

σ known z -test
 σ unknown t -test

AP STATS - Which Procedure?!

Name: Key

The table below lists the different inference procedures you should know for the AP Exam. In each of the scenarios below, choose the correct inference procedure.

- One-sample z interval for p
- One-sample t interval for μ (including paired data)
- Two-sample z interval for $p_1 - p_2$
- Two-sample t interval for $\mu_1 - \mu_2$
- t interval for the slope of an LSR line
- Chi-square test for goodness-of-fit
- Chi-square test for association/independence

- One-sample z test for p
- One-sample t test for μ (including paired data)
- Two-sample z test for $p_1 - p_2$
- Two-sample t test for $\mu_1 - \mu_2$
- t test for the slope of an LSR line
- Chi-square test for homogeneity

1. According to a recent survey, a typical teenager has 38 contacts stored in his/her cellphone. Is this true at your school?
one-sample t -test for μ

2. What percent of students at your school have a Facebook page?
one-sample z interval for p

3. Is there a relationship between students' favorite academic subject and preferred type of music at a large high school?
 χ^2 test for association/independence

4. How long do teens typically spend brushing their teeth?
one-sample t -interval for μ

5. Which brand of razor gives a closer shave? To answer this question, researchers recruited 25 men to shave one side of their face with Razor A and the other side with Razor B.
one-sample t -interval for μ_p (paired t -int)

6. A high-school administrator who is concerned about the amount of sleep the students in his district are getting selects a random sample of 14 seniors in his district and asks them how many hours of sleep they get on a typical school night. He then uses school records to determine the most recent grade-point average (GPA) for each student. His data and a computer regression output are given below.

Sleep (hrs)	9	8.5	9	7	7.5	6	7	8	5.5	6	8.5	6.5	8	8
GPA	3.8	3.3	3.5	3.6	3.4	3.3	3.2	3.2	3.2	3.4	3.6	3.1	3.4	3.7

Predictor	Coef	SE Coef	T	P
Constant	2.6532	0.3311	8.01	0.000
Sleep	0.10197	0.04327	2.32	0.038

$s = 0.162110$ $R\text{-Sq} = 31.0\%$ $R\text{-Sq(Adj)} = 25.3\%$

Do these data provide convincing evidence of a linear relationship between the hours of sleep students typically get and their academic performance, as measured by their GPA?

t -test for the slope of an LSR line

7. A manufacturer claims its Brand A battery lasts longer than its competitor's Brand B battery. Nine batteries of each brand are tested independently, and the hours of battery life are shown in the table below.

Brand A	88	85	80	81	72	90	85	85	84
Brand B	80	79	77	82	75	81	77	73	78

Provided that the assumptions for inference are met, which test should be conducted to determine if Brand A batteries do, in fact, last longer than Brand B batteries?

Two-sample t -test for $\mu_1 - \mu_2$

(1999 #6)

8. Researchers want to see whether training increases the capability of people to correctly predict outcomes of coin tosses. Each of twenty people is asked to predict the outcome (heads or tails) of 100 independent tosses of a fair coin. After training, they are retested with a new set of 100 tosses. (All 40 sets of 100 tosses are independently generated.) Since the coin is fair, the probability of a correct guess by chance is 0.5 on each toss. The numbers correct for each of the 20 people were as follows.

Score Before Training (number correct)	Score After Training (number correct)
46	61
48	62
50	53
54	46
54	50
54	52
54	53
54	59
54	60
54	61
55	55
56	59
57	55
58	50
58	56
61	58
61	64
63	57
64	61
65	54
Sum 1,120	Sum 1,126

Do the data suggest that after training people can correctly predict coin toss outcomes better than the 50 percent expected by chance guessing alone?

one-sample t-test for μ_0 (paired t test)

(Practice Exam #5)

9. Bone mineral density (BMD) is a measure of bone strength. It is defined as the ratio of bone mass to the cross-sectional area of the bone that is scanned, and it is expressed in units of grams per square centimeter (g/cm^2). Recent studies suggest that peak BMD in women is achieved between ages 15 and 40, and BMD declines after age 45. Decreased BMD is associated with increased risk of bone fracture. In a recent study, the impact of regular physical exercise on women in different stages of BMD development was examined. A simple random sample of 59 women between the ages of 41 and 45 with no major health problems were enrolled in the study. The women were classified into one of the two following groups, based on their level of exercise activity.

