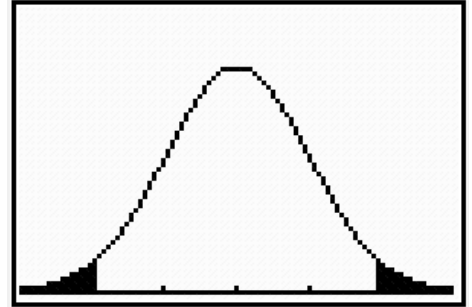


Lesson 58: Comparing Confidence Intervals and Significance Tests

Confidence Intervals

Confidence intervals provide additional information that significance tests do not – a range of plausible values for the true population parameter.

- The confidence level is 95%
- The inside area is 95% and the edges are the confidence interval
- The total area in the tails is 5% (2.5% on each side)
- The left tail starts at Z-value -2
- The right tail starts at Z-value 2
- For proportions, this curve is centered at \hat{p}
- For means, this curve is centered at \bar{x}

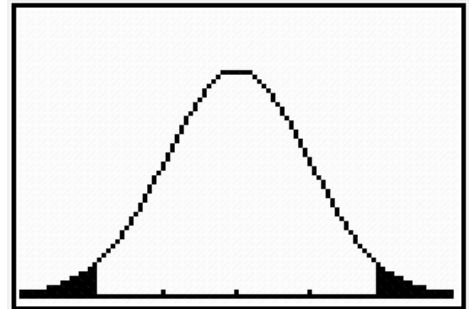


Hypothesis Test

Significance tests describe if evidence exists to reject a hypothesis (usually to one side).

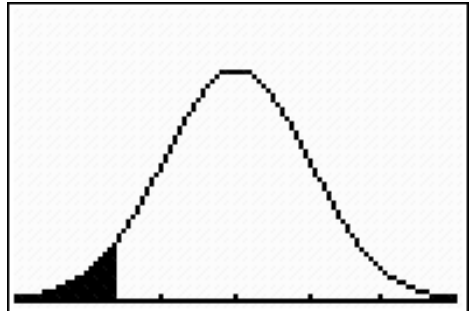
Two Sided Test (\neq)

- The significance level is 5%
- The inside area is 95%
- The total area in the tails is 5% (2.5% on each side)
- The left tail starts at Z-value -2
- The right tail starts at Z-value 2
- The curve is centered at the null value



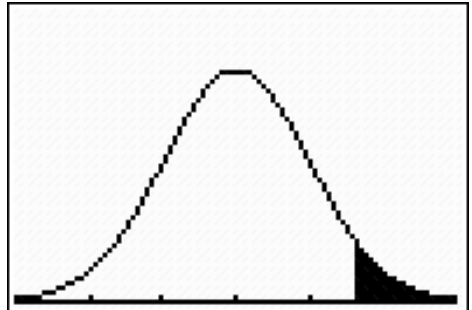
One Sided Test to the left ($<$)

- The area of the shaded portion represents 5% of the curve.
- Significance level = .05
- The unshaded area is 95% of the total area.
- The shaded portion starts at Z-value -1.64
- The curve is centered at the null value



One Sided Test to the right ($>$)

- The shaded portion starts at Z-value -1.64
- The area of the shaded portion represents 5% of the curve.
- Significance level = .05
- The unshaded area is 95% of the total area.
- The curve is centered at the null value



United States Department of Health and Human Services
(HHS) figures for Federal Poverty Level in 2018^[26]

Persons in Family Unit	48 Contiguous States and D.C.	Alaska	Hawaii
1	\$12,140	\$15,180	\$13,960
2	\$16,460	\$20,580	\$18,930
3	\$20,780	\$25,980	\$23,900
4	\$25,100	\$31,380	\$28,870
5	\$29,420	\$36,780	\$33,840
6	\$33,740	\$42,180	\$38,810
7	\$38,060	\$47,580	\$43,780
8	\$42,380	\$52,980	\$48,750
Each additional person adds	\$4,320	\$5,400	\$4,970

Countries are experimenting with Universal Basic Income in varying degrees.

Starting this year, Finland is giving out a guaranteed monthly income of nearly \$600 to 2,000 citizens. The citizens were randomly selected but had to have received unemployment benefits or an income subsidy. The money they are paid isn't taxed. It's a two-year program that could be expanded nationwide depending on the results.

Canada's province of Ontario, which includes Toronto, started a pilot program in April that provides 4,000 citizens with an unconditional income of about \$12,600 a year. Applicants must be between ages 18 and 64 and living on a limited income.

Voters in Switzerland shot down a referendum last year to provide a basic income to citizens.

Daily Data Collection

The poverty level describes the minimum amount of money necessary to survive in this country.

In 2015, 43 million Americans lived below the poverty level (13.5%)

A negative income tax is a system in which a person earning less than the poverty level receives income from the government to lift them to the basic poverty level. This does NOT have a work requirement.

