

Problems For You To Do (Sections 8.1 - 8.5)

- The mean annual driving distance for women is 11490 km. An insurance company wants to determine if younger women (between 16 - 24 years) should pay a lower insurance premium because they drive less than other women. In a study of 750 randomly selected younger women, aged 16 - 24 years, the mean annual driving distance was 9750 km with a standard deviation of 4750 km.
 - Set up appropriate hypotheses to determine if there is sufficient evidence to support the claim that younger women drive less.
 - What is the test statistic?
 - What is the critical region? Use a significance level of 0.05.
 - Evaluate the test statistic for the sample data.
 - State your decision using proper statistical language.
 - Restate your conclusions in "plain English" referring to this specific application.
 - In the context of this application, explain
 - a Type I error
 - a Type II error
- In a statistical hypothesis test describe (define) in general what is meant by
 - a test statistic
 - the significance level
- A cell phone battery manufacturer claims that the battery has a "stand by" lifetime of at least 36 hours of continuous use. To test this claim, a consumer agency randomly selects and tests the lifetimes of 60 batteries.
 - Set up the null and alternative hypotheses. Define all symbols that you use.
 - At the 0.01 level of significance, when would you reject H_0 ?
 - If the sample of 60 batteries produced an average lifetime of 35.8 hours and a standard deviation of 1.2 hours, what conclusion would you make at the 0.01 significance level?
 - Hopefully the conclusion that you made in Part c) is correct, but if it is incorrect, what type of error (I or II) *might* you have made?
- Find the critical values from the standard normal distribution for each of the following. Also, draw a graph showing the critical value and clearly identify the critical region on your graph.
 - a left tailed test with $\alpha = 0.01$
 - a two tailed test with $\alpha = 0.04$
 - a right tailed test with $\alpha = 0.05$
 - a two tailed test with a level of significance of 0.01
- Vancouver city engineers claim that the 60-minute parking meters have been set to give an average of at least 61 minutes of parking time. You are doubtful, but reluctant to make a false accusation until you have strong evidence.
 - Set up H_0 and H_1 to test this claim. Define all symbols introduced.
 - At the 0.10 level of significance, when would you reject H_0 ?
 - If you randomly sampled 50 meters and calculated an average meter time of 60.8 minutes with an SD of 0.5 minutes, what conclusion would you make at the 0.10 significance level? State your decision in "statistical language" and your conclusion in "plain English".

6. A major industry-funded research project concluded that the new standard width for seats should be 46 cm. However the owners of a newly planned basketball arena suspect that this will not be wide enough. Their own assessment of the body mass of 80 randomly chosen basketball fans will be used to challenge the conclusions drawn from the major industry-funded project.

Seats get wider to meet heavier demands

**Bulging American bottoms
are dictating a change in US
minimum seat standards**

James Bone
TIMES OF LONDON

NEW YORK - Sports arenas, cinemas, ferry boats, subways, offices and opera houses in the U.S. are being re-fitted with bigger seats to accommodate the bulging American bottoms.

a) Carefully define an appropriate pair of hypotheses for this test using correct notation and defining any parameters.

b) The basketball arena's owners' study yielded an average required seat width of 48 cm, with a SD of 6 cm. Complete the hypothesis test, showing all steps, clearly defining the test statistic, the critical region, and stating your conclusion in "non-statistical jargon" in the context of the problem

- at a level of significance of 0.01.
- at a level of significance of 0.1%.

7. In a statistical hypothesis test define (in general terms) what is meant by the "critical region".

8. The promoters of a new physical fitness program claim that their program will reduce the 10 km runtime by an average of at least 5 minutes for "out of shape" young adults. You are skeptical, but prepared to give them the benefit of the doubt until you have strong evidence against their claim.

a) Set up H_0 and H_1 to test this claim. Define any parameters.

b) At the 0.05 level of significance, what conclusion would you make if

i) a random sample of 60 participants in the fitness program had an average improvement in runtime of 4.8 minutes with a SD of 0.5 minutes? Show all steps and give a "plain English" conclusion.

ii) a random sample of 12 participants in the fitness program had an average improvement in runtime of 4.8 minutes with a SD of 0.5 minutes? Show all steps and give a "plain English" conclusion. What additional assumption do you have to make for the validity of the analysis?

9. The table below shows the results of a random sample of 36 male students aged 18 - 22 years. Each student was first asked to self evaluate his fitness level using the scale Very Good (VG) Good (G) OK Poor (P) Very Poor (VP) and then was tested for lung capacity as measured by the volume (in litres) of air that he was able to expel in one second.

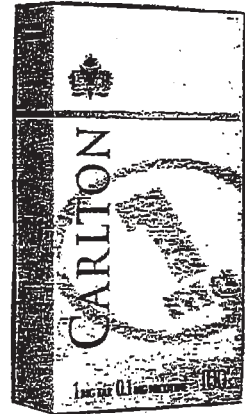
- a) What is the level of measurement used for the self evaluation of fitness?
- b) At the .01 level of significance is there sufficient evidence to conclude that a majority of male students aged 18 - 22 years evaluate their fitness levels as OK or better?