- Sedentary: minimal participation in physical exercise in the past three years (This group contained 31 women.)
- Walkers: walk at an aerobic pace at least 135 minutes per week during the past three years (This group contained 28 women.)

The table below shows the mean BMD and corresponding standard deviation for each of the two groups of women.

Exercise Group	Number of Women	Mean BMD	Standard Deviation
Sedentary	31	1.151	0.068
Walkers	28	1.209	0.067

Is there a significant difference at the 0.01 level of significance between the mean BMD levels for sedentary women and walkers?

Two-sample t test for $\mu_1 - \mu_2$

(2010B #5)

10. An advertising agency in a large city is conducting a survey of adults to investigate whether there is an association between highest level of educational achievement and primary source for news. The company takes a random sample of 2,500 adults in the city. The results are shown in the table below.

Primary Source for News	HIGHEST LEVEL OF EDUCATIONAL ACHIEVEMENT			Total
	Not High School Graduate	High School Graduate But Not College Graduate	College Graduate	
Newspapers	49	205	188	442
Local television	90	170	75	335
Cable television	113	496	147	756
Internet	41	401	245	687
None	77	165	38	280
Total	370	1,437	693	2,500

The company wants to conduct a statistical test to investigate whether there is an association between educational achievement and primary source for news for adults in the city. What is the name of the statistical test that should be used?

χ^2 test for association/independence

11. In some countries, people believe that blood type has a strong impact on personality. For example, Type B blood is thought to be associated with passion and creativity. A statistics student at a large U.S. university decides to test this theory. Reasoning that people involved in the arts should be passionate and creative, she takes a simple random sample of students majoring or minoring in arts at her university and asks them for their blood type. Here are her results:

Observed number of performing arts majors with each blood type				Total
Type A	Type B	Type AB	Type O	
50	23	10	67	150

Assume the distribution of blood type among all U.S. residents is as follows: Type A: 42%; Type B: 10%; Type AB: 4%; Type O: 44%.

The student wants to carry out a test of significance to see if the distribution of blood types among arts majors or minors is different from the U.S. distribution.

χ^2 test for GOF

12. The human resources department of a very large corporation (more than 20,000 employees) suspects that people are more likely to call in sick on Monday or Friday, so they can take a long weekend. They took a random sample of 850 sick-day reports from the past few years and determined the day of the week for each report. Here are the results:

Day	Monday	Tuesday	Wednesday	Thursday	Friday
# of sick days	192	151	148	152	207

Do the data provide convincing evidence that sick day calls are not evenly distributed throughout the week?

χ^2 test for GOF

13. Lumber companies dry freshly-cut wood in kilns before selling it. As a result of the drying process a certain percentage of the boards become "checked," which means that cracks develop at the ends of the boards. The current drying procedure for 1" x 4" red oak boards is known to produce cracks in 16% of the boards. The drying supervisor at a lumber company wants to test a new method to determine if fewer boards crack.

one-sample z-test for p

14. (2006B #2)

A large company has two shifts—a day shift and a night shift. Parts produced by the two shifts must meet the same specifications. The manager of the company believes that there is a difference in the proportions of parts produced within specifications by the two shifts. To investigate this belief, random samples of parts that were produced on each of these shifts were selected. For the day shift, 188 of its 200 selected parts met specifications. For the night shift, 180 of its 200 selected parts met specifications. Use a 96 percent confidence interval to estimate the difference

Two-sample z interval for $p_1 - p_2$

15. (2003B #6)

Researchers at a large health maintenance organization (HMO) are planning a study of a certain mild illness. They will select a random sample of patients who are ages 35 to 54 and see if they contract the illness in the next year. The researchers are interested in estimating the proportions of men and of women who are likely to develop the illness in each of 4 age-groups: 35-39, 40-44, 45-49, and 50-54.

The researchers plan to include 2,000 patients in the study. Suppose the researchers draw a random sample from all of the patients at this HMO who are ages 35 to 54 and find the following numbers within each gender and age-group.

