

Chapter 20: Hypothesis Tests – Proportions

1. In a 2007 Gallup poll, 1000 adults were asked which best describes the Bible. 31% picked “actual word of God, to be taken literally” (other results from the poll: 47% selected “inspired by word of God”, and 19% chose “ancient fables, history, legends recorded by man”). Do these data provide evidence that less than 1/3 of Americans who believe that the Bible is the actual word of God? (<http://www.gallup.com/poll/27682/OneThird-Americans-Believe-Bible-Literally-True.aspx>)

a) Write appropriate hypotheses and name the test.

$$H_0: p = 1/3 \quad H_A: p < 1/3$$

Type of Test: 1 Proportion Z Test

b) Check the necessary assumptions.

1. Independence –

a. Randomization – We must assume that the adults were randomly sampled

b. 10% condition – 1000 adults is less than 10% of the population of all American adults

2. Success/Failure – $np = (1000)(.33) = 330 \geq 10$; same for nq

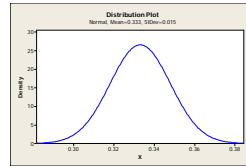
c) Specify the model.

Normal Model.

$$E(X) = .33$$

$$SD(X) = \sqrt{\frac{(.33)(.67)}{1000}} = 0.015.$$

Model: $N(0.33, 0.015)$



d) Perform the mechanics of the test.

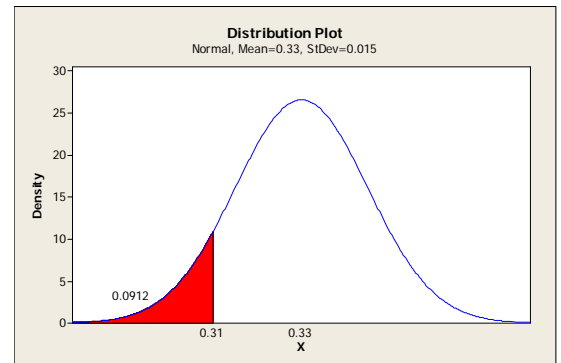
events = 310 # trials = 1000

Hypothesized proportion = 0.33

Sample	X	N	Sample p	95% Upper Bound	Z-Value	P-Value
1	310	1000	0.310000	0.334057	-1.35	0.089

Test Statistic = -1.35

p-value = 0.089



e) Explain what the p-value means in this context.

The p-value of 0.089 says that if the true proportion of Americans who believe the Bible is the “actual word of God, to be taken literally” is 33%, then an observed proportion as low as 31% would occur at random 9 times out of 100.

f) What is your conclusion?

The p-value is not too small (in particular, I am willing to believe that a 9% chance can happen). Therefore, I will **not reject H_0** .

There is **no evidence** that the proportion who believe the Bible is the actual word of God is lower than 33%.

2. In a 2008 Gallup Poll of 1007 Americans, 443 thought that China will be the leading economic power in 20 years. A politician claimed that less than half of Americans think that China will be the leading economic power in 20 years. Does the poll provide evidence to support the politician?

(<http://www.gallup.com/poll/104479/Americans-See-China-Crowding-US-Economic-Leader.aspx>)

a) Hypotheses.

$$H_0: p = 0.5 \quad H_A: p < 0.5$$

Type of Test: 1 Proportion Z Test

b) Model.

1. Independence –

a. Randomization – We must assume that the Americans were randomly sampled

b. 10% condition – 1007 adults is less than 10% of the population of all American adults

2. Success/Failure – $np = (1007)(.5) = 503.5 \geq 10$; same for nq

Normal Model.

$$E(X) = .5$$

$$SD(X) = \sqrt{\frac{(.5)(.5)}{1007}} = 0.016.$$

Model: $N(0.5, 0.016)$

c) Mechanics.

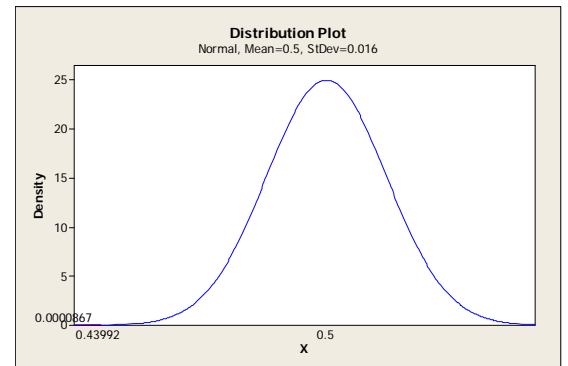
events = 443 # trials = 1007

Hypothesized proportion = 0.5

Sample	X	N	Sample p	95% Upper Bound	Z-Value	P-Value
1	443	1007	0.439921	0.465650	-3.81	0.000

Test Statistic = -3.81

p-value = 0.000



d) Explain what the p-value means in this context.

The p-value of 0.000 says that it is VERY UNLIKELY that I observe a sample proportion as low as 44%, under the assumption that the proportion is 50%.

e) Conclusion.

The p-value is exceptionally small. Therefore, I will **reject H_0** .

There is **strong evidence** to support the politician.

3. In a 2007 Gallup survey, 77% of 269 Democrats (including independents who lean toward the Democratic party) answered “yes” to the question “*When a person has a disease that cannot be cured, do you think doctors should be allowed by law to end the patient's life by some painless means if the patient and his or her family request it?*”. Is this evidence to show that Democrats feel differently from the national proportion of 71%? Show your work. (<http://www.gallup.com/poll/27727/public-divided-over-moral-acceptability-doctorassisted-suicide.aspx>)

Hypotheses.

$H_0: p = 0.71$

$H_A: p \neq 0.71$

Type of Test: 1 Proportion Z Test

Model.

1. Independence –

a. Randomization – We must assume that the Democrats were randomly sampled

b. 10% condition – 269 Democrats is less than 10% of the population of all Democrats

2. Success/Failure – $np = (269)(.29) = 78 \geq 10$; nq also larger than 10

Normal Model.

$$E(X) = .71$$

$$SD(X) = \sqrt{\frac{(.71)(.29)}{269}} = 0.028.$$

Model: $N(0.71, 0.028)$

Mechanics.

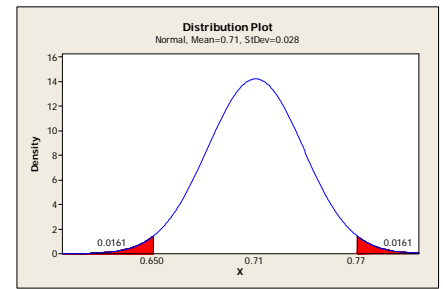
events = 207 # trials = 269

Hypothesized proportion = 0.71

Sample	X	N	Sample p	95% CI	Z-Value	P-Value
1	207	269	0.769517	(0.719190, 0.819844)	2.15	0.031

Test Statistic = 2.15

p-value = 0.031



The p-value of 0.031 says that it is FAIRLY UNLIKELY that I observe a sample proportion as **extreme** as 77%, under the assumption that the proportion is 71%.

Conclusion.

The p-value is small. Therefore, I will **reject H₀**.

There **is evidence** to show that Democrats feel differently from the national proportion of 71%.

4. The manufacturer of a pain relief medication claims that fewer than 10% of patients experience side effects. Of the 340 people who took this medication, 35 suffered some side effects. Without performing a hypothesis test, explain why there is no evidence to support the claim.

There is **NO EVIDENCE** for fewer than 10% because our sample showed **MORE** than 10% (35/340 = 10.3%) experienced side effects.