Subject Number	Fitness Level	Air Expelled (l)
1	VG	4.5
2	OK	4.1
3	VG	4.8
4	G	4.2
5	OK	3.8
6	G	4.1
7	P	3.6
8	VP	3.4
9	OK	4.0
10	G	4.3
11	OK	4.3
12	OK	3.9
13	P	3.5
14	G	3.9
15	VG	4.3
16	VP	3.3
17	OK	3.9
18	P	3.7
19	P	4.1
20	G	4.2
21	VG	4.8
22	G	4.6
23	G	4.2
24	OK	4.0
25	VP	3.5
26	VP	3.1
27	G	4.2
28	OK	4.1
29	P	4.0
30	VG	4.2
31	VG	4.9
32	OK	3.8
33	OK	3.8
34	OK	4.1
35	P	3.7
36	G	4.4

10. a) The 1 mg tar appearing on the box of Carlton cigarettes is a mean tar value per cigarette as determined by testing done on a smoking machine (not a person). A researcher believes that the tar level inhaled by humans has a higher mean value. He conducts an experiment measuring the tar content inhaled by human smokers of this brand of cigarette and records the following tar levels per cigarette (mg) for a random sample of 8 smokers:

1.1 0.7 1.6 1.1 0.9 1.4 1.2 1.3

At the 0.10 level is this sufficiently strong evidence that the mean tar content is higher for human smokers than the advertised amount of 1 mg per cigarette?



- b) Clearly state any assumptions required for the validity of the test in Part a)
- c) For your conclusion in Part a) what type of error *might* you have made?
11. A Ford engineer claims that a new fuel injection design increases the mean mileage on the Taurus above its current 30 miles/gallon level.
- Express the claim in symbolic form.
 - What is the competing claim?
 - Identify the null hypothesis.
 - Identify the alternative hypothesis.
 - In terms of this application, explain what is meant by
 - a Type I error
 - a Type II error
12. The mean time between radio failures for a radio used in light aircraft is 420 hours. After 35 new radios were modified in an attempt to improve their reliability, tests showed that the times between failures for this sample have a mean of 485 hours and a standard deviation of 24 hours. Use a 0.05 significance level to determine whether there is sufficient evidence to support the claim that the modifications resulted in longer mean time between failures.
13. In a study of factors affecting hypnotism visual analogue scale (VAS) sensory ratings were obtained for 16 randomly selected subjects. For these sample ratings the mean was found to be 8.33 points and the SD 1.96 points. At the 0.01 level of significance, is there sufficient evidence to conclude that this sample came from a population with a mean rating of less than 10 points?
14. A medical researcher obtains the systolic blood pressure readings (in mm Hg) given in the list below for women aged 18 - 24 who have a new strain of viral infection.
- 134.9 78.7 108.9 133.0 123.7 96.1 126.9 89.8
132.0 134.7 132.1 121.7 112.3 150.2 158.3 154.4
- Find the sample mean and standard deviation.
 - Use a 0.05 significance test to test the claim that the sample comes from a population with a mean equal to 114.8.

15. A reservations system for Air America suffered from a 7% rate of no-shows. A new procedure was instituted whereby reservations are confirmed on the day preceding the actual flight, and the study was then made of 5218 randomly selected reservations made under the new system. If 333 no-shows were recorded, is this sufficient evidence at the 0.05 significance level to conclude that the no-show rate is lower with the new system?
16. In a study of distances traveled by buses before the first major engine failure, a sampling of 191 buses resulted in a mean of 96,700 miles and a standard deviation of 37,500 miles (based on *Technometrics*, Vol. 22, No. 4). At the 0.05 level of significance, is this sufficient evidence to support the manufacturer's claim that the mean distance traveled before a major engine failure is more than 90,000 miles?
17. We wish to investigate the claim that the proportion of B.C. voters who will vote NDP is less than 20%. Let p be the actual proportion of B.C. voters who will vote NDP.
- Express the claim in symbolic form.
 - What is the competing claim?
 - State the null hypothesis in symbolic form.
 - State the alternative hypothesis in symbolic form.
 - If we run a statistical test and reject H_0 , what does this mean about p ?

18. The following are birth weights (in kilograms) for a random sample of male babies born to mothers on a special vitamin supplement.

3.73	4.37	3.73	4.33	3.39	3.68	4.68	3.52
3.02	4.09	2.47	4.13	4.47	3.22	3.43	2.54

At the 0.05 level of significance test the claim that the mean for all male babies whose mothers used the special vitamin supplement is equal to 3.39 kg, which is the mean birth weight for the population of all male babies.

Does the vitamin supplement appear to have an effect on birth weight?

