

1. Set up Hypotheses

- What is α ? Is it a one-tail test?
or a two tail test?
- Set up null hypothesis H_0
- Set up alternative hypothesis H_a

2. What is the appropriate test statistic to use?

Is σ known? is the sample size large enough? What is the mean?

(t-test, z-test, X^2 test, F-test)

3. Calculate the test statistics value

(t_{observed} , z_{observed} , X^2_{observed} , F_{observed})

4. Find the critical value for the test statistic.

(t_{critical} , z_{critical} , X^2_{critical} , F_{critical})

5. Define your decision rule

(Reject H_0 if..., Do not Reject H_0 if....)

6. Make your decision

(Since the observed value does not fall/falls in the rejection region, we Reject/Do not Reject H_0)

7. Interpret the conclusion in context

PROBLEM # 8.1 What is the difference between a null hypothesis and an alternative hypothesis? Is the null hypothesis always the same as the verbal claim or assertion that led to the test? Why or Why not?

PROBLEM # 8.2 Following a major earthquake, the cite engineer must determine whether the stadium is structurally sound for an upcoming athletic event. If the null hypothesis is “ the stadium is structurally sound,” and the alternative hypothesis is “ the stadium is not structurally sound,” which type of error (Type I or Type II) would the engineer least like to commit?

PROBLEM # 8.3 A researcher wants to carry out a hypothesis test involving the mean for a sample of size $n = 18$. She does not know the true value of the population standard deviation, but is reasonably sure that the underlying population is approximately normally distributed. Should she use a z-test or a t-test in carrying out the analysis? Why?

PROBLEM # 8.4 The president of a company that manufactures central home air conditioning units has told an investigative reporter that at least 85% of its homeowner customers claim to be “completely satisfied” with the overall purchase experience. If the reporter were to subject the president’s statement to statistical scrutiny by questioning a sample of the company’s residential customers, would the test one-tail or two-tail? What would be the appropriate null and alternative hypotheses?

PROBLEM # 8.5 It has been claimed that no more than 5% of the units coming off an assembly line are defective. Formulate a null hypothesis and an alternative hypothesis for this situation. Will the test be one-tail or two-tail? Why? If the test is one-tail, will it be left-tail or right-tail? Why?

PROBLEM # 8.6 In hypothesis testing, what is meant by the decision rule? What role does it play in the hypothesis testing procedure?

PROBLEM # 8.7 What is the central limit theorem, and how is it applicable to hypothesis testing?

PROBLEM # 8.8 If the population standard deviation is known, but the sample size is less than 30, what assumption is necessary to use the z-statistic in carrying out a hypothesis test for the population mean?

PROBLEM # 8.9 For a sample of 35 items from a population for which the standard deviation is $\sigma=20.5$, the sample mean is 458.0. At the 0.05 level of significance, test $H_0: \mu = 450$ versus $H_1: \mu \neq 450$. Determine and interpret the p-value for the test.

1. Set up hypotheses:

H_0 :

H_1 :

Level of significance: $\alpha =$

2. What is the appropriate test statistic to use?

3. Calculate the test statistics value

4. Find the critical value for the test statistic

5. Define your decision rule:

6. Make your decision:

7. Interpret the conclusion in context:

	A	B	C	D
1	z-Test of a Mean			
2				
3	Sample mean	458.0	z Stat	2.31
4	Population standard deviation	20.5	P(Z<=z) one-tail	0.0105
5	Sample size	35	z Critical one-tail	1.645
6	Hypothesized mean	450	P(Z<=z) two-tail	0.0210
7	Alpha	0.05	z Critical two-tail	1.960

PROBLEM # 8.10 For each of the following tests and z-values, determine the p-value for the test:

- Right-tail test and $z=1.54$
- Left-tail test and $z=-1.03$
- Two-tail test and $z=1.27$

PROBLEM # 8.11 For a sample of 12 items from a normally distributed population for which the standard deviation is $\sigma=17.0$, the sample mean is 230.8. At the 0.05 level of significance, test $H_0: \mu \leq 220$ versus $H_1: \mu > 220$. Determine and interpret the p-value for the test.

