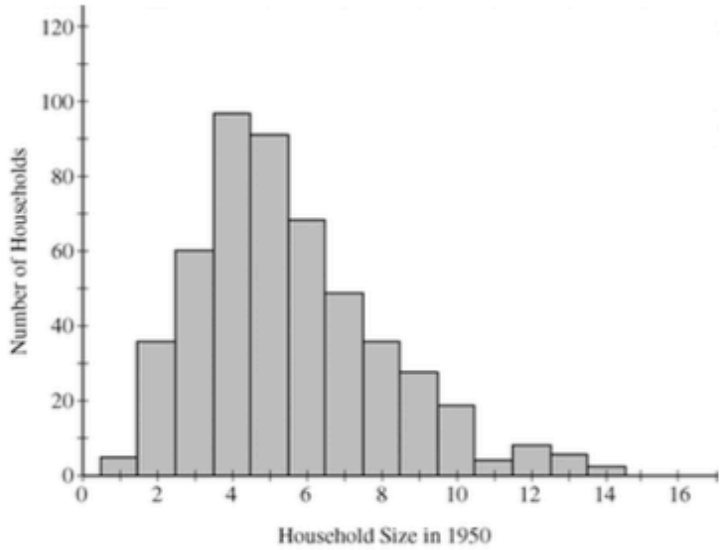
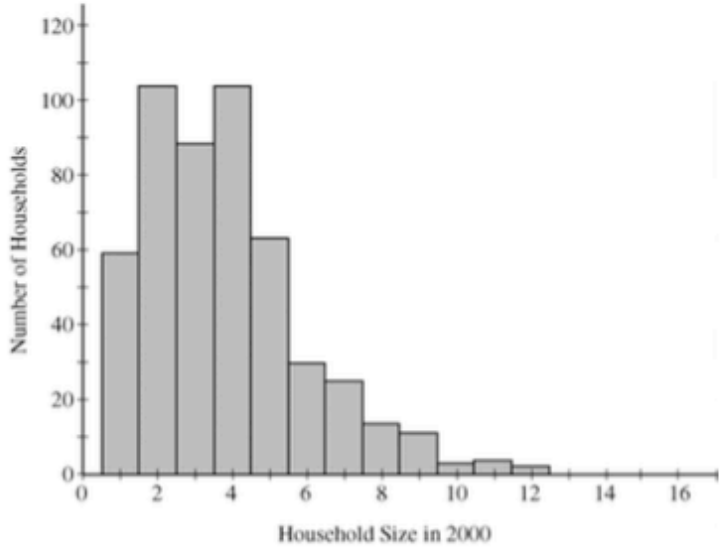
12 Common Communication Errors

…on the AP Stats Exam…see if you can find them… NAME_____

2012 Stud.A 3. Independent random samples of 500 households were taken from a large metropolitan area in the United States for the years 1950 and 2000. Histograms of household size (number of people in a household) for the years are shown below.





(a) Compare the distributions of household size in the metropolitan area for the years 1950 and 2000.

shape – Both distributions are skewed right; distribution of Year 2000 has a stronger skew

Center – The center has moved slightly (left) lower from 1950's to 2000's distribution.

spread – the spread of 1950's distribution is slightly greater than that of 2000's.

2012 #3: Student B

The distribution of household size in 1950 is slightly skewed to the right, but does not show any extreme outliers. It also includes households with sizes between 1 and 14.

The distribution of household size in 2000 is extremely skewed to the right and households with 10-12 people may be considered outliers. This distribution includes households with sizes between 1 and 12, which is different than the 1950s distribution.

2014

3. Schools in a certain state receive funding based on the number of students who attend the school. To determine the number of students who attend a school, one school day is selected at random and the number of students in attendance that day is counted and used for funding purposes. The daily number of absences at High School A in the state is approximately normally distributed with mean of 120 students and standard deviation of 10.5 students.

   (a) If more than 140 students are absent on the day the attendance count is taken for funding purposes, the school will lose some of its state funding in the subsequent year. Approximately what is the probability that High School A will lose some state funding?

