Statistics – Chapter 7 Calendar
Inference for Distributions

Day	Topic	Assignment
1	The t Distribution One-sample *t* confidence interval	p. 419 (7.1) p. 422 (7.3, 7.4) p. 428 (7.5, 7.6) p. 441 (7.15, 7.16)
2	TI-Nspire Activity Characteristics of the t-distribution	Complete all questions in the packet pages 3-5. Due on day 3
3	The one-sample *t* test Matched pairs *t* procedures Robustness	p. 431 (7.8, 7.9, 7.10) p. 441-2 (7.20 a-d, 7.21 a-d, 7.25)
4	Matched Pairs Activity	Finish matched pairs activity Packet p. 9-10
5	In class worksheet: Matched pairs *t* procedures packet pages 9-10	p. 444 (7.32, 7.34, 7.35) packet page 11
6	Two Sample t Distribution	p. 455 (7.56) p. 467 (7.61, 7.62, 7.63) Packet p.12
7	Pooled two-sample procedures Putting it all together	p. 469 (7.69, 7.70, 7.86, 7.87)
8	Pooled two-sample procedures Putting it all together	*all homework problems do not necessarily use the pooled formulas…read carefully!* p. 472 (7.71, 7.85, 7.88)
9	In class practice Worksheets: 7-9a and 7-9b Packet p. 13-16	p. 484 (7.130, 7.133)
10	Review packet p. 17-23	Finish review packet p. 17-23
11	Test	None ☺

Problem 1 – Characteristics of the *t* Distribution

1.3: How does the *t* distribution for $n = 4$ (d.f. = 3) compare to the normal distribution?

1.4: What happens as *n* gets larger? Why?

Problem 2 – Comparing Areas

2.2: Use the **Integral** tool to find the areas bounded by (–3, 0) and (3, 0) on the *x*-axis. To use the **Integral** tool, go to menu->6: Analyze Graph->6: Integral. Click on the desired curve, then the left boundary point on the *x*-axis and then the right boundary point.

Normal distribution: _____

t distribution: $n = 4$: _____ $n = 9$: _____

$n = 16$: _____ $n = 26$: _____

What happens as *n* changes? Why?

Problem 3 – Critical Values for a *t* Distribution

3.2: Use the **invt** command to find the critical values for a 95% confidence interval. (df = $n - 1$)

$t_{\frac{\alpha}{2}}$, $n = 3$	$t_{\frac{\alpha}{2}}$, $n = 8$	$t_{\frac{\alpha}{2}}$, $n = 25$	$z_{\frac{\alpha}{2}}$

If any, what patterns did you find?

3.4: Predict how the following critical values will compare. Then find the values.

50% CI, $t_{\frac{\alpha}{2}}$, $n = 28$

80% CI, $t_{\frac{\alpha}{2}}$, $n = 28$

100% CI, $t_{\frac{\alpha}{2}}$, $n = 28$

Problem 4 – Constructing a Confidence Interval

4.2: What is the mean and standard deviation of the weights ($n = 10$)?

4.3: For 90% and 95% confidence, what is the critical value, margin of error, and CI?

Matched Pairs t procedures

1. We hear that listening to Mozart improves students' performance on tests. Perhaps pleasant odors have a similar effect. To test this idea, 21 subjects worked a paper-and-pencil maze while wearing a mask. The mask was either unscented or carried a floral scent. The response variable is their average time on three trials. Each subject worked the maze with both masks, in a random order. The randomization is important because subjects tend to improve their times as they work a maze repeatedly. The table below gives the subjects' average times with both masks.

Subject	Unscented (seconds)	Scented (seconds)	Difference	Subject	Unscented (seconds)	Scented (seconds)	Difference
1	30.60	37.97		12	58.93	83.50	
2	48.43	51.57		13	54.47	38.30	
3	60.77	56.67		14	43.53	51.37	
4	36.07	40.47		15	37.93	29.33	
5	68.47	49.00		16	43.50	54.27	
6	32.43	43.23		17	87.70	62.73	
7	43.70	44.57		18	53.53	58.00	
8	37.10	28.40		19	64.30	52.40	
9	31.17	28.23		20	47.37	53.63	
10	51.23	68.47		21	53.67	47.00	
11	65.40	51.10					

a) To analyze these data, subtract the scented time from the unscented time for each subject. The 21 differences form a single sample.

b) Identify the population of interest and the parameter of interest you want to draw conclusions about. State the null and alternative hypotheses in words and symbols.

c) Choose the appropriate inference procedure, and verify the conditions for using the selected procedure.

d) If the conditions are met, carry out the inference procedure:

e) Interpret your results:

2. Our subjects are 11 people diagnosed as being dependent on caffeine. Each subject was barred from coffee, colas, and other substances containing caffeine. Instead, they took capsules containing their normal caffeine intake. During a different time period, they took placebo capsules. The order in which subjects took caffeine and the placebo was randomized. The table below contains data on two of the several tests given to the subjects. "Depression" is the score on the Beck Depression Inventory. Higher scores show more symptoms of depression. "Beats" is the beats per minute the subject achieved when asked to press a button 200 times as quickly as possible. We are interested in whether being deprived of caffeine affects these outcomes.

