Hypothesis Testing

Math 122

Rare Event Rule

Suppose that an assumption H_0 implies that the probability of a certain event is exceptionally small.

If we observe that event happening then either

1. H_0 is correct and we have observed a highly unlikely event, or
2. H_0 is not correct.

It is more likely that H_0 is false.

In any hypothesis test:

- We define two hypotheses H_0 and H_1 .
- We collect data relevant to the claim.
- We assume H_0 and use this assumption to calculate the probability of seeing data as extreme as our data. This probability is P.
- If P is small, the observations are inconsistent with H_0. We reject H_0 and support H_1.
- If P is large, the observations are consistent with H_0. We do not reject H_0 and do not support H_1.

P-value and formal conclusion

- If $\mathbf{P \leq \alpha}$ then H_0 is not consistent with the observations.
  - Reject H_0 and support H_1.

- If $\mathbf{P > \alpha}$ then H_0 is consistent with the observations.
  - Do not reject H_0 and do not support H_1.

n

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**.

x

p = prop. of pods which are green

Claim: $p = .75$

- p= prop. of pods which are green
- n= 580
- x= 428
- Claim: $p = .75$ H_0
- Opposite: $p \neq .75$ H_1
- H_0: $p = 0.75$ – Claim
- H_1: $p \neq 0.75$
- P-value= 0.502 1-prop Z Note P > 5%
- Formal Conclusion: Do Not Reject H_0 / Do not support H_1
- Conclusion: There is not enough evidence to reject the claim

There is no reason to think the proportion is anything other than 0.75

One Mean

T- test

Claims about Means

H_0	H_1
$\mu \leq a$	$\mu > a$
$\mu = a$	$\mu \neq a$
$\mu \geq a$	$\mu < a$

Super Models

- A random sample of super models had these heights (in inches)

66, 69, 69, 72, 72, 70, 71, 68

data

- Use this data to test the claim:

means

- **Super models have an average height which is different from the average adult female height of 63.6 in.**

α

- Use a 0.01 significance level.

- μ= avg. height of super models
- n=
- $\bar{x}$= from data
- S=
- Claim: $\mu \neq 63.6$ H_1
- Opposite: $\mu = 63.6$ H_0
- H_0: $\mu = 63.6$
- H_1: $\mu \neq 63.6$
- P-value= (From T-test) = 0.0001 Note $P < \alpha$
- Formal Conclusion: Reject H_0 / Support H_1
- Conclusion:

The sample evidence supports the claim.

Bon Air Elementary School has 1000 students. The principal of the school thinks that the average IQ of students at Bon Air is at least 110. To prove her point, she administers an IQ test to 20 randomly selected students. Among the sampled students, the average IQ is 108 with a standard deviation of 10. Use this data to test the claim that the average IQ of the Bon Air students is at least 110.

n $\bar{x}$ s

μ = avg. IQ for These Students

Claim: $\mu \geq 110$

- $\mu=$
- n= 20
- $\bar{x}=$ 108
- S= 10
- Claim: $\mu \geq 110$ H_0
- Opposite: $\mu < 110$ H_1
- H_0:
- H_1:
- P-value= 0.1911 $P > 5\%$
- Formal Conclusion: Do not reject H_0 / Do not support H_1
- Conclusion: Do not reject the claim

In the population of Americans who drink coffee, the average daily consumption is 3 cups per day. A university wants to know if their students tend to drink more coffee than the national average. They ask 50 students how many cups of coffee they drink each day and found $\bar{x}$=3.8 cups and s=1.5 cups. Use this data to test the claim that their students drink more than the national average?

μ = avg. # cups of coffee drunk by their students

Claim: $\mu > 3$

- μ= avg # cup...
- n= 50
- $\bar{x}$= 3.8
- S= 1.5
- Claim: $\mu > 3$ H_1
- Opposite: $\mu \leq 3$ H_0
- H_0: $\mu \leq 3$
- H_1: $\mu > 3$
- P-value= (T-test) = 2.19×10^{-4} = .000219 Note $P < 5\%$
- Formal Conclusion: Reject H_0 / Support H_1
- Conclusion:

Support claim