Chapter 8 review questions

Disclaimer: Actual exam questions do not mirror these questions. This is here as a tool for practice only. The actual exam is fill in and not multiple choice, also.

Solve the problem.

1) What do you conclude about the claim below? Do not use formal procedures or exact calculations. Use only the rare event rule and make a subjective estimate to determine whether the event is likely.

Claim: A die is fair and in 100 rolls there are 63 sixes.

Assume that a hypothesis test of the given claim will be conducted. Identify the type I or type II error for the test.

2) The principal of a school claims that the percentage of students at his school that come from single-parent homes is 13%. Identify the type II error for the test.

A) Fail to reject the claim that the percentage of students that come from single-parent homes is equal to 13% when that percentage is actually different from 13%.

B) Fail to reject the claim that the percentage of students that come from single-parent homes is equal to 13% when that percentage is actually 13%.

C) Reject the claim that the percentage of students that come from single-parent homes is equal to 13% when that percentage is actually 13%.

D) Reject the claim that the percentage of students that come from single-parent homes is equal to 13% when that percentage is actually less than 13%.

Formulate the indicated conclusion in nontechnical terms. Be sure to address the original claim.

3) A researcher claims that the amounts of acetaminophen in a certain brand of cold tablets have a standard deviation different from the $\sigma = 3.3$ mg claimed by the manufacturer. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is failure to reject the null hypothesis, state the conclusion in nontechnical terms.

A) There is not sufficient evidence to support the claim that the standard deviation is different from 3.3 mg.

B) There is sufficient evidence to support the claim that the standard deviation is different from 3.3 mg.

C) There is not sufficient evidence to support the claim that the standard deviation is equal to 3.3 mg.

D) There is sufficient evidence to support the claim that the standard deviation is equal to 3.3 mg.

4) A skeptical paranormal researcher claims that the proportion of Americans that have seen a UFO, p, is less than 2 in every ten thousand. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is failure to reject the null hypothesis, state the conclusion in nontechnical terms.

A) There is not sufficient evidence to support the claim that the true proportion is less than 2 in ten thousand.

B) There is sufficient evidence to support the claim that the true proportion is less than 2 in ten thousand.

C) There is sufficient evidence to support the claim that the true proportion is greater than 2 in ten thousand.

D) There is not sufficient evidence to support the claim that the true proportion is greater than 2 in ten thousand.

5) Carter Motor Company claims that its new sedan, the Libra, will average better than 30 miles per gallon in the city. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is to reject the null hypothesis, state the conclusion in nontechnical terms.

A) There is sufficient evidence to support the claim that the mean is greater than 30 miles per gallon.
B) There is not sufficient evidence to support the claim that the mean is greater than 30 miles per gallon.
C) There is sufficient evidence to support the claim that the mean is less than 30 miles per gallon.
D) There is not sufficient evidence to support the claim that the mean is less than 30 miles per gallon.

6) The owner of a football team claims that the average attendance at games is over 694, and he is therefore justified in moving the team to a city with a larger stadium. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is failure to reject the null hypothesis, state the conclusion in nontechnical terms.

A) There is not sufficient evidence to support the claim that the mean attendance is greater than 694.
B) There is sufficient evidence to support the claim that the mean attendance is less than 694.
C) There is not sufficient evidence to support the claim that the mean attendance is less than 694.
D) There is sufficient evidence to support the claim that the mean attendance is greater than than 694.

Identify the null hypothesis, alternative hypothesis, test statistic, P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

7) According to a recent poll 53% of Americans would vote for the incumbent president. If a random sample of 100 people results in 45% who would vote for the incumbent, test the claim that the actual percentage is 53%. Use a 0.10 significance level.

Solve the problem.

8) What do you conclude about the claim below? Do not use formal procedures or exact calculations. Use only the rare event rule and make a subjective estimate to determine whether the event is likely.

Claim: A company claims that the proportion of defective units among a particular model of computers is 4%. In a shipment of 200 such computers, there are 10 defective units.

Use the given information to find the P–value. Also, use a 0.05 significance level and state the conclusion about the null hypothesis (reject the null hypothesis or fail to reject the null hypothesis).

9) With H_1: $p \neq 0.612$, the test statistic is $z = -3.06$.