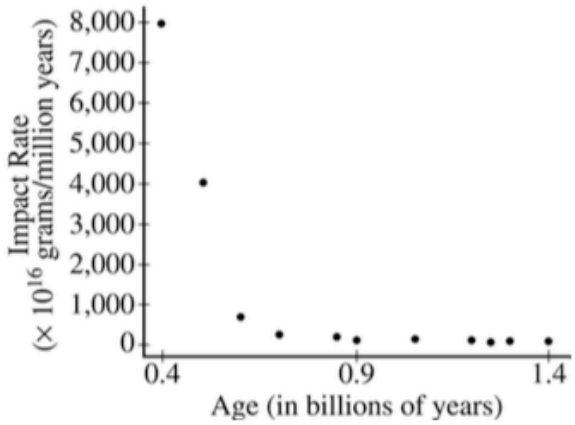
normalcdf (141, 10000, 120, 10.5)

= .0228

The probability High School A will lose some state funding is 2.28%.

2004B (focus on part (b))

1. The Earth's Moon has many impact craters that were created when the inner solar system was subjected to heavy bombardment of small celestial bodies. Scientists studied 11 impact craters on the Moon to determine whether there was any relationship between the age of the craters (based on radioactive dating of lunar rocks) and the impact rate (as deduced from the density of the craters). The data are displayed in the scatterplot below.



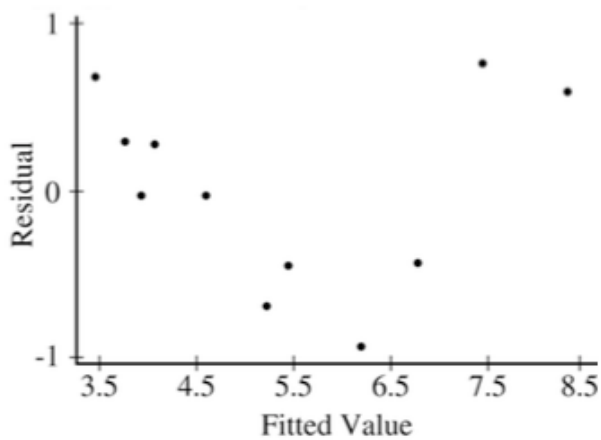
(a) Describe the nature of the relationship between impact rate and age.

Prior to fitting a linear regression model, the researchers transformed both impact rate and age by using logarithms. The following computer output and residual plot were produced.

Regression Equation: ln(rate) = 4.82 – 3.92 ln(age)

Predictor	Coef	SE Coef	T	P
Constant	4.8247	0.1931	24.98	0.000
ln(age)	–3.9232	0.4514	–8.69	0.000

S = 0.5977 R-Sq = 89.4% R-Sq (adj) = 88.2%



(b) Interpret the value of r^2.

89.4 % of the variability in impact rate is accounted for by the variability in age.

2007

2. As dogs age, diminished joint and hip health may lead to joint pain and thus reduce a dog's activity level. Such a reduction in activity can lead to other health concerns such as weight gain and lethargy due to lack of exercise. A study is to be conducted to see which of two dietary supplements, glucosamine or chondroitin, is more effective in promoting joint and hip health and reducing the onset of canine osteoarthritis. Researchers will randomly select a total of 300 dogs from ten different large veterinary practices around the country. All of the dogs are more than 6 years old, and their owners have given consent to participate in the study. Changes in joint and hip health will be evaluated after 6 months of treatment.

   (a) What would be an advantage to adding a control group in the design of this study?

An advantage to adding a control group to this design would be that it gives the experiment something to compare its results to, to see how much of a difference the treatments make.

2005

5. A survey will be conducted to examine the educational level of adult heads of households in the United States. Each respondent in the survey will be placed into one of the following two categories:

   - Does not have a high school diploma
   - Has a high school diploma

   The survey will be conducted using a telephone interview. Random-digit dialing will be used to select the sample.

   (a) For this survey, state one potential source of bias <u>and</u> describe how it might affect the estimate of the proportion of adult heads of households in the United States who do not have a high school diploma.

One possible source of bias would be that a greater amount of households that are head by a person who does not have a high school diploma would not have phones. This would be undercoverage bias because they would not reach these people. A greater prop. of heads of houses will be in this sample than the true pop. prop.

2007 (focus on part (c))

2. As dogs age, diminished joint and hip health may lead to joint pain and thus reduce a dog's activity level. Such a reduction in activity can lead to other health concerns such as weight gain and lethargy due to lack of exercise. A study is to be conducted to see which of two dietary supplements, glucosamine or chondroitin, is more effective in promoting joint and hip health and reducing the onset of canine osteoarthritis. Researchers will randomly select a total of 300 dogs from ten different large veterinary practices around the country. All of the dogs are more than 6 years old, and their owners have given consent to participate in the study. Changes in joint and hip health will be evaluated after 6 months of treatment.

