

Malaria Molecular Surveillance Study Design Workshop

Module 4: Power

		Conclusion about H_0	
		Fail to reject	Reject
Truth about H_0	True	True negative $1 - \alpha$	False positive α
	False		

α sets the **false positive rate** of a test. Using α we can control how often we incorrectly conclude that there is a real effect when there is none.

In power analysis, we also specify an **alternative hypothesis**

H_0 : The population prevalence equals p_0

H_1 : The population prevalence equals p , which is different from p_0

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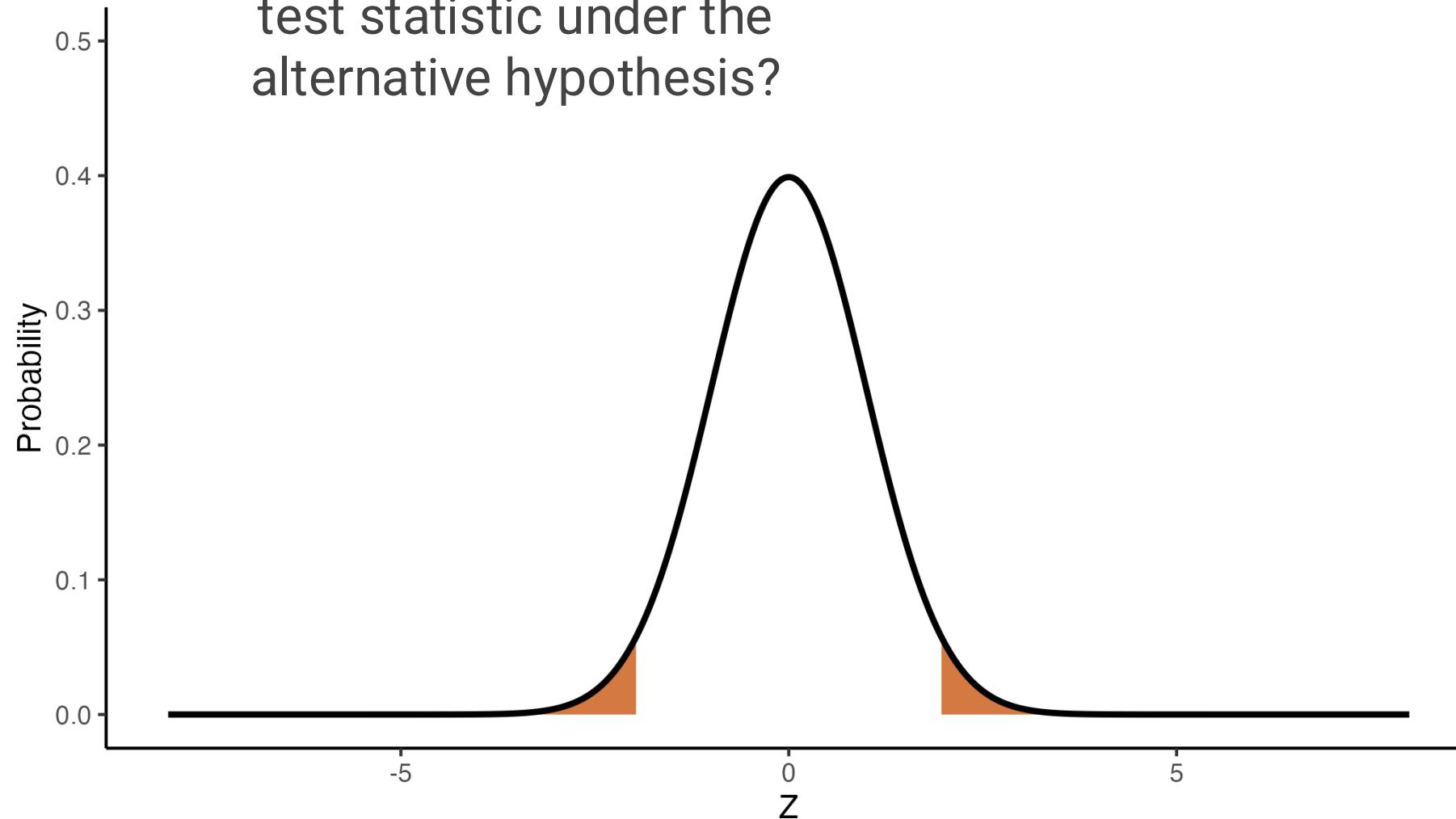
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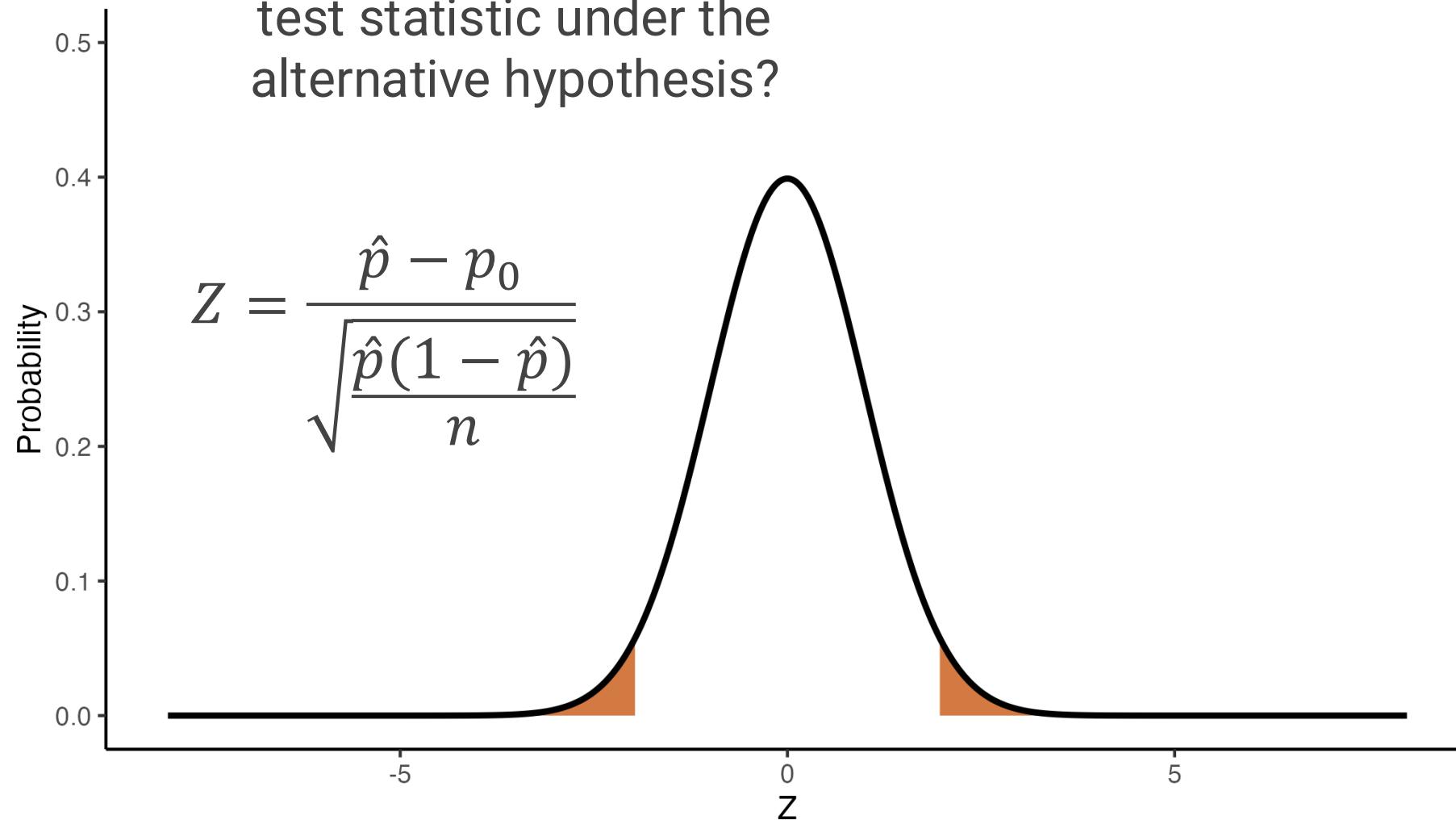
For example...

