

- 14. Quality control.** Production managers on an assembly line must monitor the output to be sure that the level of defective products remains small. They periodically inspect a random sample of the items produced. If they find a significant increase in the proportion of items that must be rejected, they will halt the assembly process until the problem can be identified and repaired.
- In this context, what is a Type I error?
  - In this context, what is a Type II error?
  - Which type of error would the factory owner consider more serious?
  - Which type of error might customers consider more serious?
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- 16. Production.** Consider again the task of the quality control inspectors in Exercise 14.
- In this context, what is meant by the power of the test the inspectors conduct?
  - They are currently testing 5 items each hour. Someone has proposed they test 10 each hour instead. What are the advantages and disadvantages of such a change?
  - Their test currently uses a 5% level of significance. What are the advantages and disadvantages of changing to an alpha level of 1%?
  - Suppose that as a day passes one of the machines on the assembly line produces more and more items that are defective. How will this affect the power of the test?

12. **Alzheimer's.** Testing for Alzheimer's disease can be a long and expensive process, consisting of lengthy tests and medical diagnosis. Recently, a group of researchers (Solomon *et al.*, 1998) devised a 7-minute test to serve as a quick screen for the disease for use in the general population of senior citizens. A patient who tested positive would then go through the more expensive battery of tests and medical diagnosis. The authors reported a false positive rate of 4% and a false negative rate of 8%.
- Put this in the context of a hypothesis test. What are the null and alternative hypotheses?
  - What would a Type I error mean?
  - What would a Type II error mean?
  - Which is worse here, a Type I or Type II error? Explain.
  - What is the power of this test?

3. **Alpha.** A researcher developing scanners to search for hidden weapons at airports has concluded that a new device is significantly better than the current scanner. He made this decision based on a test using  $\alpha = 0.05$ . Would he have made the same decision at  $\alpha = 0.10$ ? How about  $\alpha = 0.01$ ? Explain.
5. **Significant?** Public health officials believe that 90% of children have been vaccinated against measles. A random survey of medical records at many schools across the country found that among more than 13,000 children only 89.4% had been vaccinated. A statistician would reject the 90% hypothesis with a P-value of  $P = 0.011$ .
- Explain what the P-value means in this context.
  - The result is statistically significant, but is it important? Comment.

- 11. Homeowners.** In 2003 the Department of Commerce reported that 68.3% of American families owned their homes. In one small city, census data reveal that the ownership rate is much lower. The City Council is debating a plan to offer tax breaks to first-time home buyers in order to encourage people to become homeowners. They decide to adopt the plan on a 2-year trial basis and use the data they collect to make a decision about continuing the tax breaks. Since this plan costs the city tax revenues, they will continue to use it only if there is strong evidence that the rate of home ownership is increasing.
- In words, what will their hypotheses be?
  - What would a Type I error be?
  - What would a Type II error be?
  - For each type of error, tell who would be harmed.
  - What would the power of the test represent in this context?

- 17. Equal opportunity?** A company is sued for job discrimination because only 19% of the newly hired candidates were minorities when 27% of all applicants were minorities. Is this strong evidence that the company's hiring practices are discriminatory?
- Is this a one-tailed or a two-tailed test? Why?
  - In this context, what would a Type I error be?
  - In this context, what would a Type II error be?
  - In this context, describe what is meant by the power of the test.
  - If the hypothesis is tested at the 5% level of significance instead of 1%, how will this affect the power of the test?
  - The lawsuit is based on the hiring of 37 employees. Is the power of the test higher than, lower than, or the same as it would be if it were based on 87 hires?