A) 0.0022; reject the null hypothesis
B) 0.0011; reject the null hypothesis
C) 0.0011; fail to reject the null hypothesis
D) 0.0022; fail to reject the null hypothesis

Express the null hypothesis and the alternative hypothesis in symbolic form. Use the correct symbol (μ, p, σ) for the indicated parameter.

10) A skeptical paranormal researcher claims that the proportion of Americans that have seen a UFO, p, is less than 3 in every one thousand.

A) H_0: $p = 0.003$
H_1: $p < 0.003$

B) H_0: $p > 0.003$
H_1: $p \le 0.003$

C) H_0: $p < 0.003$
H_1: $p \ge 0.003$

D) H_0: $p = 0.003$
H_1: $p > 0.003$

Identify the null hypothesis, alternative hypothesis, test statistic, P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

11) A supplier of digital memory cards claims that no more than 1% of the cards are defective. In a random sample of 600 memory cards, it is found that 3% are defective, but the supplier claims that this is only a sample fluctuation. At the 0.01 level of significance, test the supplier's claim that no more than 1% are defective.

12) In a clinical study of an allergy drug, 108 of the 202 subjects reported experiencing significant relief from their symptoms. At the 0.01 significance level, test the claim that more than half of all those using the drug experience relief.

Formulate the indicated conclusion in nontechnical terms. Be sure to address the original claim.

13) An entomologist writes an article in a scientific journal which claims that fewer than 12 in ten thousand male fireflies are unable to produce light due to a genetic mutation. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is to reject the null hypothesis, state the conclusion in nontechnical terms.

A) There is sufficient evidence to support the claim that the true proportion is less than 12 in ten thousand.
B) There is not sufficient evidence to support the claim that the true proportion is less than 12 in ten thousand.
C) There is sufficient evidence to support the claim that the true proportion is greater than 12 in ten thousand.
D) There is not sufficient evidence to support the claim that the true proportion is greater than 12 in ten thousand.

Use the given information to find the P–value. Also, use a 0.05 significance level and state the conclusion about the null hypothesis (reject the null hypothesis or fail to reject the null hypothesis).

14) The test statistic in a left–tailed test is $z = -2.05$.

A) 0.0202; reject the null hypothesis
B) 0.4798; fail to reject the null hypothesis
C) 0.0404; reject the null hypothesis
D) 0.0453 fail to reject the null hypothesis

Assume that the data has a normal distribution and the number of observations is greater than fifty. Find the critical z value used to test a null hypothesis.

15) $\alpha = 0.08$; H_1 is $\mu \neq 3.24$

A) ±1.75
B) 1.75
C) 1.41
D) ±1.41

Use the given information to find the P–value. Also, use a 0.05 significance level and state the conclusion about the null hypothesis (reject the null hypothesis or fail to reject the null hypothesis).

16) The test statistic in a right–tailed test is $z = 1.43$.

A) 0.0764; fail to reject the null hypothesis
B) 0.0764; reject the null hypothesis
C) 0.1528; fail to reject the null hypothesis
D) 0.1528; reject the null hypothesis

17) With H_1: $p > 0.383$, the test statistic is $z = 0.41$.

A) 0.3409; fail to reject the null hypothesis
B) 0.6591; fail to reject the null hypothesis
C) 0.3409; reject the null hypothesis
D) 0.6818; reject the null hypothesis

Find the value of the test statistic z using $z = \dfrac{\hat{p} - p}{\sqrt{\dfrac{pq}{n}}}$.

18) The claim is that the proportion of accidental deaths of the elderly attributable to residential falls is more than 0.10, and the sample statistics include $n = 800$ deaths of the elderly with 15% of them attributable to residential falls.

A) 4.71
B) –3.96
C) –4.71
D) 3.96

19) A claim is made that the proportion of children who play sports is less than 0.5, and the sample statistics include $n = 1671$ subjects with 30% saying that they play a sport.

A) –16.35 B) 16.35 C) –33.38 D) 33.38

Express the null hypothesis and the alternative hypothesis in symbolic form. Use the correct symbol (μ, p, σ) for the indicated parameter.

20) The owner of a football team claims that the average attendance at games is over 62,900, and he is therefore justified in moving the team to a city with a larger stadium.

