Section 8.4

<u>**Theorem**</u>: Consider a random sample of n data pairs. Suppose the differences d between the first and second members of each data pair are (approximately) normally distributed, with population mean μ_d. Then the t values

$$t = \frac{\bar{d}-\mu_d}{s_d/\sqrt{n}}$$

where $\bar{d}$ is the sample mean of the d values, n is the number of data pairs, and

$$s_d = \sqrt{\frac{\Sigma(d-\bar{d})^2}{n-1}}$$

is the sample standard deviation of the d values, follow a Student's t distribution with degrees of freedom $= n - 1$.

Exercise 1. A scientist is interested in seeing whether the pill he has developed helps improve the free throw shooting percentage of basketball players. He gives the pill to a random sample of 5 NBA players. Here are the pre-pill and post-pill percentages for each player (presented as an ordered pair): (76,80), (62,68), (82,88), (88, 81), (52,56). Is the improvement of free throw shooting significant? (Assume that the population of free throw percentages is approximately normal.)

Let μ_d =

H_0:

H_1:

The hypothesis test is being conducted on the differences. Let's find those:

Player	**Before**	**After**	**Difference**
Player 1	76	80	
Player 2	62	68	
Player 3	82	88	
Player 4	88	81	
Player 5	52	56	

Let $\bar{x}_d$ = average difference in the above sample.

Let s_d = standard deviation of the differences in the sample.

What are $\bar{x}_d$ and s_d?

$\bar{x}_d =$

.

$s_d =$

Let $\bar{X}_d =$

In words, the p-value is the probability of obtaining a mean difference <u>**as big or bigger than**</u> 2.6 if the null hypothesis is true.

Since 0.05, we reject H_o.

There is from the sample that the pill improves free throw shooting.

Exercise 2. Suppose a randomly chosen group of 150 high school juniors and seniors who took the SAT twice over a period of six months showed an average improvement on the second SAT of 25 points. The standard deviation of the difference in the scores between the first and second SAT was 200 points. Is the difference significant (in a statistical sense)?

Let $\mu_d =$

H_0: H_1:

What are $\bar{x}_d$ and s_d?

$$\bar{x}_d = \qquad \text{and } s_d =$$

Let $\bar{X}_d =$

Since 0.05, we reject H_o.

The difference

Exercise 3. The table shows the weights of 8 adults before a dieting program and 2 weeks after the dieting program. At $\alpha = 0.10$, is there enough evidence to conclude that the program helped adults lose weight?

Patient	1	2	3	4	5	6	7	8
Weight in lbs (before)	194	234	265	188	170	212	139	280
Weight in lbs (after)	190	235	255	187	175	209	139	277

Let $\mu_d =$

H_0:

H_1:

The hypothesis test is being conducted on the differences. Let's find those:

Patient	**Before**	**After**	**Difference**
1	194	190	
2	234	235	
3	265	255	
4	188	187	
5	170	175	
6	212	209	
7	139	139	
8	280	277	

Let $\bar{x}_d$ = average difference in the above sample.

Let s_d = standard deviation of the differences in the sample.

What are $\bar{x}_d$ and s_d?

$\bar{x}_d =$

.

$s_d =$

Let $\bar{X}_d =$

In words, the p-value is the probability of obtaining a mean difference **as small or smaller than** -1.875 if the null hypothesis is true.

Since 0.10, we reject H_o.

There is that the dieting program helps adults lose weight.

Class Exercise 1. A physical therapist suggests that soft tissue therapy and spinal manipulation help reduce the length of time patients suffer from headaches. The table shows the number of hours per day 6 patients suffer from headaches before and after 7 weeks of receiving soft tissue therapy and spinal manipulation. At $\alpha = 0.01$, is there enough evidence to support the therapist's claim? p-**value** $= 4.355 \cdot 10^{-8}$

Patient	1	2	3	4	5	6
Daily headache hours (before)	2.8	2.4	2.8	2.6	2.7	2.9
Daily headache hours (after)	1.6	1.3	1.6	1.4	1.5	1.6

Class Exercise 2. A state legislator wants to determine whether her performance rating (0-100) has changed from last year to this year. The following table shows the legislator's performance rating from the same 8 randomly selected votes for last year and this year. At $\alpha = 0.01$, is there enough evidence to conclude that the legislator's performance rating has changed? **Answer:** p-**value** $=$ **0.123**

Voter	1	2	3	4	5	6	7	8
Rating(last year)	60	54	78	84	91	25	50	65
Rating(this year)	56	48	70	60	85	40	40	55

Class Exercise 3. A pharmaceutical company guarantees that its new drug reduces systolic blood pressure. The table shows the systolic blood pressures (in millimeters of mercury) of eight patients before taking the new drug and two hours after taking the drug. At $\alpha = 0.05$, can you conclude that the new drug reduces systolic blood pressure? **Answer:** p-**value** $=$ **2.50**$\cdot 10^{-4}$

Patient	1	2	3	4	5	6	7	8
Systolic blood pressure (before)	201	171	186	162	165	167	175	148
Systolic blood pressure (after)	192	165	167	155	148	144	152	134

Homework

C Problems

Section 8.4: 7-21 ODD

B Problems

Section 8.4: 1-5 ODD

A Problems

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