Subject	Depression (caffeine)	Depression (placebo)	Beats (caffeine)	Beats (placebo)
1	5	16	281	201
2	5	23	284	262
3	4	5	300	283
4	3	7	421	290
5	8	14	240	259
6	5	24	294	291
7	0	6	377	354
8	0	3	345	346
9	2	15	303	283
10	11	12	340	391
11	1	0	408	411

Construct a 90% confidence interval for the mean change in depression score.

Step 1: Identify the population of interest and the parameter you want to draw conclusions about.

Step 2: Choose the appropriate inference procedure, and verify the conditions for using the selected procedure.

Step 3: If the conditions are met, carry out the inference procedure.

Step 4: Interpret your results in the context of the problem.

Homework 7-5: Matched Pair Homework

Refer to the data in the table below that lists SAT scores before and after the sample of 10 students took a preparatory course (based on data from the College Board and "An Analysis of the Impact of Commercial Test Preparation Courses on SAT Scores," by Sesnowitz, Bernhardt, and Knain, *American Educations Research Journal*, Vol. 19, No. 3.).

a) List the assumptions for this model.
b) Is there sufficient evidence to conclude that the preparatory course is effective in raising scores? Use a 0.05 significance level.
c) Construct a 95% confidence interval estimate of the mean difference between the before and after scores. Write a statement that interprets the resulting confidence interval. (Remember, all confidence intervals are two-sided!)

Student	A	B	C	D	E	F	G	H	I	J
SAT score before course	700	840	830	860	840	690	830	1180	930	1070
SAT score after course	720	840	820	900	870	700	800	1200	950	1080

Two Sample Homework Worksheet 7-6

In a study of cereal leaf beetle damage on oats, researchers measured the number of beetle larvae per stem in small plots of oats after randomly applying one of two treatments: no pesticide, or malathion at the rate of 0.25 pound per acre. The data appear roughly normal. Here are the summary statistics.

Group	Treatment	n	$\overline{x}$	S
1	Control	13	3.47	1.21
2	Malathion	14	1.36	0.52

Is there significant evidence at the 1% level that malathion reduces the mean number of larvae per stem? Be sure to state H_o and H_a.

Two Sample Confidence Interval Example Worksheet 7-9a

1. College financial aid offices expect students to use summer earnings to help pay for college. But how large are these earnings? One college studied this question by asking a sample of students how much they earned. Omitting students who were not employed, there were 1296 responses. Here are the data in summary form:

Group	n	$\overline{x}$	S
Males	675	$1884.52	$1368.37
Females	621	$1360.39	$1037.46

a) The distribution of earnings is strongly skewed to the right. Nevertheless, use of the t procedures is justified. Why?

b) Give a 90% confidence interval for the difference between the mean summer earnings of males and female students.

2. Calcium supplements were thought to lower blood pressure. The data below represent a decrease in systolic blood pressure after 12 weeks, in millimeters of mercury. The data for the 10 men in Group 1 (calcium) were:

7	- 4	18	17	- 3	- 5	1	10	11	- 2

and for the 11 men in Group 2 (placebo):

- 1	12	- 1	- 3	3	- 5	5	2	- 11	- 1	- 3

Is there enough evidence to suggest that calcium does indeed lower blood pressure?

More Practice on the Two-Sample t-Statistic
Worksheet 7-9b

1. The Chapin Social Insight test is a psychological test designed to measure how accurately a person appraises other people. The possible scores on the test range from 0 to 41. During the development of the Chapin test, it was given to several different groups of people. Here are the results for male and female college students majoring in liberal arts.

Group	Sex	n	$\bar{x}$	s
1	Male	133	25.34	5.05
2	Female	162	24.94	5.44

Do these data support the contention that female and male students differ in average social insight?

The Two-Sample t Confidence Interval

$$\left(\overline{x_1} - \overline{x_2}\right) \pm t^* \left(\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}\right) \qquad \text{remember } t^* = t_{\alpha/2,df}$$

2. How badly does logging damage tropical rainforests? One study compared forest plots in Borneo that had never been logged with similar plots nearby that had been logged 8 years earlier. The study found that the effects of logging were somewhat less severe than expected. Here are the data on the number of tree species in 12 unlogged plots and 9 logged plots.

