Hypothesis Testing
One Proportion

Math 122

Normal Approximation to Binomial Central Limit Theorem Variant

Suppose that x has a binomial distribution with n trials and probability of success p.

If $np \geq 5$ and $n(1-p) \geq 5$, then x is approximately normally distributed with

$$\mu = np \text{ and } \sigma = \sqrt{np(1-p)}.$$

Normal Approximation to Binomial

Suppose that x is a binomial random variable with n=1000 and p=0.25. Find P(x≤260).

- P(x≤260) = binomialcdf(1000,0.25,260)=.7791
- Assuming x is normal with μ=np=250 and $\sigma = \sqrt{np(1-p)}$=13.931 gives

$$P(x \leq 260) = P\left(z \leq \frac{260 - 250}{13.931}\right)$$

$$= \mathrm{normalcdf}(-9,0.7303) = 0.7674$$

Traditionally, tests about proportions are done using the normal approximation to the binomial rather than the binomial.

Steps for Hypothesis Testing

1. Define your parameters. Say explicitly what symbols like p, $\hat{p}$, n, x, $\bar{x}$, and μ represent
2. State the claim being tested in symbols.
3. State the opposite of the claim in symbols.
4. Determine H_0 and H_1. H_0 is the statement from 2 and 3 which involves equality. H_1 is the statement from 2 and 3 which does not involve equality.
5. Select a significance level α. If α is not given, use $\alpha = 0.05$.
6. Decide on the appropriate distribution (binomial, z, t, etc.) and test statistic (observed successes, z-score, t-score, etc.). If using technology, you are deciding which test to use on your machine.
7. Find the P-value. This is the probability of getting a test statistic at least as extreme as your calculated test statistic. The P-value is a measure of consistency between your observations and the null hypothesis H_0.
8. Decide if you should reject H_0.
   (a) If $P < \alpha$, then the observations are not consistent with H_0.
   REJECT H_0 (Support H_1).
   (b) If $P > \alpha$, then the observations are consistent with H_0.
   DO NOT REJECT H_0 (Do not support H_1).
9. Restate your conclusion in non-technical terms that refer directly to the claim being tested.
   - If your claim is H_0, your conclusion will be one of these
     - There is enough sample evidence to reject the claim.
     - There is NOT enough sample evidence to reject the claim.
   - If your claim is H_1, then your conclusion will be one of these
     - There is enough sample evidence to support the claim.
     - There is NOT enough sample evidence to support the claim.

Technology

- Online: one proportion z-test
- TI: 1-PropZTest

Gender Selection

n

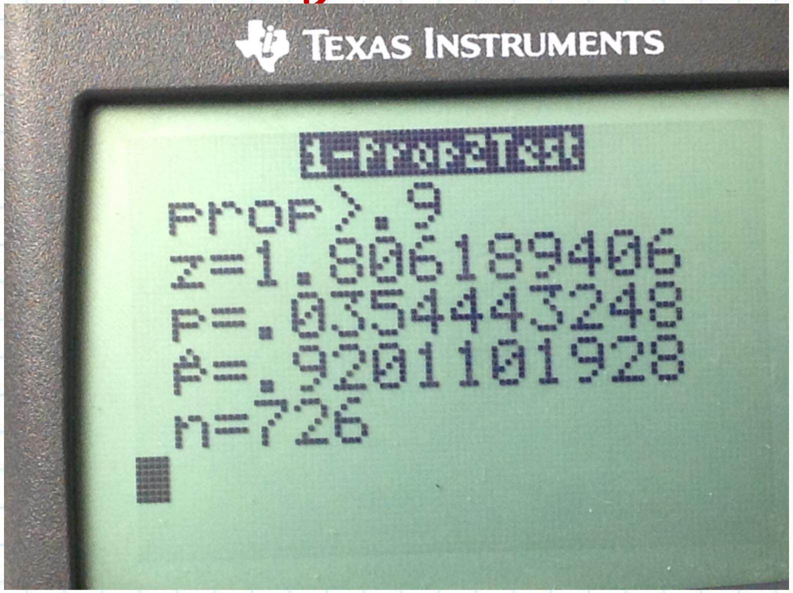
- Among 726 babies born to couples using the XSORT method in an attempt to have a baby girl, x 668 of the babies were girls.
- Test the claim: **More than 90% of babies born to couples using the XSORT method are female.**

p = proportion of these infants which are girls

born w/ XSORT

Claim: $p > .9$

- p= prop. of XSORT babies which are girls



- n= 726
- x= 668
- Claim: $p > .9 \leftarrow H_1$
- Opposite: $p \leq .9 \leftarrow H_0$
- H_0: $p \leq .9$
- H_1: $p > .9 \leftarrow$ claim
- P-value= $P(X \geq 668)$ = use 1-Prop Z = .0354   Note: P<5%
- Formal Conclusion: Reject H_0 / Support H_1
- Conclusion:

There is enough sample evidence to support the claim.

Gender Prediction

- 104 pregnant women were asked to predict the gender of their child. Of these, 57 guessed correctly.
- Test the claim: **Most women can predict the gender of their children.**

- p=

- n=
- x=
- Claim:
- Opposite:
- H_0:
- H_1:
- P-value=
- Formal Conclusion:
- Conclusion:

Clinical Testing

- Among 724 patients given Tamiflu in a clinical trial, 72 experienced nausea.
- Test the claim: **The rate of nausea in patients using Tamiflu is greater than 6%.**

- p=

- n=
- x=
- Claim:
- Opposite:
- H_0:
- H_1:
- P-value=
- Formal Conclusion:
- Conclusion:

March Madness

In 2010, GA Tech computer science professors correctly predicted the outcomes of 51 of 64 games. Use this data to test the claim that these professors do a better job of predicting basketball games than guessing.

$51 - x$

$64 - n$

p = prop of BB-game they would predict correctly

Claim: $p > .5$

- p= prop. of games they predict correctly
- n= 64
- x= 51
- Claim: $p > .5$ H_1
- Opposite: $p \le .5$ H_0
- H_0: $p \le .5$
- H_1: $p > .5$ ← claim
- P-value= $1.01 \times 10^{-6} = 0.00000101$ $P < 0.05$
- Formal Conclusion: Reject H_0 / Support H_1
- Conclusion:

The sample evidence supports the claim

In a laboratory experiment, of 580 pea pods with green/yellow genes, 428 were green. Use this information to test Gregor Mendel's claim that **the proportion of pods of this type which are green is 0.75**.

- p=

- n=
- x=
- Claim:
- Opposite:
- H_0:
- H_1:
- P-value=
- Formal Conclusion:
- Conclusion: