

IMS 14 (ish): Decision Errors

Errors

Hypothesis tests are not flawless.

		Truth	
		H_0	H_A
Choice	H_0	Correct	Type II Error
	H_A	Type I Error	Correct

Errors

- When H_0 is true, a **Type I error** occurs when H_0 is rejected.
- When H_0 is false, a **Type II error** occurs when H_0 is not rejected.

Significance Level

- Hypothesis tests allows us to quantify just how often the data may lead us to the incorrect conclusion.
- The α used to calculate the confidence interval is called the **significance level**. It determines how strict the cutoff value is for concluding in favor of H_0 .
- If H_0 is true, α is the probability of a Type 1 error.
- The significance level (α) should reflect consequences of errors.
- If a Type 1 Error is dangerous or especially costly, we should choose a small significance level (i.e. $\alpha = 0.01, 0.001$)

Practice

[IMS 11.6]: Write the null and alternative hypotheses in words and using symbols for each of the following situations. State the Type 1 and Type 2 errors.

- a) Since 2008, chain restaurants in California have been required to display calorie counts of each menu item. Prior to menus displaying calorie counts, the average calorie intake of diners at a restaurant was 1100 calories. After calorie counts started to be displayed on menus, a nutritionist collected data on the number of calories consumed at this restaurant from a random sample of diners. Do these data provide convincing evidence of a difference in the average calorie intake of a diners at this restaurant?
- b) Based on the performance of those who took the GRE exam between July 1, 2004 and June 30, 2007, the average Verbal Reasoning score was calculated to be 462. In 2021 the average verbal score was slightly higher. Do these data provide convincing evidence that the average GRE Verbal Reasoning score has changed since 2021?

[IMS 14.1] Testing for Fibromyalgia. A patient named Diana was diagnosed with Fibromyalgia, a long-term syndrome of body pain, and was prescribed anti-depressants. Being the skeptic that she is, Diana didn't initially believe that anti-depressants would help her symptoms. However, after a couple months of being on the medication she decides that the anti-depressants are working, because she feels like her symptoms are in fact getting better.

- a) Write the hypotheses in words for Diana's skeptical position when she started taking the anti-depressants.
- b) What is a Type 1 Error in this context?
- c) What is a Type 2 Error in this context?

[IMS 14.3] Testing for food safety. A food safety inspector is called upon to investigate a restaurant with a few customer reports of poor sanitation practices. The food safety inspector uses a hypothesis testing framework to evaluate whether regulations are not being met. If he decides the restaurant is in gross violation, its license to serve food will be revoked.

- a) Write the hypotheses in words.
- b) What is a Type 1 Error in this context?
- c) What is a Type 2 Error in this context?
- d) Which error is more problematic for the restaurant owner? Why?
- e) Which error is more problematic for the diners? Why?
- f) As a diner, would you prefer that the food safety inspector requires strong evidence or very strong evidence of health concerns before revoking a restaurant's license? Explain your reasoning.