A) H_0: $\mu = 62{,}900$ H_1: $\mu > 62{,}900$
B) H_0: $\mu > 62{,}900$ H_1: $\mu \le 62{,}900$
C) H_0: $\mu < 62{,}900$ H_1: $\mu \ge 62{,}900$
D) H_0: $\mu = 62{,}900$ H_1: $\mu < 62{,}900$

Assume that the data has a normal distribution and the number of observations is greater than fifty. Find the critical z value used to test a null hypothesis.

21) $\alpha = 0.09$ for a right–tailed test.

A) 1.34 B) ±1.34 C) 1.96 D) ±1.96

Solve the problem.

22) Write the claim that is suggested by the given statement, then write a conclusion about the claim. Do not use symbolic expressions or formal procedures; use common sense.

A person claims to have extra sensory powers. A card is drawn at random from a deck of cards and without looking at the card, the person is asked to identify the suit of the card. He correctly identifies the suit 28 times out of 100.

Find the P–value for the indicated hypothesis test.

23) A medical school claims that more than 28% of its students plan to go into general practice. It is found that among a random sample of 130 of the school's students, 32% of them plan to go into general practice. Find the P–value for a test of the school's claim.

A) 0.1539 B) 0.3461 C) 0.3078 D) 0.1635

Express the null hypothesis and the alternative hypothesis in symbolic form. Use the correct symbol (μ, p, σ) for the indicated parameter.

24) A researcher claims that the amounts of acetaminophen in a certain brand of cold tablets have a standard deviation different from the $\sigma = 3.3$ mg claimed by the manufacturer.

A) H_0: $\sigma = 3.3$ mg H_1: $\sigma \ne 3.3$ mg
B) H_0: $\sigma \ne 3.3$ mg H_1: $\sigma = 3.3$ mg
C) H_0: $\sigma \ge 3.3$ mg H_1: $\sigma < 3.3$ mg
D) H_0: $\sigma \le 3.3$ mg H_1: $\sigma > 3.3$ mg

Assume that the data has a normal distribution and the number of observations is greater than fifty. Find the critical z value used to test a null hypothesis.

25) $\alpha = 0.05$ for a left–tailed test.

A) –1.645 B) ±1.645 C) –1.96 D) ±1.96

Express the null hypothesis and the alternative hypothesis in symbolic form. Use the correct symbol (μ, p, σ) for the indicated parameter.

26) A cereal company claims that the mean weight of the cereal in its packets is at least 14 oz.

A) H_0: $\mu = 14$ H_1: $\mu < 14$
B) H_0: $\mu < 14$ H_1: $\mu \ge 14$
C) H_0: $\mu = 14$ H_1: $\mu > 14$
D) H_0: $\mu > 14$ H_1: $\mu \le 14$

Find the P–value for the indicated hypothesis test.

27) In a sample of 88 children selected randomly from one town, it is found that 8 of them suffer from asthma. Find the P–value for a test of the claim that the proportion of all children in the town who suffer from asthma is equal to 11%.

A) 0.5686 B) 0.2843 C) 0.2157 D) –0.2843

Identify the null hypothesis, alternative hypothesis, test statistic, P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

28) The health of employees is monitored by periodically weighing them in. A sample of 54 employees has a mean weight of 183.9 lb. Assuming that σ is known to be 121.2 lb, use a 0.10 significance level to test the claim that the population mean of all such employees weights is less than 200 lb.

Determine whether the given conditions justify testing a claim about a population mean μ.

29) The sample size is $n = 19$, σ is not known, and the original population is normally distributed.

A) Yes B) No

Find the P–value for the indicated hypothesis test.

30) Find the P–value for a test of the claim that less than 50% of the people following a particular diet will experience increased energy. Of 100 randomly selected subjects who followed the diet, 47 noticed an increase in their energy level.

A) 0.2743 B) 0.7257 C) 0.2257 D) 0.5486

Determine whether the hypothesis test involves a sampling distribution of means that is a normal distribution, Student t distribution, or neither.

31) Claim: $\mu = 82$. Sample data: $n = 20$, $\bar{x} = 100$, $s = 15.1$. The sample data appear to come from a population with a distribution that is very far from normal, and σ is unknown.