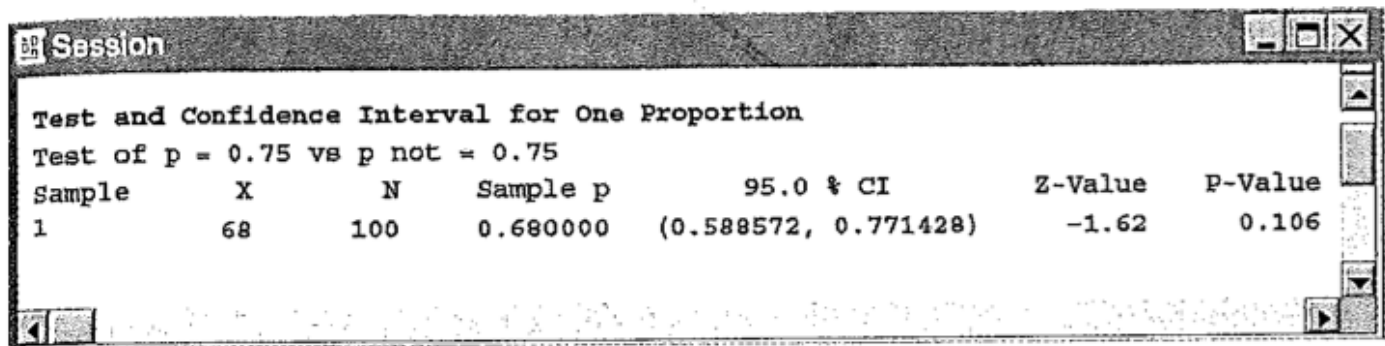
True or False: The US should implement a negative income tax.

Conduct a hypothesis test on the claim that most students in this class feel the US should NOT implement a negative income tax.

Examples

A union spokesperson claims that 75% of union members will support a strike if their basic demands are not met. A company negotiator believes the true percentage is lower and runs a hypothesis test at the 10% significance level. What is the conclusion if 87 out of an SRS of 125 union members say they will strike?

The figure below shows the results of running a two-sided test and a confidence interval to see if the true proportion of people willing to strike is actually 75%.



The screenshot shows a window titled "Session" with the following text:

```
Test and Confidence Interval for One Proportion
Test of p = 0.75 vs p not = 0.75
Sample      X      N      Sample p      95.0 % CI      Z-Value      P-Value
1           68     100     0.680000     (0.588572, 0.771428)     -1.62        0.106
```

Which is more valuable and why?

When smoking was first suspected as a cause of disease, Sir Ronald Fisher offered the *constitution hypothesis* as an alternative explanation for the observed association. The constitutional hypothesis suggested that people genetically disposed to lung cancer were more likely to smoke. In other words, the relation between smoking and disease was *confounded* by constitutional factors. The constitutional hypothesis was put to the ultimate test by a study in which 22 smoking-discordant monozygotic twins were studied to see which twin first succumbed to death.² In this study, the smoking-twin died first in 17 of the pairs (i.e., $u = 17$, $u + v = 22$, so $v = 5$).

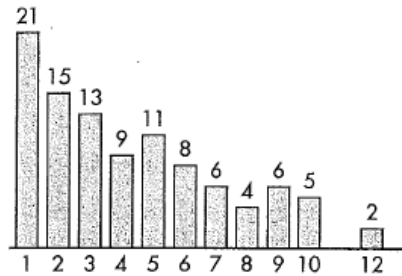
A cancer research group surveys 500 women more than 40 years old to test the hypothesis that 28% of women in this age group have regularly scheduled mammograms. Should the hypothesis be rejected at the 5% significance level if 151 of the women respond affirmatively?

5. According to one national survey, 20% of 18–24-year-olds have passports.

- (a) Assuming the 20% figure is correct, use simulation to determine the approximate probability that in a random sample of ten 18–24-year-olds, at least three have passports.

2498346851	4113296825	1485367833	8663018872	7373275392
5062790330	2367029195	4153038298	7360048279	4207598980
9574649262	4488086249	2651769472	9462095309	4072555345
7894788460	2391904958	0201791131	9856022851	1405559336
6003121057	4154811850	7697586849	9644852135	0811348895

- (b) Calculate the above probability exactly.
- (c) Suppose you believe that the 20% claim is too high and run a hypothesis test. In a simple random sample of 200 18–24-year-olds you find only 33 who have passports. Is this sufficient evidence to dispute the 20% claim?
- (d) If the 20% claim is true, what is the probability that the first 18–24-year-old with a passport will be the third one sampled?
- (e) A 100-trial simulation is performed to determine the number of 18–24-year-olds sampled before finding one with a passport. The results are as follows:



Use the above information and barplot to estimate the mean number of 18–24-year-olds sampled before finding one with a passport.