	Age-Group			
	35-39	40-44	45-49	50-54
Male	350	230	150	60
Female	445	370	245	150

Suppose that at the end of the study, 10 percent of the females in the 40-44 age-group contracted the illness. Calculate a 95 percent confidence interval to estimate the population proportion of females in this age-group that contracted the illness.

One-sample z interval for p

16. (2004B #6)

In order to monitor the populations of birds of a particular species on two islands, the following procedure was implemented.

Researchers captured an initial sample of 200 birds of the species on Island A; they attached leg bands to each of the birds, and then released the birds. Similarly, a sample of 250 birds of the same species on Island B was captured, banded, and released. Sufficient time was allowed for the birds to return to their normal routine and location.

Subsequent samples of birds of the species of interest were then taken from each island. The number of birds captured and the number of birds with leg bands were recorded. The results are summarized in the following table.

	Island A	Island B
Number Captured in Subsequent Sample	180	220
Number with Leg Bands in Subsequent Sample	12	35

Assume that both the initial sample and the subsequent samples that were taken on each island can be regarded as random samples from the population of birds of this species.

Do the data from the subsequent samples indicate that there is a difference in proportions of the banded birds on these two islands? Give statistical evidence to support your answer.

Two sample z test (or interval) for $p_1 - p_2$

17. (2005B #4)

A researcher believes that treating seeds with certain additives before planting can enhance the growth of plants. An experiment to investigate this is conducted in a greenhouse. From a large number of Roma tomato seeds, 24 seeds are randomly chosen and 2 are assigned to each of 12 containers. One of the two seeds is randomly selected and treated with the additive. The other seed serves as a control. Both seeds are then planted in the same container. The growth, in centimeters, of each of the 24 plants is measured after 30 days. These data were used to generate the partial computer output shown below. Graphical displays indicate that the assumption of normality is not unreasonable.

	N	Mean	StDev	SE Mean
Control	12	15.989	1.098	0.317
Treatment	12	18.004	1.175	0.339
Difference	12	-2.015	1.163	0.336

Construct a confidence interval for the mean difference in growth, in centimeters, of the plants from the untreated and treated seeds. Be sure to interpret this interval.

one-sample t interval for μ_0 (paired t interval)

18. (2005B #6)

Regulations require that product labels on containers of food that are available for sale to the public accurately state the amount of food in those containers. Specifically, if milk containers are labeled to have 128 fluid ounces and the mean number of fluid ounces of milk in the containers is at least 128, the milk processor is considered to be in compliance with the regulations. The filling machines can be set to the labeled amount. Variability in the filling process causes the actual contents of the milk containers to be normally distributed. A random sample of 12 containers of milk was drawn for the milk processing line in a plant, and the amount of milk in each container was recorded.

The sample mean and standard deviation of this sample of 12 containers of milk were 127.2 ounces and 2.1 ounces, respectively. Is there sufficient evidence to conclude that the packaging plant is not in compliance with the regulations? Provide statistical justification for your answer.

one sample t test for μ

19. (McGraw Hill – 5 Steps to a 5 – p. 272)

A university dean suspects that there is a difference between how tenured and nontenured professors view a proposed salary increase. She randomly selects 25 tenured and 20 nontenured professors to see if there is a difference. She gets the following results.

	Favor Plan	Do not favor plan
Tenured	15	10
Nontenured	8	12

Do these data provide good evidence that tenured and nontenured faculty differ in their attitudes toward the proposed salary increase?

χ^2 test for homogeneity

20. (???)

These data are x = average on five quizzes prior to midterm exam and y = score on midterm exam for $n = 11$ students randomly selected from a statistics class of about 950 students:

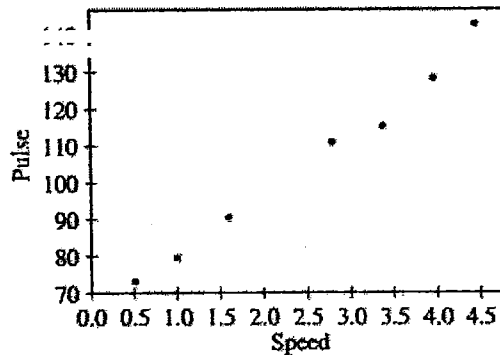
x = Quiz avg	80	68	94	72	74	83	56	68	65	75	88
y = mid score	72	71	96	77	82	72	58	83	78	80	90

Test the claim that as average quiz grade increases, so does midterm score.

t-test for the slope of the CSR line

21. (2005B #5)

John believes that as he increases his walking speed, his pulse rate will increase. He wants to model this relationship. John records his pulse rate, in beats per minute (bpm), while walking at each of seven different speeds, in miles per hour (mph). A scatterplot and regression output are shown below.



