Chapter 1

Null hypotheses (H₀)
Alternative hypotheses (H₁)

Type I error = reject H₀ when H₀ is true
Type II error = accept H₀ when H₁ is true.

Let's do it! Testing a new drug.

H₀: The new drug is as effective as the standard drug.
H₁: The new drug is more effective than the standard drug.

Type I error: Conclude that the new drug is more effective when it is not.
Type II error: Conclude that the new drug is no better than the standard drug when it is actually better.
American justice system:

H₀: innocent
H₁: guilty

What will happen if we don’t want any type I error?
then we never reject H₀.

α = level of significance.
   = chance of a Type I error occurring
β = chance of a Type II error occurring
   ↓ probability.

1.4 What’s in the bag?

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-1000</td>
<td>$1000</td>
</tr>
</tbody>
</table>
Frequency plot for Bag A.

Frequency plot for Bag B.

H₀: The shown bag is Bag A.
H₁: The shown bag is Bag B.

Type I error = Reject H₀ if H₀ is true
= decide the shown bag is B when it is A.
= keep that shown bag is A. pay $560.
Type II error = accept $H_0$ when $H_1$ is true
= decide the shown bag is A when it's B
= keep the other bag (A). Pay $560.

<table>
<thead>
<tr>
<th>Face value</th>
<th>if Bag A</th>
<th>if Bag B</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5000</td>
<td>$\frac{1}{20}$</td>
<td>0</td>
</tr>
<tr>
<td>$1000</td>
<td>$\frac{7}{20}$</td>
<td>$\frac{1}{20}$</td>
</tr>
<tr>
<td>$500</td>
<td>$\frac{6}{20}$</td>
<td>$\frac{1}{20}$</td>
</tr>
<tr>
<td>$200</td>
<td>$\frac{2}{20}$</td>
<td>$\frac{2}{20}$</td>
</tr>
<tr>
<td>$100</td>
<td>$\frac{1}{20}$</td>
<td>$\frac{1}{20}$</td>
</tr>
<tr>
<td>$50</td>
<td>$\frac{1}{20}$</td>
<td>$\frac{6}{20}$</td>
</tr>
<tr>
<td>$20</td>
<td>$\frac{1}{20}$</td>
<td>$\frac{7}{20}$</td>
</tr>
</tbody>
</table>

Definition:
The direction of extreme corresponds to the position of the values that are most likely under the alternative hypothesis $H_1$ than under the null hypothesis $H_0$.

If the larger values are most likely under $H_1$ than under $H_0$, then the direction of extreme is said to be to the **right**.
Decision Rule 1:
Reject $H_0$ if you select $\geq 60$ or $\leq 1000$
voucher, otherwise accept $H_0$.

$\alpha = \text{chance of selecting } 60 \text{ or } 1000$
from bag A.
$= \frac{1}{20} = 0.05$

$\beta = \text{chance of selecting } 60 \text{ or } 1000$
from bag B
$= \frac{12}{20} = 0.6$

Definition:

A rejection region is the set of values for which you would reject the null hypothesis.

An acceptance region is the set of values for which you will accept the null hypothesis.

The cutoff value or critical value is the value which marks the start of rejection region.