

# LHS APstats

## Spring Break Packet

### 2018

Name and provide *complete* numerical solutions to the attached challenges.

Do not hesitate to contact Mr. Petto by email or text message, if you get stuck identifying the correct inference procedure.

To check a manufacturer's claim that its audio tapes have an average playing time of at least 90 min, 900 tapes are randomly selected and timed. These yield a sample average playing time of 89.95 min and a sample standard deviation of .3 min. Does the data refute the manufacturer's claim? Comment on the statistical and practical significance of this result.

1 -

*U.S.A. Today* (January 15, 1986) reported on a study of medical costs incurred by automobile accident victims. A survey of 135 accident victims resulted in an average medical cost of \$565 for motorists wearing seat belts and an average of \$1200 for motorists who were not wearing seat belts. Suppose that the sample sizes and standard deviations for the two groups were as given in the accompanying table.

2 -

	Sample size $n$	Medical cost	
		$\bar{x}$	$s$
Wearing seat belts	90	565	268
No seat belts	45	1200	506

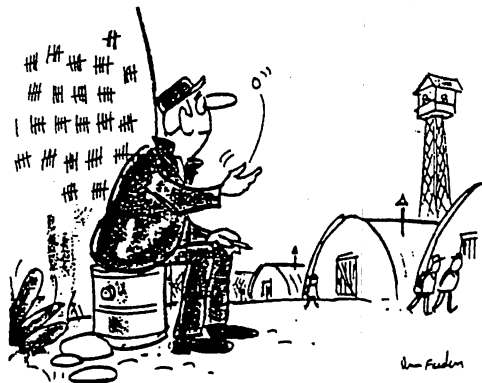
- Construct a 90% confidence interval for the mean medical cost for accident victims who were wearing seat belts.
- Construct a 90% confidence interval for the mean medical cost for accident victims who were not wearing seat belts.

Using an electronic process called time compression, a 30-s television commercial can be broadcast in its entirety in only 24 s. There is no shift in voice pitch and subjects are not aware that commercials have been altered. The article "Reducing the Costs of TV Commercials by Use of Time Compressions" (*J. of Marketing Research* (1980):52-57) reported on a study involving recall ability for subjects watching compressed as compared to noncompressed commercials. For one commercial, 15 of the 57 subjects viewing the normal version could subsequently recall the commercial, whereas 32 of the 74 subjects viewing the compressed version could subsequently recall it. Does this data suggest any difference between true recall proportions for the two versions?

3 -

The Food and Nutrition Board of the National Academy of Sciences reports that the mean daily sodium intake should not exceed 3300 mg. In a study of sodium intake (*Consumer Reports* (1984):17-22), a sample of U.S. residents was found to have a mean daily sodium intake of 4600 mg. Suppose that this result was based on a sample of size 100 and that the population standard deviation is  $\sigma = 1100$  mg. The researchers were interested in determining whether the mean daily sodium intake for U.S. residents exceeded the maximum recommended level.

4 -



The authors of the paper "Dynamics of Canopy Structure and Light Interception in *Pinus elliottii*, North Florida" (*Ecological Monographs* (1991):33-51) planned an experiment to determine the effect of fertilizer on a measure of leaf area. A number of plots were available for the study, and half were selected at random to be fertilized. In order to assure that the plots to receive the fertilizer and the control plots were similar, prior to beginning the experiment tree density (the number of trees per hectare) was recorded for eight plots to be fertilized and eight control plots, resulting in the given data.

5 -

Fertilizer plots:	1024	1216	1312	1280
	1216	1312	992	1120
Control plots:	1104	1072	1088	1328
	1376	1280	1120	1200

Based on this data, would you conclude that there is a significant difference in the mean tree density for fertilizer and control plots? Use  $\alpha = .05$ .

The formula given in the text for computing the sample size necessary to estimate  $\pi$  to within an amount  $B$  has an associated confidence level of 95%. How would you modify the formula to obtain the sample size required for 99% confidence? Will the value of  $n$  for 99% confidence be larger than that for 95% confidence (based on the same  $B$ )? Explain.

6 -

Should quizzes be given at the beginning or the end of a lecture period? The paper "On Positioning the Quiz: An Empirical Analysis" (*Accounting Review* (1980): 664-670) provides some insight. Two sections of an introductory accounting class were given identical instructions to read and study assigned text materials. Three quizzes and a final exam were given during the term, with one section taking quizzes at the beginning of the lecture and the other section taking quizzes at the end. Final exam scores for the two groups are summarized. Does the accompanying data indicate that there is a significant difference in the true mean final exam scores for students who take quizzes at the beginning of class and those who take quizzes at the end?

7 -

	Quiz at beginning	Quiz at end
Sample size	40	40
Mean	143.7	131.7
Standard deviation	21.2	20.9

One method for straightening wire prior to coiling it to make a spring is called "roller straightening." The paper "The Effect of Roller and Spinner Wire Straightening on Coiling Performance and Wire Properties" (*Springs* (1987):27-28) reported on the tensile properties of wire. Suppose that a sample of 16 wires is selected and each is tested to determine tensile strength ( $N/mm^2$ ). The resulting sample mean and standard deviation are 2160 and 30, respectively.

8 -

- The mean tensile strength for springs made using spinner straightening is  $2150 N/mm^2$ . What hypotheses should be tested to determine if the mean tensile strength for the roller method exceeds 2150?
- Assuming that the tensile strength distribution is approximately normal, what test statistic would you use to test the hypotheses in part (a)?
- What is the value of the test statistic for this data?
- Place bounds on the  $P$ -value associated with the value of the test statistic computed in part (c).
- For a level .05 test, what conclusion would you reach?

Is it appropriate for a physician to help a gravely ill person die? In a survey of 588 doctors, 365 responded that it was sometimes right to agree to hasten a patient's death ("Hemlock Poll: Doctors Favor Mercy Killing," Associated Press, February 19, 1988). Based on this information, would you conclude that more than 60% of all doctors feel it is sometimes appropriate to help a seriously ill person die?

- a. Test the relevant hypotheses using a .01 level of significance.
- b. Would your conclusion have been different if a significance level of .05 had been employed?

Are very young infants more likely to imitate actions that are modeled by a person or simulated by an object? This question was the basis of a research study summarized in the paper "The Role of Person and Object in Eliciting Early Imitation" (*J. Experimental Child Psych.* (1991):423-433). One action examined was mouth opening. This action was modeled repeatedly by either a person or a doll, and the number of times that the infant imitated the behavior was recorded. Twenty-seven infants participated, with 12 exposed to a human model and 15 exposed to the doll. Summary values are given here. Is there sufficient evidence to conclude that the mean number of imitations is higher for infants who watch a human model than for infants who watch a doll? Test the relevant hypotheses using a .01 significance level.

	Person model	Doll model
$\bar{x}$	5.14	3.46
$s$	1.6	1.3

Do teachers find their work rewarding and satisfying? The paper "Work-Related Attitudes" (*Psychological Reports* (1991):443-450) reported the results of a survey of 395 elementary school teachers and 266 high school teachers. Of the elementary school teachers, 224 said they were very satisfied with their jobs, whereas 126 of the high school teachers were very satisfied with their work. Based on this data, is it reasonable to conclude that the proportion very satisfied is different for elementary school teachers than it is for high school teachers? We will test the appropriate hypotheses using a .05 significance level.

A manufacturer of college textbooks is interested in estimating the strength of the bindings produced by a particular binding machine. Strength can be measured by recording the force required to pull the pages from the binding. If this force is measured in pounds, how many books should be tested in order to estimate with 95% confidence to within .1 lb the average force required to break the binding? Assume that  $\sigma$  is known to be .8 lb.

In 1988, the *Dallas Morning News* contacted 162 randomly selected people whose names appeared on nominating petitions for Democratic presidential candidate Jesse Jackson (*Austin American-Statesman*, January 23, 1988). One hundred sixteen of those contacted confirmed that they had signed the petitions, whereas the remaining individuals denied signing the petition and said that their names had been forged. Estimate the proportion of valid signatures on the nominating petitions using a 99% confidence interval.

