

120 Points.

Elements of Statistics (Math 106) - Quiz 3
Fall 2009 - Brad Hartlaub

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Directions: Please answer all of the questions below. The point values for each problem are indicated in parentheses. Partial credit will be awarded if you show your work.

1. Computers in some vehicles calculate various quantities related to performance. One of these is fuel efficiency, or gas mileage, usually measured in miles per gallon (mpg). For one vehicle equipped in this way, the mpg were recorded each time the gas tank was filled, and the computer was then reset. In addition to the computer calculating mpg, the driver also recorded the mpg by dividing the miles driven by the amount of gallons at fill-up. The driver wants to determine if these calculations are different. Use the data in p:\data\math\stats\fillup.mtw to conduct the appropriate statistical inference. (25)

Paired data \Rightarrow Let μ_d = mean of the differences (computer - driver)
The normal probability plot of the differences is linear (with one very small difference of -4.2) so the paired t test can be used.
Normality assumption is OK.

$$H_0: \mu_d = 0 \text{ vs } H_1: \mu_d \neq 0$$

If students use sign test:
Test stat: 3 Below, OR 17 Above
P-value = .0026

Test stat: $t = 4.36$; $P\text{-value} = 0.000$
Since the $P\text{-value} < .01$, we reject H_0 and conclude that there is a statistically significant difference between the computer and driver calculations.

2. In a 2004 survey of 1200 undergraduate students throughout the United States, 89% of the respondents said they owned a cell phone. It was also reported that cell phone ownership by undergraduate students in 2003 was 83%. If the sample size was the same in 2003, do these data provide good evidence that this percent has significantly increased? (25)

Let p_{2004} = proportion of 2004 undergraduates who own a cell phone
and p_{2003} = " " 2003 " " " " " "

of successes (1068 and 996) and # of failures (~~1132~~ and ~~1132~~²⁰⁴) are all bigger than 10, so the large sample procedure can be used.

$$H_0: p_{2004} = p_{2003} \text{ vs } H_1: p_{2004} > p_{2003}$$

Test Stat: $Z = 4.24$

$P\text{-value} = 0.000$
Since the $P\text{-value}$ is < 0.01 , we reject H_0 and conclude that the proportion of undergraduates who own a cell phone has significantly increased.

3. Do various occupational groups differ in their diets? A British study of this question compared 98 drivers and 83 conductors of London double-decker buses. The conductors' jobs require more physical activity. The article reporting the study gives the data as "mean daily consumption (\pm se)." Some of the results are shown in the table below.

	Drivers $n=98$	Conductors $n=83$
Total Calories	2821 \pm 44	2844 \pm 48
Alcohol (grams)	0.24 \pm 0.06	0.39 \pm 0.11

- a. What does "se" stand for? Give \bar{x} and s for each of the four sets of measurements. (10)

se stands for standard error (s/\sqrt{n}). The means for the 4 groups are 2821 (TC_D), 2844 (TC_C), .24 (AD) and .39 (AC). The std deviations are 435.578 (TC_D), 437.3008 (TC_C), .594 (AD) and 1.0021 (AC).

- b. Is there significant evidence at the 5% level that conductors consume more calories per day than do drivers? (25)

$H_0: \mu_{TC_D} = \mu_{TC_C}$ vs $H_1: \mu_{TC_D} < \mu_{TC_C}$ Large sample sizes so use z sample t test

Test stat: -0.35

P-value: 0.362

Since .362 > .05, we do not have evidence to refute the null hypothesis. There is not a statistically significant difference in the average amount of calories consumed.

- c. Give a 99% confidence interval for the difference in mean daily alcohol consumption between drivers and conductors. (10)

A 99% CI for $\mu_{AD} - \mu_{AC}$ is (-.478, .178) We are 99% confident that the mean difference is between -.478 and .178.

4. Are you more likely to have a motor vehicle collision when using a cell phone? A study of 699 drivers who were using a cell phone when they were involved in a collision examined this question. These drivers made 26,798 cell phone calls during a 14-month study period. Each of the 699 collisions was classified in various ways. The numbers for each day are shown in the table below.

Number of collisions by day of the week						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
20	133	126	159	136	113	12

Are the accidents equally likely to occur on any day of the week, exclude weekends from your analysis since the participants did much less driving on the weekend? (25)

$$H_0: \pi_M = \pi_T = \pi_W = \pi_R = \pi_F = 1/5$$

H_a : Not all proportions are equal

* All cell counts are > 5 so we can use the χ^2 test.

GOODNESS OF FIT Stat = $\chi^2 = 8.49475$; P-value = .075

Since .075 > .05, we do not have evidence to refute H_0 . It appears that accidents are equally likely to appear on any work day.