible

The body of the table has a 0.0505 and a 0.0495 which are equally close to .0500

but

The cells at the bottom of the table states that for an area of 0.0500 use \( Z = -1.645 \)

Z = \(-1.645\)

<table>
<thead>
<tr>
<th>Negative Z Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Normal (Z) Distribution: Cumulative Area to the LEFT of Z</td>
</tr>
<tr>
<td>Z</td>
</tr>
<tr>
<td>-1.6</td>
</tr>
</tbody>
</table>

Z scores of -3.5 or less use .0001

<table>
<thead>
<tr>
<th>AREA</th>
<th>Z Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0500</td>
<td>-1.645</td>
</tr>
<tr>
<td>0.0050</td>
<td>-2.575</td>
</tr>
</tbody>
</table>

the area to the left of \( z \) is .05

left tail area \( \alpha = .05 \)

\( z = -1.645 \)

negative critical value
The Right Tail Critical Value for the z Distribution with a right tail area of $\alpha$.

A **Right Tail Critical z Value** for a Standard Normal Distribution is a positive z value on the z axis that is the vertical boundary separating the area in the right tail denoted by $\alpha$ from the area to the left of the Critical z Value.

The Positive Z Scores Table is used to find the **Right Tail Critical z Value** if the area denoted by $\alpha$ is in the right tail. The use of the positive z table requires an additional step. We are trying to find a z score **given an area to the right of the z score** but the z tables lists the area to the left of the z score. When we are given a right tail area of $\alpha$ we must **first find the area to the left of z** by subtracting the right tail area $\alpha$ from 1. If the right tail area is $\alpha$ then area to the left of z is $1 - \alpha$. We then use the Positive z Table to look for an area of $1 - \alpha$ to the left of the z value.

**Finding the Right Tail Critical Value for the z Distribution with a right tail area of $\alpha$**

The area to the right of the z value is given as $\alpha$

The area to the left of the z value is $1 - \alpha$

The critical value is the positive z score that has an area of $1 - \alpha$ to the left of the z value.
The Positive Z Scores Table is used to find the **Right Tail Z Value** if the area denoted by $\alpha$ is in the right tail. The area to the right of the **Right Tail Z Value** is shown in the right tail as $\alpha$ and the area to the left of the z Value is shown to the left of the z value as $1 - \alpha$

**Positive Z Scores Table**

The numbers in YELLOW in the body of the table represent an area to the left of a given z score. The numbers in the table are greater than .5000 because the right tail area is very small so the area in the left tail is large.

The z score is the 2 digit z value from the left column (in red) with an additional decimal place from the row on top (in red).

A number in yellow that is at the intersection of the left column z value (in red) and top row z value (in red) stands for the area to the LEFT of that given z score.

Find a number in the body of the table as close to $\alpha$ as possible (in yellow). The right tail critical z value is the 2 digit z value from the left column (in red) with an additional decimal place from the row on top (in red).

