

Exercises on hypothesis testing:

- 9.4 During 2000 and 2001 many people in Europe objected to purchasing genetically modified food that was produced by farmers in the United States. The U.S. farmers argued that there was no scientific evidence to conclude that these products were not healthy. The Europeans argued that there still might be a problem with the food.
- State the null and alternative hypotheses from the perspective of the Europeans.
  - State the null and alternative hypotheses from the perspective of the U.S. farmers.

Europe:  $H_0$  : gen mod food is not safe,  $H_1$ : it is safe.

Us farmers:  $H_0$ : gen mod food is safe,  $H_1$ : it is not safe.

- 9.6 A random sample is obtained from a population with variance  $\sigma^2 = 625$ , and the sample mean is computed. Test the null hypothesis  $H_0 : \mu = 100$  versus the alternative hypothesis  $H_1 : \mu > 100$  with  $\alpha = 0.05$ . Compute the critical value  $\bar{x}_c$  and state your decision rule for the following options:
- Sample size  $n = 25$
  - Sample size  $n = 16$
  - Sample size  $n = 44$
  - Sample size  $n = 32$

- Reject if  $\bar{X} > 100 + 1.645 \cdot 25 / \sqrt{25} = 108.225$
- Reject if  $\bar{X} > 110.281$
- Reject if  $\bar{X} > 106.199$
- Reject if  $\bar{X} > 107.269$

- 9.7 A random sample of  $n = 25$  is obtained from a population with variance  $\sigma^2$ , and the sample mean is computed. Test the null hypothesis  $H_0 : \mu = 100$  versus the alternative hypothesis  $H_1 : \mu > 100$  with  $\alpha = 0.05$ . Compute the critical value  $\bar{x}_c$  and state your decision rule for the following options:
- The population variance is  $\sigma^2 = 225$ .
  - The population variance is  $\sigma^2 = 900$ .
  - The population variance is  $\sigma^2 = 400$ .
  - The population variance is  $\sigma^2 = 600$ .

- Reject if  $\bar{X} > 100 + 1.645 \cdot 15 / \sqrt{25} = 104.935$
- Reject if  $\bar{X} > 109.87$

- c) Reject if  $\bar{X} > 106.58$
- d) Reject if  $\bar{X} > 108.0588$

Question 9.15:

9.15 Test the hypotheses

$$H_0: \mu = 100$$

$$H_1: \mu < 100$$

using a random sample of  $n = 36$ , a probability of Type I error equal to 0.05, and the following sample statistics:

- a.  $\bar{x} = 106; s = 15$
- b.  $\bar{x} = 104; s = 10$
- c.  $\bar{x} = 95; s = 10$
- d.  $\bar{x} = 92; s = 18$

Reject if  $(\bar{X} - 100) / (s / \sqrt{n}) < -1.697$ .

- a) 2.40. Do not reject.
- b) 2.40. Do not reject.
- c) -3.00, reject.
- d) -2.67, reject.

Question 9.17:

9.17 A random sample of 1,562 undergraduates enrolled in management ethics courses was asked to respond on a scale from 1 (strongly disagree) to 7 (strongly agree) to this proposition: "Senior corporate executives are interested in social justice." The sample mean response was 4.27, and the sample standard deviation was 1.32. Test at the 1% level, against a two-sided alternative, the null hypothesis that the population mean is 4.

$H_0: \mu = 4, H_1: \mu \neq 4$ . From the t-table,  $t_{1561, 0.005} = 2.576$ .

Reject if  $|t| > 2.576$ .  $t = (4.27 - 4) / (1.32 / \sqrt{1562}) = 8.08$ .

9.23 A company selling licenses for new e-commerce computer software advertises that firms using this software obtain, on average during the first year, a yield of 10% on their initial investments. A random sample of 10 of these franchises produced the following yields for the first year of operation:

6.1 9.2 11.5 8.6 12.1 3.9 8.4 10.1 9.4 8.9

Assuming that population yields are normally distributed, test the company's claim.

$H_0: \mu=10$ ,  $H_1: \mu<10$ .  $\bar{X} = 8.82$ ,  $s = 2.4013$ ,  $t = -1.554$ , p-value between 0.1 and 0.05.

Do not reject  $H_0$ .

9.28 A random sample of women is obtained, and each person in the sample is asked if she would purchase a new shoe model. To determine if the new shoe model would have sales at least 25% to meet corporate profit objectives, the following hypothesis test is performed at a level of  $\alpha = 0.03$  using  $\hat{p}$  as the sample proportion of women who said yes.

$$H_0: P \leq 0.25$$

$$H_1: P > 0.25$$

What value of the sample proportion,  $\hat{p}$ , is required to reject the null hypothesis, given the following sample sizes?

- |              |              |
|--------------|--------------|
| a. $n = 400$ | c. $n = 625$ |
| b. $n = 225$ | d. $n = 900$ |

Reject  $H_0$  if  $\hat{p} > p_0 + Z_{\alpha} \sqrt{p_0(1-p_0)/n}$ .

- a) 0.2907, b) 0.3042, c) 0.2825, d) 0.2771.

9.35 Of a random sample of 172 elementary school educators, 118 said that parental support was the most important source of a child's success. Test the hypothesis that parental support is the most important source of a child's success for at least 75% of elementary school educators against the alternative that the population percentage is less than 75%. Use  $\alpha = 0.05$ .

$H_0: p=0.75$ ,  $H_1: p<0.75$ .

$$Z = (0.686 - 0.75) / (\sqrt{0.25}(0.75)/172) = -1.94$$

$$p\text{-value} = 1 - F(1.94) = 0.0262.$$

Reject  $H_0$  when  $\alpha > 2.62\%$ .

