

Practice exercises for Chapter 8 and 9:

Note: A complete hypothesis test includes  $H_0$ ,  $H_a$ , test statistic value, rejection region, (or p-value), decision and conclusion.

CH.8: Hypothesis testing for one population

- **Learning Objective:**

After study of chapter8, you should be able to:

1. Name basic elements of a test of hypothesis.
2. Describe Type I and Type II error.
3. Specify a correct rejection region for a z-test and t-test.
4. Conduct a large-sample z-test about one population mean.
5. Conduct a small-sample t-test about one population mean.
6. Conduct a large-sample z-test about one population proportion.
7. Use the p-value to make a decision for a hypothesis test.
8. Identify the information from software output.

1. The length of stay (in days) in hospital for 100 randomly selected patients are presented in the table. Based on the following SPSS output, conduct a test of hypothesis to determine if the true mean length of stay (LOS) at the hospital is less than 5 days. Use significance level  $\alpha = 0.05$ .

LOS for 100 hospital patients	2, 3, 8, 6, 4, 4, 6, ....., 10, 2, 4, 2
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SPSS output for HOSPLOS,

**One-Sample Statistics**

	N	Mean	Std. Deviation	Std. Error Mean
LOS	100	4.53	3.678	.368

**One-Sample Test**

Test Value = 5						
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
LOS	-1.278	99	.204	-.470	-1.20	.26

## 2. Mongolian desert ants

To study the ants in Mongolia, the botanists placed seed baits at 11 sites and observed the number of ant species attracted to each site. Do the data indicate that the average number of ant species at Mongolian desert sites is greater than 5 species? Use  $\alpha = 0.10$ .

# of ant species	3, 3, 52, 7, 5, 49, 5, 4, 4, 5, 4
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SPSS output Mongolian desert ants,

### One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
ANTS	11	12.82	18.675	5.631

### One-Sample Test

Test Value = 5						
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
ANTS	1.388	10	.195	7.818	-4.73	20.36

## CH. 9: Comparing two population means and proportions

- **Learning Objective:**

After study of chapter 9, you should be able to:

1. Construct a confidence interval to estimate the difference between two population means (independent sampling: large and small samples; paired difference experiment: large and small samples)
2. Conduct a hypothesis test to compare two population means (independent sampling: large samples and small samples with equal variance; paired difference experiment: large and small samples)
3. Construct a confidence interval to estimate the difference between two population proportions (independent sampling: large samples)
4. Conduct a hypothesis test to compare two population proportions (independent sampling: large samples)
5. Make inference for two population means or proportions based on the confidence interval of the difference between those two parameters
6. Identify the information from the software output

- **Comparing two population means: independent sampling**

### 1: READING

Suppose we wish to compare a new method of teaching reading to “slow learners” to the current standard method. The response variable is the reading test score after 6 months. 22 slow learners are randomly selected, 10 are taught by the new method, 12 by the standard method. The test score is listed below.

New method (1)	80, 80, 79, 81, 76, 66, 71, 76, 70, 85
Standard method (2)	79, 62, 70, 68, 73, 76, 86, 73, 72, 68, 75, 66

Based on the SPSS output, answer the following questions.

- a. Give a 95% confidence interval to estimate the mean test score difference between the new method and the standard method. Interpret the interval.
- b. Based on the 95% confidence interval for mean difference ( $\mu_1 - \mu_2$ ), can we infer the new teaching method leads to a higher score than the standard method?
- c. Conduct a test of hypothesis to determine whether the standard method has a lower test score than the new method. (p-value = ?) Use  $\alpha = 0.05$ .

SPSS output for READING

Group Statistics					
	METHOD	N	Mean	Std. Deviation	Std. Error Mean
SCORE	NEW	10	76.40	5.835	1.845
	STD	12	72.33	6.344	1.831

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
SCORE	Equal variances assumed	.002	.967	1.552	20	.136	4.067	2.620	-1.399	9.533
	Equal variances not assumed			1.564	19.769	.134	4.067	2.600	-1.360	9.493

- **Comparing two population means: paired difference experiment**

1. NEW PROTEIN DIET: To investigate a new protein diet on weight-loss, FDA randomly choose five individuals and record their weight (in pounds), then instruct them to follow the protein diet for three weeks. At the end of this period, their weights are recorded again.

Person	Weight before (1)	Weight after (2)	Difference $x_D$
1	148	141	
2	193	188	
3	186	183	
4	195	189	
5	202	198	

Based on the SPSS output, answer the following questions.

- Give a 95% confidence interval for the difference between the mean weights before and after the diet is used. Interpret the interval.
- Based on the 95% confidence interval for mean difference ( $\mu_1 - \mu_2$ ), can we infer that the new protein diet has effect on weight loss?
- Do the data provide sufficient evidence that the protein diet has effect on the weight loss? Use  $\alpha = 0.05$ . (p-value = ?)

SPSS output for NEW PROTEIN DIET

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	W1	184.80	5	21.347	9.547
	W2	179.80	5	22.354	9.997

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	W1 - W2	5.000	1.581	.707	3.037	6.963	7.071	4	.002

- **Comparing two population proportions: independent sampling**

1. In a random sample of 300 women, 45% favored stricter gun control legislation. In a random sample of 200 men, 25% favored stricter gun control legislation. Construct a 90% confidence interval for the difference between the population proportions ( $p_1 - p_2$ ).
  
2. In a random sample of 300 women, 195 favored stricter gun control laws. In a random sample of 220 men, 132 favored stricter gun control laws. Test the claim that the proportion of men favoring stricter gun control is lower than the proportion of women favoring stricter gun control. Use a significance level of 0.05.