### Positive Z Scores

<table>
<thead>
<tr>
<th>Standard Normal (Z) Distribution: Area to the LEFT of Z</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Z</strong></td>
<td><strong>0.00</strong></td>
<td><strong>0.01</strong></td>
<td><strong>0.02</strong></td>
<td><strong>0.03</strong></td>
<td><strong>0.04</strong></td>
<td><strong>0.05</strong></td>
<td><strong>0.06</strong></td>
<td><strong>0.07</strong></td>
</tr>
<tr>
<td>0.0</td>
<td>0.5000</td>
<td>0.5040</td>
<td>0.5080</td>
<td>0.5120</td>
<td>0.5160</td>
<td>0.5199</td>
<td>0.5239</td>
<td>0.5279</td>
</tr>
<tr>
<td>0.1</td>
<td>0.5398</td>
<td>0.5438</td>
<td>0.5478</td>
<td>0.5517</td>
<td>0.5557</td>
<td>0.5596</td>
<td>0.5636</td>
<td>0.5675</td>
</tr>
<tr>
<td>0.2</td>
<td>0.5793</td>
<td>0.5832</td>
<td>0.5871</td>
<td>0.5910</td>
<td>0.5948</td>
<td>0.5987</td>
<td>0.6026</td>
<td>0.6064</td>
</tr>
<tr>
<td>0.3</td>
<td>0.6179</td>
<td>0.6217</td>
<td>0.6255</td>
<td>0.6293</td>
<td>0.6331</td>
<td>0.6368</td>
<td>0.6406</td>
<td>0.6443</td>
</tr>
<tr>
<td>0.4</td>
<td>0.6554</td>
<td>0.6591</td>
<td>0.6628</td>
<td>0.6664</td>
<td>0.6700</td>
<td>0.6736</td>
<td>0.6772</td>
<td>0.6808</td>
</tr>
<tr>
<td>0.5</td>
<td>0.6915</td>
<td>0.6950</td>
<td>0.6985</td>
<td>0.7019</td>
<td>0.7054</td>
<td>0.7088</td>
<td>0.7123</td>
<td>0.7157</td>
</tr>
<tr>
<td>0.6</td>
<td>0.7257</td>
<td>0.7291</td>
<td>0.7324</td>
<td>0.7357</td>
<td>0.7389</td>
<td>0.7422</td>
<td>0.7454</td>
<td>0.7486</td>
</tr>
<tr>
<td>0.7</td>
<td>0.7580</td>
<td>0.7611</td>
<td>0.7642</td>
<td>0.7673</td>
<td>0.7704</td>
<td>0.7734</td>
<td>0.7764</td>
<td>0.7794</td>
</tr>
<tr>
<td>0.8</td>
<td>0.7881</td>
<td>0.7910</td>
<td>0.7939</td>
<td>0.7967</td>
<td>0.7995</td>
<td>0.8023</td>
<td>0.8051</td>
<td>0.8078</td>
</tr>
<tr>
<td>0.9</td>
<td>0.8159</td>
<td>0.8186</td>
<td>0.8212</td>
<td>0.8238</td>
<td>0.8264</td>
<td>0.8289</td>
<td>0.8315</td>
<td>0.8340</td>
</tr>
<tr>
<td>1.0</td>
<td>0.8413</td>
<td>0.8438</td>
<td>0.8461</td>
<td>0.8485</td>
<td>0.8508</td>
<td>0.8531</td>
<td>0.8554</td>
<td>0.8577</td>
</tr>
<tr>
<td>1.1</td>
<td>0.8643</td>
<td>0.8665</td>
<td>0.8686</td>
<td>0.8708</td>
<td>0.8729</td>
<td>0.8749</td>
<td>0.8770</td>
<td>0.8790</td>
</tr>
<tr>
<td>1.2</td>
<td>0.8849</td>
<td>0.8869</td>
<td>0.8888</td>
<td>0.8907</td>
<td>0.8925</td>
<td>0.8944</td>
<td>0.8962</td>
<td>0.8980</td>
</tr>
</tbody>
</table>

This is only a portion of the entire Positive z Score table.
Finding the Right Tail (One Tail) Critical Value for the z Distribution with a right tail area of $\alpha$

**Example 4**

Find the Critical Value for an area of $\alpha = .08$ in the right tail

The Z Tables only give areas to the left of a Z value. If we are given an area to the right of a z value then we must find the remaining area that is to the left of the Z value and then look that area up in the Z table.

If the area to the right of the Z score is .08 then the area to the left of the Z score is $1 - .08 = .9200$

Find a number in YELLOW in the body of the table as close to .9200 as possible.

The number at the intersection of the 1.4 row and the 0.01 column is 0.9070 which is as close to .9200 as possible.