   (a) What would be an advantage to adding a control group in the design of this study?

   (b) Assuming a control group is added to the other two groups in the study, explain how you would assign the 300 dogs to these three groups for a completely randomized design.

   (c) Rather than using a completely randomized design, one group of researchers proposes blocking on clinics, and another group of researchers proposes blocking on breed of dog. How would you decide which one of these two variables to use as a blocking variable?

Rather than using a completely randomized design, I would encorporate blocking on the specific breed of dog, because the different treatments could possibly have a different effect on the different types of dogs, therefore I would use the blocking on breed of dog so it would eliminate any variables that could change the actual data. I would rather block on breed of dog than clinic, because breeds of dogs seem to be much more different than different clinics, therefore I would block on breeds of dogs.

2012

4. A survey organization conducted telephone interviews in December 2008 in which 1,009 randomly selected adults in the United States responded to the following question.

At the present time, do you think television commercials are an effective way to promote a new product?

Of the 1,009 adults surveyed, 676 responded "yes." In December 2007, 622 of 1,020 randomly selected adults in the United States had responded "yes" to the same question. Do the data provide convincing evidence that the proportion of adults in the United States who would respond "yes" to the question changed from December 2007 to December 2008 ?

Define: P_1 = proportion of adults who said 'yes' in 2007.

P_2 = proportion of adults who said 'yes' in 2008.

Test:

1. $H_0: P_1 = P_2$ The true proportion of adults who said 'yes' to the stated question did not change between 2007 & 2008.

$H_a: P_1 \neq P_2$ The true proportion of adults who said 'yes' to the stated question in 2008 was different from 2007.

2013 (focus on the interpretation of the interval)

1. An environmental group conducted a study to determine whether crows in a certain region were ingesting food containing unhealthy levels of lead. A biologist classified lead levels greater than 6.0 parts per million (ppm) as unhealthy. The lead levels of a random sample of 23 crows in the region were measured and recorded. The data are shown in the stemplot below.

Lead Levels

2	8
3	0
3	5 8 8
4	1 1 2
4	6 8 8
5	0 1 2 2 3 4
5	9 9
6	3 4
6	6 8

Key: 2|8 = 2.8 ppm

(a) What proportion of crows in the sample had lead levels that are classified by the biologist as unhealthy?

(b) The mean lead level of the 23 crows in the sample was 4.90 ppm and the standard deviation was 1.12 ppm. Construct and interpret a 95 percent confidence interval for the mean lead level of crows in the region.

conditions: Simple random sample stated in problem
23(10) = 2300, safe to assume > 2300 crows in world
histogram of data (as shown by stemplot) is
approx normal w/ no outliers.

1 sample t-interval at 95% confidence:

(4.4157, 5.3843)

we are 95% confident that in repeated samples the mean lead level of
crows in the region falls between the values of
4.4157 and 5.3843 ppm

2014 #1

(c) After verifying that the conditions for inference were satisfied, the administrator performed a chi-square test of the following hypotheses.

H_0 : There is no association between residential status and level of participation in extracurricular activities among the students at the university.

H_a : There is an association between residential status and level of participation in extracurricular activities among the students at the university.

The test resulted in a p-value of 0.23. Based on the p-value, what conclusion should the administrator make?

Based on the p-value of 0.23, the administrator should make the conclusion that there is a correlation between residential status and the level of participation in extracurricular activities among the students at the university.

2014 (focus on part (b))

2. Nine sales representatives, 6 men and 3 women, at a small company wanted to attend a national convention. There were only enough travel funds to send 3 people. The manager selected 3 people to attend and stated that the people were selected at random. The 3 people selected were women. There were concerns that no men were selected to attend the convention.

(a) Calculate the probability that randomly selecting 3 people from a group of 6 men and 3 women will result in selecting 3 women.

$P(3 \text{ women selected}) : \left(\frac{3}{9}\right)\left(\frac{2}{8}\right)\left(\frac{1}{7}\right) \approx 0.0119$ or $\approx 1.2\%$ chance

(b) Based on your answer to part (a), is there reason to doubt the manager's claim that the 3 people were selected at random? Explain.

Yes, because there is only a 1.2% chance that the 3 women were chosen at random, and we are generally suspicious of anything under a 5% chance of occuring randomly.

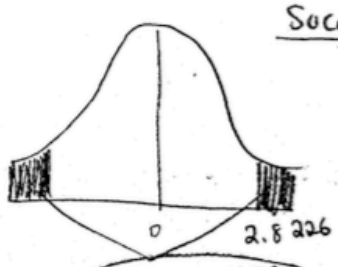
2012 #4

2 Proportion Z - Test is appropriate

2008	2007
$n_1 = 1009$	$n_2 = 1020$
$x_1 = 676$	$x_2 = 622$
$p_1 = 0.670$	$p_2 = 0.61$

$H_0: p_1 = p_2$

$H_A: p_1 \neq p_2$



$P = 0.00476$

$$z = 2.8226 = \frac{0.34 - 0}{\sqrt{\frac{(0.670)(0.33)}{1009} + \frac{(0.61)(0.39)}{1020}}}$$

Randomization: 1,009 randomly selected adults in the US in 2008
1,020 randomly selected adults in the US in 2007

10% condition: 1,009 randomly selected adults in the United States in 2008 and 1,020 randomly selected adults in the United States in 2007 are likely less than 10% of their respective population.

Success/Failure: $(1009)(0.670) \geq 10$
$(1009)(0.33) \geq 10$
$(1020)(0.61) \geq 10$
$(1020)(0.39) \geq 10$

Independent ~~Groups~~: response of 1009 randomly selected adults in 2008 is likely independent from 1020 randomly selected adults in 2007.

Since a p-value of 0.00476 is less than any reasonable significance level, we reject the null hypothesis. There is evidence to suggest that the proportion of adults in the United States who would respond "yes" to the question changed from December 2007 to December 2008

ANSWERS: The point of emphasis in each example is underlined below.

Each graded part on the AP Statistics Exam is scored as: **E**(ssentially) correct, **P**(artially) correct or **I**(ncorrect)

2012 #3: Stud A: This student COMPARED shape, center and spread, but there is no mention of context (household sizes). Score = P.

2012 #3: Stud B: Part (a) is worth three points.

1) Correctly compares centers. Score = I (no direct comparison)
2) Correctly compares variability. Score = I (no direct comparison)
3) Correctly compares shapes AND includes context (somewhere)
   Shapes ARE compared, and the student mentioned household sizes. Score = E

Takeaway: ALWAYS write statements of direct comparison when comparing distributions.

2014 #3: There is danger in only showing "calculator speak." To earn an "E" for this problem, students need to 1) identify a normal model AND the two parameters, 2) use a correct boundary, and 3) calculate the correct normal probability. Since the parameters are not clearly identified, this student earned a P.

2004B #1b: Context is incorrect. The variables are the LN(age) and LN(impact rate). Score = P.
(This brought the student's overall problem score down from a 4 to a 3.)

2007 #2: No context. Score = P

2005 #5: No explanation of how this bias "might affect the estimate of the proportion of adult heads…"
(The student did not answer the second part of the question, even with the hint of "***and***") Score=P

2007 #2c: There are several issues here. First, the writing is very disjointed and confusing to read. Second, there is a lack of precision of language with the phrase "change the actual data" and FIVE usages of the word "different." But the third is the fatal one: "eliminate any variables." This is a false statement—blocking does not eliminate variables. Score = P.
Takeaways: 1) use precise language, and 2) answer the question, then stop writing.

2012 #4: "…adults who said 'yes' to the stated question…" is referring to the ***sample,*** not the ***population.*** The hypotheses should always describe the population parameters. Score=P

2013 #1 [FYI: In Part (a), students need to show "work," even if it's only a fraction: 4/23=17.4%).]
In Part (b), the added phrase "in repeated samples" makes the statement incorrect. In fact, this statement is neither a correct interpretation of the interval NOR a correct explanation of confidence LEVEL. Score on this part = I (they earned E's for conditions/name and interval).

2014 #1c: No linkage from p-value to decision ("since the p-value is greater than alpha=0.05…") AND, wrong conclusion based on a high p-value. Score = I

2014 #2b: This student incorrectly interprets the probability that was calculated. The CORRECT interpretation should be "Given the process is random, there is a 1.2% chance of selecting three women." [Even though this was not a hypothesis test, what the student stated is essentially the probability that the null hypothesis ("The process is random.") is true.]
The student DID make the correct decision AND supported it by comparing it to a reasonable standard (5%), so their score is a P.

2012 #4: Looking at their table, p_1 and p_2 are the statistics (should be parameters); t and p-value are correct but formula is for NON-pooled test. Both sections earned a P. Overall score: PPEE = 3.