13 -

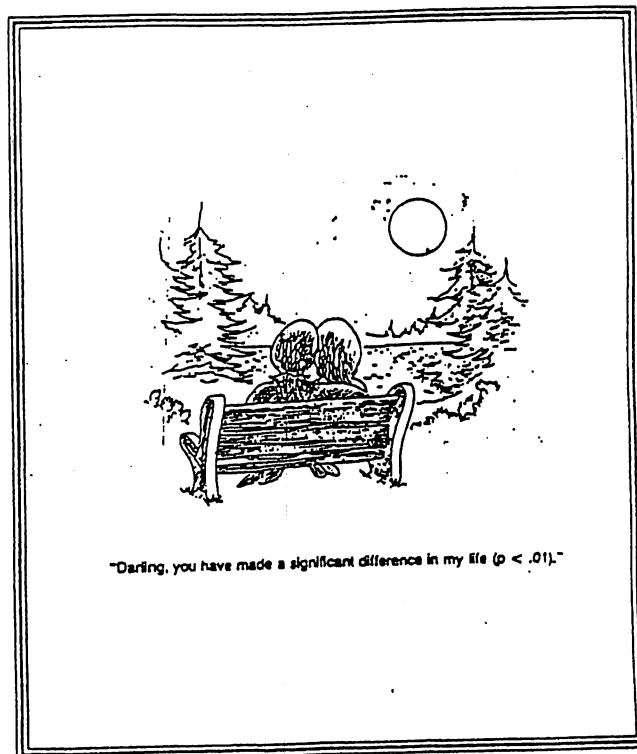
A soda manufacturer is interested in determining whether its bottling machine tends to overfill. Each bottle is supposed to contain 12 oz of fluid. A random sample of size 36 is taken from bottles coming off the production line, and the contents of each bottle is carefully measured. It is found that the mean amount of soda for the sample of bottles is 12.1 oz and the sample standard deviation is .2 oz. The manufacturer will use this information to test  $H_0: \mu = 12$  versus  $H_a: \mu > 12$ .

14 -

- What value does the  $z$  test statistic take for this data?
- Find the  $P$ -value associated with the value of  $z$  computed in part (a).
- If the manufacturer decides on a level .05 test, should  $H_0$  be rejected in favor of the conclusion that the machine is overfilling?

Drug testing of job applicants is becoming increasingly more common. The Associated Press (May 24, 1990) reported that 12.1% of those tested in California tested positive. Suppose that this figure had been based on a sample of size 600, with 73 testing positive. Does this sample support a claim that more than 10% of job applicants in California test positive for drug use?

15 -



A triathlon consisting of swimming, cycling, and running is one of the more strenuous amateur sporting events. The paper "Cardiovascular and Thermal Response of Triathlon Performance" (*Medicine and Science in Sports and Exercise* (1988): 385-389) reported on a research study involving nine male triathletes. Maximum heart rate (beats/min) was recorded while performing each of the three events.

	$\bar{x}$	$s$
Swimming	188	7.2
Biking	186	8.5
Running	194	7.8

- Assuming that the heart rate distribution for each event is approximately normal, construct 95% confidence intervals for the true mean heart rate of triathletes for each event.
- Do the intervals in part (a) overlap? Based on the computed intervals, do you think there is evidence that the mean maximum heart rate is higher for running than for the other two events? Explain.

Are male college students more easily bored than their female counterparts? This question was examined in the paper "Boredom in Young Adults—Gender and Cultural Comparisons" (*J. of Cross-Cultural Psych.* (1991):209-223). The authors administered a scale called the Boredom Proneness Scale to 97 male and 148 female U.S. college students. Does the accompanying data support the research hypothesis that the mean Boredom Proneness Rating is higher for males than for females? We will test the appropriate hypotheses using a .05 significance level.

	Sample size	$\bar{x}$	$s$
Males	97	10.40	4.83
Females	148	9.26	4.68

The paper "Agronomic Performance of Winter versus Spring Wheat" (*Agronomy J.* (1991):527-531) described the results of an experiment to compare the yield (kg/ha) of Sundance winter wheat and Manitou spring wheat. Data for nine test plots is given next. Is there sufficient evidence to conclude that the mean yield for the Sundance winter wheat is higher than that for the Manitou spring wheat? Use  $\alpha = .01$ .

Location	1	2	3	4	5	6	7	8	9
Sundance	3201	3095	3297	3644	3604	2860	3470	2042	3689
Manitou	2386	2011	2616	3094	3069	2074	2308	1525	2779