$Z = 1.41$

<table>
<thead>
<tr>
<th>Positive Z Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Normal (Z) Distribution: Cumulative Area to the LEFT of Z</strong></td>
</tr>
<tr>
<td>Z</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1.4</td>
</tr>
</tbody>
</table>

The area to the left of $z$ is $1 - .08 = .92$

The area to the right of $z$ is .08

positive critical value

right tail area is $\alpha = .08$

$z = + 1.41$
Example 5

Find the Critical Value for an area of \( \alpha = .01 \) in the right tail

The Z Tables only give areas to the left of a Z value.
If we are given an area to the right of a Z value
then we must find the remaining area that is to the left of the Z value
and then look that area up in the Z table

If the area to the right of the Z score is .01
then the area to the left of the Z score is \( 1 - .01 = .9900 \)

Find a number in YELLOW in the body of the table as close to .9900 as possible

The number at the intersection of the \(-2.3\) row and the \(0.03\) column is \(0.9901\)
which is as close to .9900 as possible

This means that the Z score with a right tail area of .01
is \( Z = 2.33 \)
Finding the Right Tail (One Tail) Critical Value for the $z$ Distribution with a right tail area of $\alpha$

Example 6

Find the Critical Value for an area of $\alpha = .05$ in the right tail

The $Z$ Tables only give areas to the left of a $Z$ value. If we are given an area to the right of a $z$ value, then we must find the remaining area that is to the left of the $Z$ value and then look that area up in the $Z$ table.

If the area to the right of the $Z$ score is .05, then the area to the left of the $Z$ score is $1 - .05 = .9500$

Find a number in YELLOW in the body of the table as close to .9500 as possible:

The body of the table has a 0.9495 and a 0.9505, which are equally close to .9500 but

The cells at the bottom of the table show that for an area of 0.9500, use $Z = 1.645$.

Positive $Z$ Scores

<table>
<thead>
<tr>
<th>$Z$</th>
<th>0.00</th>
<th>0.01</th>
<th>0.02</th>
<th>0.03</th>
<th>0.04</th>
<th>0.05</th>
<th>0.06</th>
<th>0.07</th>
<th>0.08</th>
<th>0.09</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6</td>
<td>0.9452</td>
<td>0.9463</td>
<td>0.9474</td>
<td>0.9484</td>
<td>0.9495</td>
<td>0.9505</td>
<td>0.9515</td>
<td>0.9525</td>
<td>0.9535</td>
<td>0.9545</td>
</tr>
</tbody>
</table>

$Z$ scores of 3.5 or more use .9999

<table>
<thead>
<tr>
<th>AREA</th>
<th>Z Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9500</td>
<td>1.645</td>
</tr>
</tbody>
</table>

$\alpha = .05$ right tail area

the area to the left of $z$ is $1 - .05 = .95$

the area to the right of $z$ is $.05$
Finding Left and Right Tail Critical Values (Two Tail) for a Standard Normal Distribution $Z$

A Critical Value for a Standard Normal Distribution is a $z$ value on the $z$ axis that is the vertical boundary separating the area in one tail of the graph from the remaining area.

The total tail area in both tails is denoted by $\alpha$.
In this chapter the tail areas are normally .10 or less so the tail areas are shown as a small proportion of the total area.

Left and Right Tail areas

The total area in both tails is $\alpha$.

If this total area is divided equally between the left and right tails then the left and right tail will each have an area of $\frac{\alpha}{2}$.

How are $-z_{\alpha/2}$ and $+z_{\alpha/2}$ related

The positive critical value $+z_{\alpha/2}$ is equal to $-z_{\alpha/2}$.

The total area for both tails is $\alpha$.

The area between the 2 tails is $1 - \alpha$.
Critical Values

The Left Tail Critical Value $-z_{\alpha/2}$ for a Standard Normal Distribution $Z$ if the area to the left of $z_{\alpha/2}$ is $\alpha/2$

We call the $z$ value that separates a left tail area of $\alpha/2$ from the rest of the area under the curve a **Left Tail Critical Value**. The left tail area of $\alpha/2$ must have a negative $z$ value that has an area of $\alpha/2$ to its left. The **Left Tail Critical Value for a left tail area of $\alpha/2$** is written $-z_{\alpha/2}$

The total area for both tails is $\alpha$

- Left tail area = $\alpha/2$
- Right tail area = $\alpha/2$

The Left Tail Critical Value $-z_{\alpha/2}$ is the area to the left of $-z_{\alpha/2}$

The Right Tail Critical Value $z_{\alpha/2}$ for a Standard Normal Distribution $Z$ if the area to the right of $z_{\alpha/2}$ is $\alpha/2$

We call the $z$ value that separates a right tail area of $\alpha/2$ from the rest of the area under the curve a **Right Tail Critical Value**. The right tail area of $\alpha/2$ must have a positive $z$ value that has an area of $\alpha/2$ to its right. The **Right Tail Critical Value for a right tail area of $\alpha/2$** is written $z_{\alpha/2}$ or $+z_{\alpha/2}$
Finding Left and Right Tail Critical Values (Two Tail) for a Standard Normal Distribution \( Z \)

**Example 7**

The total area for both tails is \( \alpha = 0.05 \) if \( \alpha = 0.05 \) then \( \frac{\alpha}{2} = 0.025 \)

Find the **Left Tail Critical Value** \(-z_{\alpha/2}\) with a left tail area of \(\alpha/2 = 0.025\)

The Negative Z Scores Table is used to find the \(z\) score with an area of .05 to its left.

Find an number in YELLOW in the body of the table as close to .025 as possible

The number at the intersection of the \(-1.9\) row and the .06 column is 0.0250

The tail area to the left of \(z = -1.96\) is .025

\[-z_{\alpha/2} = -1.96\]

<p>| Standard Normal (Z) Distribution: Cumulative Area to the LEFT of Z |
|-------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|</p>
<table>
<thead>
<tr>
<th>( Z )</th>
<th>0.00</th>
<th>0.01</th>
<th>0.02</th>
<th>0.03</th>
<th>0.04</th>
<th>0.05</th>
<th><strong>0.06</strong></th>
<th>0.07</th>
<th>0.08</th>
<th>0.09</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.9</td>
<td>0.0287</td>
<td>0.0281</td>
<td>0.0274</td>
<td>0.0268</td>
<td>0.0262</td>
<td>0.0256</td>
<td><strong>0.0250</strong></td>
<td>0.0244</td>
<td>0.0239</td>
<td>0.0233</td>
</tr>
</tbody>
</table>

Find the **Right Tail Critical Value** \(z_{\alpha/2}\) with a right tail area of \(\alpha/2 = 0.025\)

The negative critical value \(-z_{\alpha/2}\) is \(-1.96\)

The positive critical value \(+z_{\alpha/2}\) is equal to \(|-z_{\alpha/2}|\)

The positive critical value \(+z_{\alpha/2}\) is 1.96
the total area for both tails is \( \alpha = .05 \)

If \( \alpha = .05 \) then \( \alpha/2 = .025 \)

The area between the 2 tails is .95

\[-z_{\alpha/2} = -1.96 \quad \text{negative Z critical value for a left tail area of .025} \]

\[z_{\alpha/2} = 1.96 \quad \text{positive Z critical value for a right tail area of .025} \]

The total area for both tails is \( \alpha = .08 \) If \( \alpha = .08 \) then \( \alpha/2 = .04 \)

Find the Left Tail Critical Value \(-z_{\alpha/2}\) with a left tail area of \( \alpha/2 = .04 \)

The Negative Z Scores Table is used to find the \( z \) score with an area of .04 to its left.

Find a number in YELLOW in the body of the table as close to .0400 as possible

The body of the table has a .0401 which is as close to .0400 as possible

The number at the intersection of the \(-1.7\) row and the .05 column is \(0.0401\)

\[-z_{\alpha/2} = -1.75 \]

<table>
<thead>
<tr>
<th>Negative Z Scores</th>
<th>Standard Normal (Z) Distribution: Cumulative Area to the LEFT of Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Z )</td>
<td>0.00 0.01 0.02 0.03 0.04</td>
</tr>
<tr>
<td>(-1.7)</td>
<td>0.0446 0.0436 0.0427 0.0418 0.0409</td>
</tr>
</tbody>
</table>

Find the Right Tail Critical Value \( z_{\alpha/2} \) with a right tail area of \( \alpha/2 = .04 \)

The negative critical value \(-z_{\alpha/2}\) is \(-1.75\)

The positive critical value \(+z_{\alpha/2}\) is equal to \( |z_{\alpha/2}| \)
The positive critical value $+z_{\alpha/2}$ is 1.75

the total area for both tails is $\alpha = .08$

If $\alpha = .08$ then $\alpha/2 = .04$

$\alpha/2$
left tail
area = .04

the area
between the
2 tails is
.92

$\alpha/2$
right tail
area = .04

Finding Left and Right Tail Critical Values (Two Tail)
for a Standard Normal Distribution $Z$

Example 9

The total area for both tails is $\alpha = .10$  If $\alpha = .10$ then $\alpha/2 = .05$

Find the Left Tail Critical Value $-z_{\alpha/2}$ with a left tail area of $\alpha/2 = .05$

The Negative Z Scores Table is used to find the $z$ score with an area of .05 to its left.

Find an number in YELLOW in the body of the table as close to .05 as possible

The cells at the bottom of the $z$ table say to use $Z = -1.645$ for a left tail area of .05

$-z_{\alpha/2} = -1.645$

Negative Z Scores

<table>
<thead>
<tr>
<th>Standard Normal (Z) Distribution: Cumulative Area to the LEFT of Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Z$ scores of $-3.5$ or less use .0001</td>
</tr>
<tr>
<td>AREA</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>0.0500</td>
</tr>
</tbody>
</table>

Find the Right Tail Critical Value $z_{\alpha/2}$ with a right tail area of $\alpha/2 = .05$

The negative critical value $-z_{\alpha/2}$ is $-1.645$

The positive critical value $+z_{\alpha/2}$ is equal to $|z_{\alpha/2}|$
The positive critical value $+z_{\alpha/2}$ is 1.645

The total area for both tails is .10

If $\alpha = .10$ then $\alpha/2 = .05$

The negative Z critical value for a left tail area of .05

$-z_{\alpha/2} = -1.645$

The positive Z critical value for a right tail area of .05

$z_{\alpha/2} = 1.645$

Finding Left and Right Tail Critical Values (Two Tail) for a Standard Normal Distribution Z

Example 10

The total area for both tails is $\alpha = .01$ If $\alpha = .01$ then $\alpha/2 = .005$

Find the Left Tail Critical Value $-z_{\alpha/2}$ with a left tail area of $\alpha/2 = .005$

The Negative Z Scores Table is used to find the z score with an area of .005 to its left.

Find an number in YELLOW in the body of the table as close to .005 as possible

The cells at the bottom of the z table say to use $Z = -2.575$ for a left tail area of .005

$-z_{\alpha/2} = -2.575$

Find the Right Tail Critical Value $z_{\alpha/2}$ with a right tail area of $\alpha/2 = .005$

The negative critical value $-z_{\alpha/2}$ is $-2.575$

The positive critical value $+z_{\alpha/2}$ is equal to $|z_{\alpha/2}|$
The positive critical value \( +z_{\alpha/2} \) is 2.575

the total area for both tails is \( \alpha = .01 \)

\[
\text{If } \alpha = .01 \text{ then } \frac{\alpha}{2} = .005
\]

the area between the 2 tails is .99

\( -z_{\alpha/2} = -2.575 \)

\( z_{\alpha/2} = 2.575 \)

**negative Z critical value**

for a **left tail area** of .005

**positive Z critical value**

for a **right tail area** of .005