A) Neither B) Student t C) Normal

32) Claim: $\mu = 120$. Sample data: $n = 11$, $\bar{x} = 100$, $s = 15.2$. The sample data appear to come from a normally distributed population with unknown μ and σ.

A) Student t B) Normal C) Neither

Test the given claim. Use the P–value method or the traditional method as indicated. Identify the null hypothesis, alternative hypothesis, test statistic, critical value(s) or P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

33) A simple random sample of 15–year old boys from one city is obtained and their weights (in pounds) are listed below. Use a 0.01 significance level to test the claim that these sample weights come from a population with a mean equal to 149 lb. Assume that the standard deviation of the weights of all 15–year old boys in the city is known to be 16.2 lb. Use the traditional method of testing hypotheses.

147 138 162 151 134 189 157 144 175 127 164

Determine whether the hypothesis test involves a sampling distribution of means that is a normal distribution, Student t distribution, or neither.

34) Claim: $\mu = 981$. Sample data: $n = 24$, $\bar{x} = 972$, $s = 26$. The sample data appear to come from a normally distributed population with $\sigma = 28$.

A) Normal B) Student t C) Neither

Find the P–value for the indicated hypothesis test.

35) A nationwide study of American homeowners revealed that 65% have one or more lawn mowers. A lawn equipment manufacturer, located in Omaha, feels the estimate is too low for households in Omaha. Find the P–value for a test of the claim that the proportion with lawn mowers in Omaha is higher than 65%. Among 497 randomly selected homes in Omaha, 340 had one or more lawn mowers.

A) 0.0559 B) 0.1118 C) 0.0505 D) 0.0252

Test the given claim. Use the P–value method or the traditional method as indicated. Identify the null hypothesis, alternative hypothesis, test statistic, critical value(s) or P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

36) The mean resting pulse rate for men is 72 beats per minute. A simple random sample of men who regularly work out at Mitch's Gym is obtained and their resting pulse rates (in beats per minute) are listed below. Use a 0.05 significance level to test the claim that these sample pulse rates come from a population with a mean less than 72 beats per minute. Assume that the standard deviation of the resting pulse rates of all men who work out at Mitch's Gym is known to be 6.6 beats per minute. Use the traditional method of testing hypotheses.

56	59	69	84	74	64	69
70	66	80	59	71	76	63

Assume that a simple random sample has been selected from a normally distributed population. Find the test statistic, P–value, critical value(s), and state the final conclusion.

37) Test the claim that the mean lifetime of car engines of a particular type is greater than 220,000 miles. Sample data are summarized as $n = 23$, $\overline{x} = 226{,}450$ miles, and $s = 11{,}500$ miles. Use a significance level of $\alpha = 0.01$.

38) Test the claim that for the population of history exams, the mean score is 80. Sample data are summarized as $n = 16$, $\overline{x} = 84.5$, and $s = 11.2$. Use a significance level of $\alpha = 0.01$.

Assume that a simple random sample has been selected from a normally distributed population and test the given claim. Use either the traditional method or P–value method as indicated. Identify the null and alternative hypotheses, test statistic, critical value(s) or P–value (or range of P–values) as appropriate, and state the final conclusion that addresses the original claim.

39) Use a significance level of $\alpha = 0.05$ to test the claim that $\mu = 32.6$. The sample data consist of 15 scores for which $\overline{x} = 39$ and $s = 7.8$. Use the traditional method of testing hypotheses.

Assume that a simple random sample has been selected from a normally distributed population. Find the test statistic, P–value, critical value(s), and state the final conclusion.

40) Test the claim that for the population of female college students, the mean weight is given by $\mu = 132$ lb. Sample data are summarized as $n = 20$, $\overline{x} = 137$ lb, and $s = 14.2$ lb. Use a significance level of $\alpha = 0.1$.

Assume that a simple random sample has been selected from a normally distributed population and test the given claim. Use either the traditional method or P–value method as indicated. Identify the null and alternative hypotheses, test statistic, critical value(s) or P–value (or range of P–values) as appropriate, and state the final conclusion that addresses the original claim.

41) A large software company gives job applicants a test of programming ability and the mean for that test has been 160 in the past. Twenty–five job applicants are randomly selected from one large university and they produce a mean score and standard deviation of 183 and 12, respectively. Use a 0.05 level of significance to test the claim that this sample comes from a population with a mean score greater than 160. Use the P–value method of testing hypotheses.

