

1. Healthy men aged 21 to 35 were randomly assigned to one of two groups: half received 0.82 grams of alcohol per kilogram of body weight; half received a placebo. Participants were then given 30 minutes to read up to 34 pages of Tolstoy's War and Peace (beginning at chapter 1, with each page containing approximately 22 lines of text). Every two to four minutes participants were prompted to indicate whether they were "zoning out." The proportion of times participants indicated they were zoning out was recorded for each subject. The table below summarizes data on the proportion of episodes of zoning out. (The study report gave the standard error of the mean s/\sqrt{n} , abbreviated as SEM, rather than the standard deviation s .)

Group	n	\bar{x}	SEM
Alcohol	25	0.25	0.05
Placebo	25	0.12	0.03

- (a) What are the two sample standard deviations?
- (b) What degrees of freedom does the conservative Option 2 use for two-sample t procedures for these samples?
- (c) Using Option 2, give a 90% confidence interval for the mean difference between the two groups.

3. Do education programs for preschool children that follow the Montessori method perform better than other programs? A study compared 5-year-old children in Milwaukee, Wisconsin, who had been enrolled in preschool programs from the age of 3.

- (a) Explain why comparing children whose parents chose a Montessori school with children of other parents would not show whether Montessori schools perform better than other programs. (In fact, all the children in the study applied to the Montessori school. The school district assigned students to Montessori or other preschools by a random lottery.)
- (b) In all, 54 children were assigned to the Montessori school and 112 to other schools at age 3. When the children were 5, parents of 30 of the Montessori children and 25 of the others could be located. Those parents who were located agreed to and subsequently participated in testing. This information reveals a possible source of bias in the comparison of outcomes. Explain why.
- (c) One of the many response variables was score on a test of ability to apply basic mathematics to solve problems. Here are summaries for the children who took this test:

Group	n	\bar{x}	s
Montessori	30	19	3.11
Control	225	17	4.19

Is there evidence of a difference in the population mean scores? (The researchers used two-sided alternative hypotheses.)

4. When one experiences a lack of control in one's life, does one compensate by seeking structure elsewhere? Assign 36 undergraduate students to one of two conditions. All are asked to identify a concept associated with a series of "grainy" pictures that contain an embedded image and are presented to them sequentially. During the task they can ask questions to help them determine the associated concept. Half of the subjects (the lack-of-control group) receive feedback that is random and noncontingent on their questions. The other half receive useful feedback (the in-control group). After attempting to complete the task, all subjects are presented with 12 grainy pictures that are similar to those used in the task but lack embedded images. All are asked whether they perceive an image in the pictures, and the number of pictures identified as containing an image is counted for each subject. Here are the summary statistics:

Group	Group Size	Mean	Std. Dev.
Lack-of-Control	18	5.16	3.5
In-Control	18	3.47	2.0

- (a) What degrees of freedom would you use in the conservative two-sample t procedures to compare the lack-of-control and in-control groups?
- (b) What is the two-sample t test statistic for comparing the mean number of pictures identified as having an image for the two groups?
- (c) Test the null hypothesis of no difference between the two population means against the two-sided alternative. Use your statistic from part (b) with degrees of freedom from part (a).

5. Researchers gave 40 index cards to a waitress at an Italian restaurant in New Jersey. Before delivering the bill to each customer, the waitress randomly selected a card and wrote on the bill the same message that was printed on the index card. Twenty of the cards had the message "The weather is supposed to be really good tomorrow. I hope you enjoy the day" Another 20 cards contained the message "The weather is supposed to be not so good tomorrow. I hope you enjoy the day anyway" After the customers left, the waitress recorded the amount of the tip (percent of bill) before taxes. Here are the tips for those receiving the good-weather message:

20.8 24.9 18.7 22.3 19.9 27.0 20.6 20.5 21.9 22.2
 23.4 24.0 22.8 21.2 24.9 22.1 22.2 22.0 20.3 22.7

The tips for the 20 customers who received the bad-weather message are

18.0 17.0 19.1 13.6 19.2 17.5 18.8 20.0 18.4 20.2
 19.0 18.8 18.5 18.0 16.1 23.2 16.8 18.2 14.0 19.4

(a) Make stemplots or histograms of both sets of data. Because the distributions are reasonably symmetric with no extreme outliers, the t procedures will work well.

(b) Is there good evidence that the two different messages produce different percent tips? State hypotheses, carry out a two-sample t test, and report your conclusions.

6. Coaching companies claim that their courses can raise the SAT scores of high school students. Of course, students who retake the SAT without paying for coaching generally raise their scores, too. A random sample of students who took the SAT twice found 427 who were coached and 2733 who were uncoached. Starting with their Verbal scores on the first and second tries, we have these summary statistics:

	n	\bar{x}_{try1}	s_{try1}	\bar{x}_{try2}	s_{try2}	\bar{x}_{gain}	s_{gain}
Coached	427	500	92	529	97	29	59
Uncoached	2733	506	101	527	101	21	52

(a) Is there good evidence that coached students gained more on the average than uncoached students? (Carry out a matched pairs t test using gain.)

(b) How much more do coached students gain on the average? Give a 99% confidence interval.

(c) Based on your work, what is your opinion: do you think coaching courses are worth paying for?

8. Can active learning improve knowledge retention? Two undergraduate calculus-based engineering statistics courses were taught in different academic quarters, with one employing active-learning methods and another using traditional learning methods. The traditional class was taught lecture-style with relatively little in-class interaction between peers and with the instructor. The active-learning course integrated four group projects into the curriculum, with in-class time devoted to group work on the projects and fewer homework assignments. To assess knowledge retention, two five-question versions of a test were created. They had similar but not identical questions covering core statistics topics, worth a total of 18 possible points. All students in both sections were randomly given one version of the test as part of their final exam. Then, eight months later, a volunteer subset of the original students were given the version that they had not taken previously. To encourage students to take the second version of the exam, a ten-dollar gift card to the university bookstore was given to each participant. The change in the score from the first version to the second is used to measure a student's long-term ability to retain the course material. Here are the changes in exam scores for the 15 students in the Active group:

0 5 7 8 0 3 6 2 5 1
 3 2 4 3 5

The changes in exam scores for the 23 students in the Traditional group are

7 0 8 2 4 3 1 2 5 8
 5 6 3 12 1 6 3 6 7 7
 5 6 2

Is there good evidence that active learning is superior to traditional lecturing?