Unlogged	22	18	22	20	15	21	13	13	19	13	19	15
Logged	17	4	18	14	18	15	15	10	12			

a) Does logging significantly reduce the mean number of species in a plot after 8 years?

b) Give a 90% confidence interval for the difference in mean number of species between unlogged and logged plots.

Name:_____ Statistics Chapter 7 Review

1. The paper "Affective Variables Related to Mathematics Achievement Among High-Risk College Freshmen" examines the relationship between attitudes toward mathematics and success at college-level mathematics. Twenty men and thirty-eight women identified as being at high risk of failure (because they did not meet the usual admission requirements for the university) participated in the study. Each student was asked to respond to a series of questions, and then answers were used to obtain a math anxiety score. For this particular scale, the higher the score, the lower the level of anxiety toward mathematics. Summary values appear in the table below. Does this data suggest that, as many researchers have hypothesized, the mean anxiety score for women is different than that for men? We will test the relevant hypotheses using a 0.05 level of significance.

	n	$\overline{x}$	**s**
Males	20	35.9	11.9
Females	38	36.6	12.3

2. Do male college students differ from female students with respect to their tolerance for boredom? A study used a scale called the Boredom Proneness Scale to 97 male and 148 female U.S. college students. Assume σ_1 and σ_2 are unknown and $\sigma_1 = \sigma_2$.

	n	$\overline{x}$	s
Males	97	10.40	4.83
Females	148	9.26	4.68

a) Does the accompanying data suggest that the mean boredom proneness score is different for males than for females? Use a 0.10 significance level.

b) Construct a 95% confidence interval for the difference in mean boredom proneness score for male and female college students.

3. In a study of memory recall, eight people were given 10 minutes to memorize a list of 20 nonsense words. Each was asked to list as many of the words as he or she could remember both 1 hr and 24 hr later, as shown in the table below. Is there evidence to suggest that the mean number of words recalled after 1 hr exceeds the mean recall after 24 hr by more than 3? Use a level 0.01 test.

Subject	1	2	3	4	5	6	7	8
1 hr later	14	12	18	7	11	9	16	15
24 hr later	10	4	14	6	9	6	12	12

Statistics Chapter 7 Review Continued

1. Refer to the sample results listed below for the measured nicotine contents of randomly selected filtered and nonfiltered king-size cigarettes. All measurements are in milligrams, and the data are from the Federal Trade Commission. Assume σ_1 and σ_2 are unknown and $\sigma_1 = \sigma_2$.

Nicotine (mg)

Filtered Kings	Nonfiltered Kings
$n_1 = 21$	$n_2 = 8$
$\overline{x_1} = 0.94$	$\overline{x_2} = 1.65$
$s_1 = 0.31$	$s_2 = 0.16$

a) Use a 0.05 significance level to test the claim that king-size cigarettes with filters have a lower mean amount of nicotine than the mean amount of nicotine in nonfiltered king-size cigarettes.

b) Construct a 95% confidence interval estimate of the difference between the two population means.

c) Do cigarette filters appear to be effective in reducing nicotine?

2. Does stress affect the recall ability of police eyewitnesses? This issue was studied in an experiment that tested eyewitness memory a week after a nonstressful interrogation of a cooperative suspect and a stressful interrogation of an uncooperative and belligerent suspect. The numbers of details recalled a week after the incident is summarized in the margin (based on data from "Eyewitness Memory of Police Trainees for Realistic Role Plays." Use a 0.01 significance level to test the claim in the article that "stress decreased the amount recalled."

Nonstress	Stress
$n_1 = 40$	$n_2 = 40$
$\overline{x_1} = 53.3$	$\overline{x_2} = 45.3$
$s_1 = 11.6$	$s_2 = 13.2$

3. Mental measurements of young children are often made by giving them blocks and telling them to build a tower as tall as possible. One experiment of block building was repeated a month later, with the times (in seconds) listed in the table below.

Child	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1st Trial	30	19	19	23	29	178	42	20	12	39	14	81	17	31	52
2nd Trial	30	6	14	8	14	52	14	22	17	8	11	30	14	17	15

a) Is there sufficient evidence to support the claim that there is a difference between the two times? Use a 0.01 significance level.

b) Construct a 99% confidence interval for the mean of the differences. Do the confidence interval limits contain 0, indicating that there is not a significant difference between he times of the first and second trails?

4. In a sample of seven cars, each car was tested for nitrogen-oxide emissions (in grams per mile) and the following results were obtained: 0.06, 0.11, 0.16, 0.15, 0.14, 0.08, 0.15 (based on data from the EPA). Assuming that this sample is representative of the cars in use, construct a 98% confidence interval estimate of the mean amount of nitrogen-oxide emissions for all cars. If the EPA requires that nitrogen-oxide emissions be less than 0.165 grams/mile, can we safely conclude that this requirement is being met?