42) A cereal company claims that the mean weight of the cereal in its packets is 14 oz. The weights (in ounces) of the cereal in a random sample of 8 of its cereal packets are listed below.

14.6 13.8 14.1 13.7 14.0 14.4 13.6 14.2

Test the claim at the 0.01 significance level.

43) A light-bulb manufacturer advertises that the average life for its light bulbs is 900 hours. A random sample of 15 of its light bulbs resulted in the following lives in hours.

995 590 510 539 739 917 571 555
916 728 664 693 708 887 849

At the 10% significance level, test the claim that the sample is from a population with a mean life of 900 hours. Use the P-value method of testing hypotheses.

Find the critical value or values of χ^2 based on the given information.

44) H_0: $\sigma = 8.0$
$n = 10$
$\alpha = 0.01$

A) 1.735, 23.589 B) 23.209 C) 21.666 D) 2.088, 21.666

45) H_1: $\sigma > 3.5$
$n = 14$
$\alpha = 0.05$

A) 22.362 B) 23.685 C) 24.736 D) 5.892

46) H_1: $\sigma < 0.14$
$n = 23$
$\alpha = 0.10$

A) 14.042 B) 30.813 C) -30.813 D) 14.848

47) H_1: $\sigma \neq 9.3$
$n = 28$
$\alpha = 0.05$

A) 14.573, 43.194 B) 16.151, 40.113 C) -40.113, 40.113 D) -14.573, 14.573

Use the traditional method to test the given hypothesis. Assume that the population is normally distributed and that the sample has been randomly selected.

48) When 12 bolts are tested for hardness, their indexes have a standard deviation of 41.7. Test the claim that the standard deviation of the hardness indexes for all such bolts is greater than 30.0. Use a 0.025 level of significance.

49) At the $\alpha = 0.05$ significance level test the claim that a population has a standard deviation of 20.3. A random sample of 18 people yields a standard deviation of 27.1.

50) With individual lines at the checkouts, a store manager finds that the standard deviation for the waiting times on Monday mornings is 5.7 minutes. After switching to a single waiting line, he finds that for a random sample of 29 customers, the waiting times have a standard deviation of 4.9 minutes. Use a 0.025 significance level to test the claim that with a single line, waiting times vary less than with individual lines.

51) Heights of men aged 25 to 34 have a standard deviation of 2.9. Use a 0.05 significance level to test the claim that the heights of women aged 25 to 34 have a different standard deviation. The heights (in inches) of 16 randomly selected women aged 25 to 34 are listed below. Round the sample standard deviation to five decimal places.

62.13	65.09	64.18	66.72	63.09	61.15	67.50	64.65
63.80	64.21	60.17	68.28	66.49	62.10	65.73	64.72

1) If the die were fair, the probability of obtaining 63 6's in 100 rolls would be extremely small. Therefore, by the rare event rule, we conclude that the claim that the die is fair is probably not correct.
2) A
3) A
4) A
5) A
6) A
7) H_0: $p = 0.53$. H_1: $p \neq 0.53$. Test statistic: $z = -1.60$. P-value: $p = 0.0548$.
Critical value: $z = \pm 1.645$. Fail to reject null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the actual percentage is 53%.
8) If the defective rate were really 4%, one could easily obtain 10 defective units among 200 computers by chance; this is not improbable. Therefore, by the rare event rule, we have no reason to reject the claim that the defective rate is 4%.
9) A
10) A
11) H_0: $p = 0.01$. H_1: $p > 0.01$. Test statistic: $z = 4.92$. P-value: $p = 0.0001$.
Critical value: $z = 2.33$. Reject null hypothesis. There is sufficient evidence to warrant rejection of the claim that no more than 1% are defective. Note: Since the term "no more than" is used, the translation is $p \le 0.01$. Therefore, the competing hypothesis is $p > 0.01$.
12) H_0: $p = 0.5$. H_1: $p > 0.5$. Test statistic: $z = 0.99$. P-value: $p = 0.1611$.
Critical value: $z = 2.33$. Fail to reject null hypothesis. There is not sufficient evidence to support the claim that more than half of all those using the drug experience relief.
13) A
14) A
15) A
16) A
17) A
18) A
19) A
20) A
21) A
22) The claim is that the person is using his extra sensory powers to determine the suit of the card and that he correctly determines the suit more often than he would if he were guessing randomly. Even if he were just guessing randomly, he would have a reasonable chance of being correct 28 times out of a hundred; this is not improbable since there are four suits. Therefore, identifying the suit correctly 28 times out of 100 does not constitute strong evidence in favor of his claim.
23) A
24) A
25) A
26) A
27) A
28) H_0: $\mu = 200$; H_1: $\mu < 200$; Test statistic: $z = -0.98$. P-value: 0.1635. Fail to reject H_0. There is not sufficient evidence to support the claim that the mean is less than 200 pounds.
29) A
30) A
31) A
32) A