Regression Analysis: Pulse Versus Speed					
Predictor	Coef	SE Coef	T	P	
Constant	63.457	2.387	26.58	0.000	
Speed	16.2809	0.8192	19.88	0.000	
S = 3.087		R-Sq = 98.7%		R-Sq (adj) = 98.5%	
Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	1	3763.2	3763.2	396.13	0.000
Residual	5	47.6	9.5		
Total	6	3810.9			

Calculate a 98 percent confidence interval for the slope parameter.

t-interval for the slope of the LSR line

(2009 #5)

22. For many years, the medically accepted practice of giving aid to a person experiencing a heart attack was to have the person who placed the emergency call administer chest compression (CC) plus standard mouth-to-mouth resuscitation (MMR) to the heart attack patient until the emergency response team arrived. However, some researchers believed that CC alone would be a more effective approach.

In the 1990s a study was conducted in Seattle in which 518 cases were randomly assigned to treatments: 278 to CC plus standard MMR and 240 to CC alone. A total of 64 patients survived the heart attack: 29 in the group receiving CC plus standard MMR, and 35 in the group receiving CC alone. Perform a test of significance to determine whether the treatment that uses CC alone produces a higher survival rate.

Two-sample z test for $p_1 - p_2$

23. A radio station trying to determine what kind of music to play takes a simple random sample of 50 students at each of three locations: a local middle school, a high school, and a college. The students are asked to choose which of three different music genres they most enjoy hearing on the radio. Here are the results:

		Music Genre		
		Hip Hop	Alternative	Post-rock
Age level	Middle School	28	18	4
	High School	22	22	6
	College	16	20	14
Total		66	60	24

Perform the appropriate statistical test to determine if there is a difference in the music preference of these three age groups.

χ^2 test for homogeneity

(2003B #4)

24.

There have been many studies recently concerning coffee drinking and cholesterol level. While it is known that several coffee-bean components can elevate blood cholesterol level, it is thought that a new type of paper coffee filter may reduce the presence of some of these components in coffee.

The effect of the new filter on cholesterol level will be studied over a 10-week period using 300 nonsmokers who each drink 4 cups of caffeinated coffee per day. Each of these 300 participants will be assigned to one of two groups: the experimental group, who will only drink coffee that has been made with the new filter, or the control group, who will only drink coffee that has been made with the standard filter. Each participant's cholesterol level will be measured at the beginning and at the end of the study.

Which test would you conduct to determine whether the change in cholesterol level would be greater if people used the new filter rather than using the standard filter?

Two-sample t test for $\mu_1 - \mu_2$

(2004B #4)

25. The principal at Crest Middle School, which enrolls only sixth-grade students and seventh-grade students, is interested in determining how much time students at that school spend on homework each night. The table below shows the mean and standard deviation of the amount of time spent on homework each night (in minutes) for a random sample of 20 sixth-grade students and a separate random sample of 20 seventh-grade students at this school.

	Mean	Standard Deviation
Sixth-grade students	27.3	10.8
Seventh-grade students	47.0	12.4

Based on dotplots of these data, it is not unreasonable to assume that the distribution of times for each grade were approximately normally distributed.

(a) Estimate the difference in mean times spent on homework for all sixth- and seventh-grade students in this school using an interval. Be sure to interpret your interval.

Two-sample t-interval for $\mu_1 - \mu_2$

26. When a law firm represents a group of people in a class action lawsuit and wins that lawsuit, the firm receives a percentage of the group's monetary settlement. That settlement amount is based on the total number of people in the group—the larger the group and the larger the settlement, the more money the firm will receive.