1. Set up hypotheses:

H_0 :

H_1 :

Level of significance: $\alpha =$

2. What is the appropriate test statistic to use?

3. Calculate the test statistics value

4. Find the critical value for the test statistic

5. Define your decision rule:

6. Make your decision:

7. Interpret the conclusion in context:

PROBLEM # 8.12 In the past, patrons of a cinema complex have spent an average of \$5.00 for popcorn and other snacks, with a standard deviation of \$1.80. The amounts of these expenditures have been normally distributed. Following an intensive publicity campaign by a local medical society, the mean expenditure for a sample of 18 patrons is found to be \$4.20. In a one-tail test at the 0.05 level of significance, does this recent experience suggest a decline in spending? Determine and interpret the p-value for the test.

	A	B	C	D
1	z-Test of a Mean			
2				
3	Sample mean	4.20	z Stat	-1.89
4	Population standard deviation	1.80	P(Z<=z) one-tail	0.0297
5	Sample size	18	z Critical one-tail	1.645
6	Hypothesized mean	5.00	P(Z<=z) two-tail	0.0593
7	Alpha	0.05	z Critical two-tail	1.960

PROBLEM # 8.13-Based on the sample data, a confidence interval has been constructed such that we have 90% confidence that the population mean is between 120 and 180. Given this information, provide the conclusion that would be reached for each of the following hypothesis tests at the $\alpha=0.10$ level:

- a. $H_0: \mu = 170$ versus $H_1: \mu \neq 170$
- b. $H_0: \mu = 110$ versus $H_1: \mu \neq 110$
- c. $H_0: \mu = 130$ versus $H_1: \mu \neq 130$
- d. $H_0: \mu = 200$ versus $H_1: \mu \neq 200$

PROBLEM # 8.14 Under what circumstances should the t-statistic be used in carrying out a hypothesis test for the population mean?

PROBLEM # 8.15 For a simple random sample of 40 items, $\bar{x} = 25.9$ and $s = 4.2$. At the 0.01 level of significance, test $H_0: \mu = 24.0$ versus $H_1: \mu \neq 24.0$

PROBLEM # 8.16 For a simple random sample of 15 items from a population that is approximately normally distributed, $\bar{x} = 82.0$ and $s = 20.5$. At the 0.05 level of significance, test $H_0: \mu \geq 90.0$ versus $H_1: \mu < 90.0$.

	A	B	C	D
1	t-Test of a Mean			
2				
3	Sample mean	82.0	t Stat	-1.511
4	Sample standard deviation	20.5	P(T<=t) one-tail	0.076
5	Sample size	15	t Critical one-tail	1.761
6	Hypothesized mean	90.0	P(T<=t) two-tail	0.153
7	Alpha	0.05	t Critical two-tail	2.145

PROBLEM # 8.17-The International Coffee Association has reported the mean daily coffee consumption for U.S. residents as 1.65 cups. Assume that a sample of 38 people from a North Carolina city consumed a mean of 1.84 cups of coffee per day, with a standard deviation of 0.85 cups. In a two-tail test at the 0.05 level, could the residents of this city be said to be significantly different from their counterparts across the nation? *Source: coffeeresearch.org, August 8, 2006.*

	A	B	C	D
1	t-Test of a Mean			
2				
3	Sample mean	1.84	t Stat	1.378
4	Sample standard deviation	0.85	P(T<=t) one-tail	0.088
5	Sample size	38	t Critical one-tail	1.687
6	Hypothesized mean	1.65	P(T<=t) two-tail	0.177
7	Alpha	0.05	t Critical two-tail	2.026

PROBLEM # 8.18 When carrying out a hypothesis test for a population proportion, under what condition is it appropriate to use the normal distribution as an approximation to the (theoretically correct) binomial distribution?