33) H_0: $\mu = 149$ lb
H_1: $\mu \neq 149$ lb
Test statistic: $z = 0.91$
Critical-values: $z = \pm 2.575$
Do not reject H_0; At the 1% significance level, there is not sufficient evidence to warrant rejection of the claim that these sample weights come from a population with a mean equal to 149 lb.
34) A
35) A
36) H_0: $\mu = 72$ beats per minute
H_1: $\mu < 72$ beats per minute
Test statistic: $z = -1.94$
Critical-value: $z = -1.645$
Reject H_0; At the 5% significance level, there is sufficient evidence to support the claim that .these sample pulse rates come from a population with a mean less than 72 beats per minute.
37) $\alpha = 0.01$
Test statistic: $t = 2.6898$
P-value: $p = 0.0066$
Critical value: $t = 2.508$
Because the test statistic, $t > 2.508$, we reject the null hypothesis. There is sufficient evidence to accept the claim that $\mu > 220{,}000$ miles.
38) $\alpha = 0.01$
Test statistic: $t = 1.607$
P-value: $p = 0.1289$
Critical values: $t = \pm 2.947$
Because the test statistic, $t < 2.947$, we do not reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the mean score is 80.
39) H_0: $\mu = 32.6$. H_1: $\mu \neq 32.6$. Test statistic: $t = 3.18$. Critical values: $t = \pm 2.145$. Reject H_0. There is sufficient evidence to warrant rejection of the claim that the mean is 32.6.
40) $\alpha = 0.1$
Test statistic: $t = 1.57$
P-value: $p = 0.1318$
Critical values: $t = \pm 1.729$
Because the test statistic, $t < 1.729$, we fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that $\mu = 132$ lb.
41) H_0: $\mu = 160$. H_1: $\mu > 160$. Test statistic: $t = 9.583$. P-value < 0.005. Reject H_0. There is sufficient evidence to support the claim that the mean is greater than 160.
42) H_0: $\mu = 14$ oz. H_1: $\mu \neq 14$ oz. Test statistic: $t = 0.408$. Critical values: $t = \pm 3.499$. Fail to reject H_0. There is not sufficient evidence to warrant rejection of the claim that the mean weight is 14 ounces.
43) H_0: $\mu = 900$ hrs. H_1: $\mu \neq 900$ hrs. Test statistic: $t = -4.342$. P-value < 0.01. Reject H_0. There is sufficient evidence to warrant rejection of the claim that the sample is from a population with a mean life of 900 hours. The light bulbs do not appear to conform to the manufacturer's specifications.
44) A
45) A
46) A
47) A
48) Test statistic: $\chi^2 = 21.253$. Critical value: $\chi^2 = 21.920$. Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that the standard deviation is greater than 30.0.

49) Test statistic: $\chi^2 = 30.297$. Critical values: $\chi^2 = 7.564, 30.191$. Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the standard deviation of the population is equal to 20.3.

50) Test statistic: $\chi^2 = 20.692$. Critical value: $\chi^2 = 15.308$. Fail to reject H_0. There is not sufficient evidence to support the claim that with a single line waiting times have a smaller standard deviation.

51) Test statistic: $\chi^2 = 9.2597$. Critical values: $\chi^2 = 6.262, 27.488$. Fail to reject H_0. There is not sufficient evidence to support the claim that heights of women aged 25 to 34 have a standard deviation different from 2.9 in.