

**University of Guelph
Numeracy Project**

About Type I and Type II Errors: Examples



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About Type I and Type II Errors: Examples

Type I Error Example

- Mrs. Dudley is a grade 9 English teacher who is marking 2 papers that are strikingly similar. She is concerned that one of her students is cheating, but she is not sure which one of the two is guilty.

Mrs. Dudley meets with the two students (Laura and Greg) who have similar papers, and suspects that Greg is probably the one who is guilty. She decides that she must deal with this situation in the same way as in a justice trial, in order to determine who is innocent and who is guilty.

The null and alternative hypotheses used in hypothesis testing can be translated into a non-numerical form:

H_0 : This is the presumption of innocence. In both a trial and statistics the null hypothesis indicates that the suspect or treatment didn't do anything. In the case of the current example, our null hypothesis is that Greg is innocent and did not cheat off Laura.

H_a : This is the reason why the suspect was accused. In the case of the current example, our alternative hypothesis is that Greg is guilty of cheating off Laura's paper, due to the fact that Greg has been guilty of cheat off other's papers in the past.

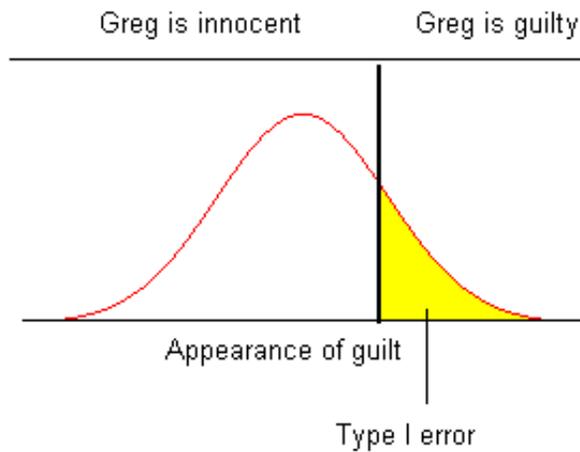
Knowing the null and alternative hypotheses for the situation:

If Mrs. Dudley decides to reject the null hypothesis in favour of the alternative, Greg will be accused of cheating off Laura and will be punished accordingly. This will be the correct decision if in fact Greg is actually guilty of cheating.

However, if Mrs. Dudley decides to reject the null hypothesis when it is in fact true, she will be committing a Type I Error. Greg will be accused of cheating when in fact he is innocent. In other words, a

Type I Error in this case means that not only has an innocent person been punished (Greg) but the truly guilty person (Laura) has also gone free.

- Graphically, this is how a Type I error would appear if Greg was accused of cheating when in fact he did not.



- So what to do? Mrs. Dudley must gather significant evidence in order to prevent a Type I Error. Obviously in this practical situation it is difficult to 100% prevent a Type I Error.
- This is the same in other situations like murder trials. The jury must gather significant evidence provided by the defence in order to determine if the accused is guilty. And we know from media footage that there are several times where a Type I Error was possibly made (an innocent person may be charged and a guilty person went free).

Type II Error Example

- Let's go back to our previous example with our teacher Sam. Recall that she has 2 students (Greg and Laura) with very similar papers. Mrs. Dudley suspects that Greg was the one who cheated (based on his past records) but she is not completely sure.

Remember our null (H_0) and alternative (H_a) hypotheses:

H_0 : Greg is innocent and did not cheat off Laura

H_a : Greg is guilty of cheating off Laura's paper
Assuming that is actually was Grey who cheated off
Laura and NOT the other way around...

If Mrs. Dudley gathers significant evidence to prove that Greg cheated and punishes him accordingly, she will be accepting H_a and her decision will be correct. However, if she does not find significant evidence to accuse Greg of cheating, he will not be punished and Sam will be committing a Type II Error.

- We can see how committing a Type II Error in this case is not as serious as a Type I Error. Instead of accusing an innocent person while a guilty person goes free, the guilty person "Greg" simply goes without being caught.

Summary Quiz

- After reading each descriptive characteristic, fill in the blank with the appropriate error definition, either:

Type I
Type II

- 1) Directly related to the power of a test = Type II
 - 2) Accepting H_0 when in fact H_a is true = Type II
 - 3) Equal to the significance level α of a fixed test = Type I
 - 4) The more common type of error to occur out of the 2 = Type I
 - 5) Rejecting H_0 when in fact H_0 is true = Type I
- In hypothesis testing, you cannot have a Type I and Type II Error at the same time.

TRUE

- Jackie wants to determine the probability of a Type I Error before she performs hypothesis testing on her sample of 40 individuals. Prior to testing, she decides on a significance level of 2%. What is the probability of a Type I Error in this case?

0.02