

# Math 243

Inv. 1.7 – Power

# Last time – the Binomial Test

Research question involves parameter  $\pi$  from a Binomial Process

$H_0$ :  $\pi =$  some number

$H_a$ :  $\pi \neq$  some number

Collect a binary variable from a sample of size  $n$

Verify that the data collection is modelled well by a binomial process

Compute a binomial p-value, either through simulating a coin toss or the exact formula for a Binomial probability, assuming  
 $\pi =$  some number

If p-value is large,  
there's no evidence against  $H_0$ .  
If p-value is small,  
there's evidence against  $H_0$ .

# Using a p-value to make a conclusion

A **p-value** is the probability of seeing a sample results at least as extreme as our sample result assuming that the null hypothesis  $H_0$  is true.

If we see a ***small*** p-value (say less than 0.05) then we conclude  ***$H_0$  must not be true.***

Could we be making a mistake?

# Consider a trial by jury

What do we assume about the defendant?

How do we decide whether to reject this assumption?

# Consider a trial by jury

What do we assume about the defendant?  $H_0$  : innocent

How do we decide whether to reject this assumption?

P-value = weight of evidence presented during the trial

Could the jury make a mistake?

# Consider a trial by jury

$H_0$  : innocent

P-value = weight of evidence presented during the trial

Could the jury make a mistake in their decision based on the p-value?

		Reality	
		Defendant is innocent	Defendant is guilty
Decision of the Jury	Defendant is guilty		
	Defendant is innocent		

# Consider a trial by jury

$H_0$  : innocent

P-value = weight of evidence presented during the trial

Could the jury make a mistake in their decision based on the p-value?

		Reality	
		Defendant is innocent	Defendant is guilty
Decision of the Jury	Defendant is guilty	wrong	Correct
	Defendant is innocent	Correct	wrong

# Consider a trial by jury as a test of significance

$H_0$  : innocent

P-value = weight of evidence presented during the trial

Could the jury make a mistake in their decision based on the p-value?

		Reality	
		$H_0$ : is true	$H_a$ : is true
Decision of the Jury	$H_a$ : is true	Type I Error	Correct
	$H_0$ : is true	Correct	Type II Error



# Inv. 1.7 – Improved Baseball Player

- A baseball player who has been a 0.250 hitter suddenly improves over one winter to the point where he is now a 0.333 hitter.
- In order to get a raise in his salary, he needs to convince his manager that he really has improved.

Let's set this up as a test of significance and that his manager will compute a p-value to determine if the player improved.

## Inv. 1.7: parts a, b,

Part a) Define the parameter of interest using appropriate notation

Part b) State the null and alternative hypotheses

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Part a) Define the parameter of interest using appropriate notation

*$\pi = \text{probability that the player gets a hit.}$*

Part b) State the null and alternative hypotheses using appropriate notation using the manager's perspective

$$H_0 : \pi = 0.250$$

$$H_a : \pi > 0.250$$