(Weirs pg 344, 10.60) PROBLEM # 8.19-For a simple random sample, $n=200$ and $p=0.34$. At the 0.01 level, test $H_0: p_0 = 0.40$ versus $H_1: p_0 \neq 0.40$.

PROBLEM # 8.20- For a simple random sample, $n=1000$ and $p=0.47$. At the 0.05 level, test $H_0: p_0 \geq 0.50$ versus $H_1: p_0 < 0.50$.

PROBLEM # 8.21 A simple random sample of 300 items is selected from a large shipment, and testing reveals that 4% of the sampled items are defective. The supplier claims that no more than 2% of the items in the shipment are defective. Carry out an appropriate hypothesis test and comment on the credibility of the supplier's claim.

PROBLEM # 8.22 It has been claimed that 65% of the homeowners would prefer to hear with electricity instead of gas. A student finds that 60% of the 200 homeowners prefer electric heating to gas. In a two-tail test at the 0.05 level of significance, can we conclude that the percentage who prefer electric heating may differ from 65%? Determine and interpret the p-value for the test.

PROBLEM # 8.23 For each of the following situations, determine whether a one-tail test or a two-tail test would be appropriate. Describe the test, including the null and alternative hypotheses, then explain your reasoning in selecting it.

- a. A machine that has not been serviced for several months is producing output in which 5% of the items are defective. The machine has just been serviced and quality should now be improved.

- b. In a speech during her campaign for reelection, a Republican candidate claims that 55% of registered Democrats in her county intend to vote for her.

- c. Of those who have bought a new car in the part, a dealer has found that 70% experience three or more mechanical problems in the first four months of ownership. Unhappy with this percentage, the dealer has heavily revised the procedure by which pre-delivery mechanical checks are carried out.

PROBLEM # 8.24 What is a p-value, and how it is relevant to hypothesis testing?

PROBLEM # 8.25 The p-value for a hypothesis test has been reported as 0.03. If the test result is interpreted using the $\alpha=0.05$ level of significance as a criterion, will H_0 be rejected? Explain.

PROBLEM # 8.26 A hypothesis test is carried out using the $\alpha=0.01$ level of significance and H_0 cannot be rejected. What is the most accurate statement we can make about the p-value for this test?

Understanding the Basics: Suggested Problems from the Book.

Chapter 9 - Hypothesis Testing													
9.1	The Null and Alternative Hypotheses and Errors in Hy	9.01	9.02	9.03	9.04	9.05	9.06	9.07					
9.2	z Tests about a Population Mean: Sigma known	9.08	9.09	9.10	9.11	9.12	9.13	9.14	9.15	9.16	9.17	9.18	9.19 9.20
9.3	t Tests about a Population Mean: sigma unknown	9.21	9.22	9.23	9.24	9.25	9.26	9.27	9.28	9.29	9.30	9.31 9.32	9.33
9.4	z Test about a population proportion	9.34	9.35	9.36	9.37	9.38	9.39	9.40	9.41	9.42			
	Supplementary	9.56	9.57	9.58	9.59								

This statistical workbook is compiled from the following books:

- Keller, G. (2012). *Statistics for management and economics*. Mason: Cengage Learning.
- Weiers, R. M. (2011). *Introduction to Business Statistics*. Mason: Cengage Learning.
- Gonick, L. W. (2005). *The Cartoon Guide to Statistics* (Vol. 1). HarperCollins.

Samie's Tips! Lesson 8-The Exam corner- TIPS and TRICKS!

Hello,
We are now reaching the period of "hypothesis testing", from now on, all chapters will be about testing a hypothesis using a specific table and knowing whether you should be using the t-tables, z-tables, f-table or X^2 table. Understand the 7 steps and you should be okay. See you in class!

Samie

HYPOTHESIS TEST - BY SMIEVISION