Referring specifically to the above application, explain the meaning of a Type I and a Type II decision error.

19. Assume that a researcher is interested in investigating the following claim:
 "The mean weight of paper discarded by all households each week in the city of North Vancouver is less than 10 pounds."
- Express the claim in symbolic form.
 - Express the null hypothesis in symbolic form.
 - Express the alternative hypothesis in symbolic form.
 - Is the hypothesis test left tailed, right tailed, or two tailed?
 - Explain what a Type I decision error is in this application.
 - Suppose that the conclusion of the test is to Fail To Reject (FTR) H_0 at $\alpha = 0.05$. State this conclusion in terms of a decision about the original claim.

20. The authors of the paper "Cultural and Sexual Differences in Test Anxiety, Trait Anxiety, and Arousability" (Journal of Cross Cultural Psychology, 1991, pgs 238 - 249) hypothesized that students in countries where high school testing had important future consequences (such as Egypt) would experience a greater level of anxiety than do students in the United States. Test anxiety scores were obtained for a random sample of 277 Egyptian high school students. The sample mean and standard deviation were 50.0 and 12.7 points, respectively. For the population of U.S. high school students the mean anxiety score is 41 points. Does the sample data support the researchers' theory at the 0.01 level of significance?
21. A Los Angeles Times article reported that 15% of all California drivers have tampered with their emission control devices on their vehicles. A random sample of 200 cars from a California county revealed that 21 of the cars had their emission control devices tampered with. Does the data suggest that the proportion of tampered cars in this county differs from the California state proportion at the 0.05 significance level?
22. a) Recently, much concern has been expressed about using nitrates as meat preservatives. In one study of possible effects of nitrates, bacteria cultures were grown in a nitrate medium. The rate of uptake of radio labelled amino acid was determined for each culture and the following results were obtained:
- | | | | | | | | |
|------|------|------|------|------|------|------|------|
| 7251 | 6871 | 9632 | 6866 | 9094 | 5849 | 8957 | 7978 |
| 7468 | 7064 | 7494 | 7883 | 8178 | 7523 | 8724 | |
- Suppose it is known that the true mean uptake for cultures without nitrates is 8000. Does the data suggest that the addition of nitrates results in a decrease in the true average uptake?
- b) State any assumptions that are required to validate the use of the statistical test.
23. People are concerned about speeding on the Squamish highway. A random sample of 20 cars yields a mean speed of 85 km/hr and a standard deviation of 10 km/hr over a certain stretch of highway. If it can be assumed that car speed is normally distributed, is there sufficient sample evidence to conclude that cars, on the average, exceed 80 km/hr? Give a full statistical analysis of this test with the probability of a Type I error being 5%.
24. A researcher believes that 25% of sexually active teens between the ages of 15 and 19 practice "safe sex". In order to check out the claim 1250 randomly chosen teens were interviewed. Of those interviewed, 200 were not sexually active. Of those sexually active 280 practiced "safe sex". Is there sufficient evidence to challenge the researcher's claim? Use 0.01 for the probability of a Type I error.
25. Duracell batteries claim that their AAA size battery will, on the average, last longer than 3.1 hours. The length of life of batteries can be assumed to be normally distributed. Statistically, check out their claim using the following sample data: 3.1 3.6 3.2 3.4 3.5 3.3 ($\alpha = 0.05$)
26. A theatre chain wishes to sell a theatre. In order to do so it claims that at least 35% of theatre goers buy food or drink. In a random sample of 120 clients, 38 people bought some food or drinks. Check out the claim at the 0.05 significance level.

27. A bank makes the claim that the average savings account has \$1352.45 in it. A random sample of 25 savings accounts yields an average of \$1478.34 and a standard deviation of \$246.28. It is known that the distribution of all the savings account balances is normal. Is there evidence to question the bank's claim? Use $\alpha = 0.01$.
28. a) The president of a university claims that the average time spent partying by all students at his university is at most 7 hours per week. A random sample of 35 students taken from this university showed that they spent an average of 10.7 hours partying the previous week with a standard deviation of 2.3 hours. Assuming that the time spent partying by all students at this university is normally distributed, test the president's claim at the 0.05 significance level.
- b) In the context of the above application, explain what is meant by:
- a Type I decision error.
 - a Type II decision error.
29. According to the National Centre for Health Sciences, 40% of all people 18 years and older did regular physical activities in 1985. A recent sample of 1000 people aged 18 years and older found that 470 of them do regular physical activity. Has the proportion of adults doing regular physical activity changed since 1985? Use $\alpha = 0.05$.
30. A psychologist claims that the mean age at which children start walking is at least 12.5 months. The following data give the age (in months) at which 18 randomly selected children started walking:
15 9 11 14 13 12 14 13 15 9 12 15 10 14 10 11 11 13
Assuming that the age at which all children start walking is normally distributed, test the psychologist's claim at the 0.01 level of significance.