

Type I and Type II Errors

1. A manufacturer of hand-held calculators receives large shipments of printed circuits from a supplier. It is too costly and time-consuming to inspect all the incoming circuits, so when each shipment arrives, a sample is selected for inspection. Information from the sample is then used to test $H_0: P = 0.05$ versus $H_A: p > 0.05$ where p is the true proportion of defective circuits in the shipment. If the null hypothesis is not rejected, the shipment is accepted, and the circuits are used in the production of calculators. If the null hypothesis is rejected, the entire shipment is returned to the supplier because of inferior quality. (A shipment is defined to be of inferior quality if it contains more than 5% defective circuits.)
 - a. In this context, define Type I and Type II errors.
 - b. From the calculator manufacturer's point of view, which error is considered more serious and why?
 - c. From the circuit supplier's point of view, which type of error is considered more serious and why?

2. Medical personnel are required to report suspected cases of child abuse. Because some diseases have symptoms that mimic those of child abuse, doctors who see a child with these symptoms must decide between two competing hypotheses:
 - i. H_0 : Symptoms are due to child abuse.
 - ii. H_A : Symptoms are due to disease.The article "Blurred Line Between Illness, Abuse Creates Problem for Authorities" included the following quote from a doctor regarding the consequences of making an incorrect decisions: "If it's disease, the worst you have is an angry family. If it is abuse, the other kids (in the family) are in deadly danger."
 - a. For the given hypotheses, describe Type I and Type II errors.
 - b. Based on the quote regarding consequences of the two kinds of error, which type of error does the doctor quoted consider more serious? Explain your answer.

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3. Occasionally, warning flares of the type contained in most car emergency kits fail to ignite. A consumer advocacy group wants to investigate a claim against a manufacturer of flares brought by a person who claims that the proportion of defective flares is much higher than the value of 0.1 claimed by the manufacturer. A large number of flares will be tested, and results will be used to decide between $H_0: p = 0.1$ versus $H_A: p > 0.1$, where p represents the true proportion of defective flares made by the manufacturer. If H_0 is rejected, charges of false advertising will be filed.
 - a. Explain why the alternative hypothesis was chosen to be $H_A: p > 0.1$.
 - b. In this context, describe Type I and Type II errors, and discuss the consequences of each.

4. The National Cancer Institute conducted a 2-year study to determine whether cancer death rates for areas near nuclear power plants are higher than for areas without nuclear facilities. A spokesperson for the Cancer Institute said "from the data at hand, there was no convincing evidence of any increased risk of death from any of the cancers surveyed due to living near nuclear facilities. However, no study can prove the absence of an effect."
 - a. Let p denote the true proportion of the population in areas near nuclear power plants who die of cancer during a given year. The researchers at the Cancer Institute might have considered the two rival hypotheses of the form

$$H_0: p = \text{value for areas without nuclear facilities}$$

$$H_A: p > \text{value for areas without nuclear facilities.}$$
 Did the researchers reject H_0 or fail to reject H_0 ?
 - b. If the Cancer Institute researchers were incorrect in their conclusions that there is no increased cancer risk associated with living near a nuclear power plant, would this be a Type I or a Type II error? Explain your answer.
 - c. Comment on the spokesperson's last statement that no study can **prove** the absence of an effect. Do you agree with the statement?

Source

- Worksheet adapted from: https://cdn5-ss18.sharpschool.com/UserFiles/Servers/Server_589998/File/Levenseller%20Files/AP%20Statistics/Type%20I%20and%20Type%20II%20Error%20WS%20Key.pdf
- Link above has answers.