A law firm is trying to decide whether to represent car owners in a class action lawsuit against the manufacturer of a certain make and model for a particular defect. If 5 percent or less of the cars of this make and model have the defect, the firm will not recover its expenses. Therefore, the firm will handle the lawsuit only if it is convinced that more than 5 percent of cars of this make and model have the defect. The firm plans to take a random sample of 1,000 people who bought this car and ask them if they experienced this defect in their cars.

one-sample z test for p

27. Baby walkers are seats hanging from frames that allow babies to sit upright with their legs dangling and feet touching the floor. Walkers have wheels on their legs that allow the infant to propel the walker around the house long before he or she can walk or even crawl. Typically, babies use walkers between the ages of 4 months and 11 months.

Because most walkers have trays in front that block babies' views of their feet, child psychologists have begun to question whether walkers affect infants' cognitive development. One study compared mental skills of a random sample of those who used walkers with a random sample of those who never used walkers. Mental skill scores averaged 113 for 54 babies who used walkers (standard deviation of 12) and 123 for 55 babies who did not use walkers (standard deviation of 15).

- (a) Is there evidence that the mean mental skill score of babies who use walkers is different from the mean mental skill score of babies who do not use walkers? Explain your answer.

Two-sample t test (or interval) for $\mu_1 - \mu_2$

28. In a random sample of 60 shoppers chosen from the shoppers at a large suburban mall, 36 indicated that they had been to a movie in the past month. In an independent random sample of 50 shoppers chosen from the shoppers in a large downtown shopping area, 31 indicated that they had been to a movie in the past month. What significance test should be used to determine whether these data provide sufficient evidence to reject the hypothesis that the proportion of shoppers at the suburban mall who had been to a movie in the past month is the same as the proportion of shoppers in the large downtown shopping area who had been to a movie in the past month?

Two-sample z test for $p_1 - p_2$

29. In order to plan its next advertising campaign, the Trendy Motor Vehicle Company is investigating whether the type of vehicle and the color of vehicle are related. Each person in a random sample of size 275 selected from the company's mailing list was classified according to the type (car or truck) and the color of the vehicle he or she drove. The data are shown in the table below.

		Vehicle Color				
		Red	Black	White	Tan	Green
Vehicle	Car	35	23	41	21	12
Type	Truck	27	55	39	12	10

Which of the following procedures would be most appropriate to use for investigating whether there is a relationship between vehicle type and color?

χ^2 test for association/independence

30. A town manager is interested in comparing requests for various town-provided services (such as street maintenance and garbage pickup) with nationally published proportions of requests for the same services. Each request in a random sample of 500 service requests from the town was classified into one of 10 different categories. Which of the test could be used to determine whether the proportions of service requests classified into the 10 service categories for the town differ from national proportions?

χ^2 test for GDF

Does the town "fit" national

AP STATS – Which Procedure?!? KEY

1. One-sample t test (or interval) for μ
2. One-sample z interval for p
3. Chi-square test for association/independence
4. One-sample t interval for μ
5. One-sample t interval for μ_D (paired t interval)
6. t test for the slope of an LSR line
7. Two-sample t test for $\mu_1 - \mu_2$
8. One-sample t test for μ_D (paired t test)
9. Two-sample t test for $\mu_1 - \mu_2$
10. Chi-square test for association/independence
11. Chi-square test for goodness-of-fit
12. Chi-square test for goodness-of-fit
13. One-sample z test for p
14. Two-sample z interval for $p_1 - p_2$
15. One-sample z interval for p
16. Two-sample z test (or interval) for $p_1 - p_2$
17. One-sample t interval for μ_D (paired t interval)
18. One-sample t test for μ
19. Chi-square test for homogeneity
20. t test for the slope of an LSR line
21. t interval for the slope of an LSR line
22. Two-sample z test for $p_1 - p_2$
23. Chi-square test for homogeneity
24. Two-sample t test for $\mu_1 - \mu_2$
25. Two-sample t interval for $\mu_1 - \mu_2$
26. One-sample z test for p
27. Two-sample t test (or interval) for $\mu_1 - \mu_2$
28. Two-sample z test for $p_1 - p_2$
29. Chi-square test for association/independence
30. Chi-square test for goodness-of-fit