I want to test if the prevalence of *pfCRT* K76T mutations is significantly different from 10%. When powering this test, I assume the true prevalence of K76T mutations is 15%.

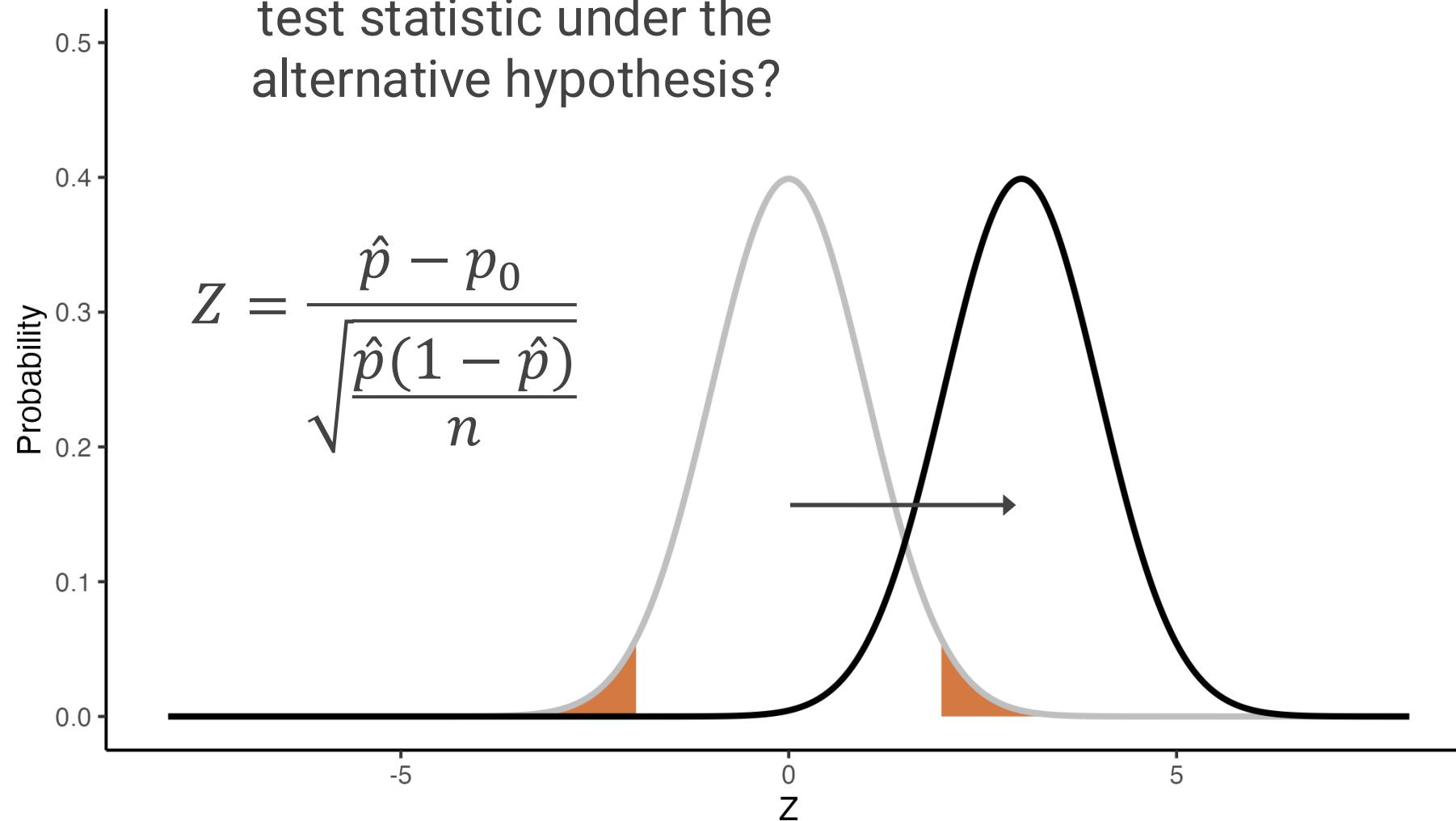
What is the distribution of my
test statistic under the
alternative hypothesis?

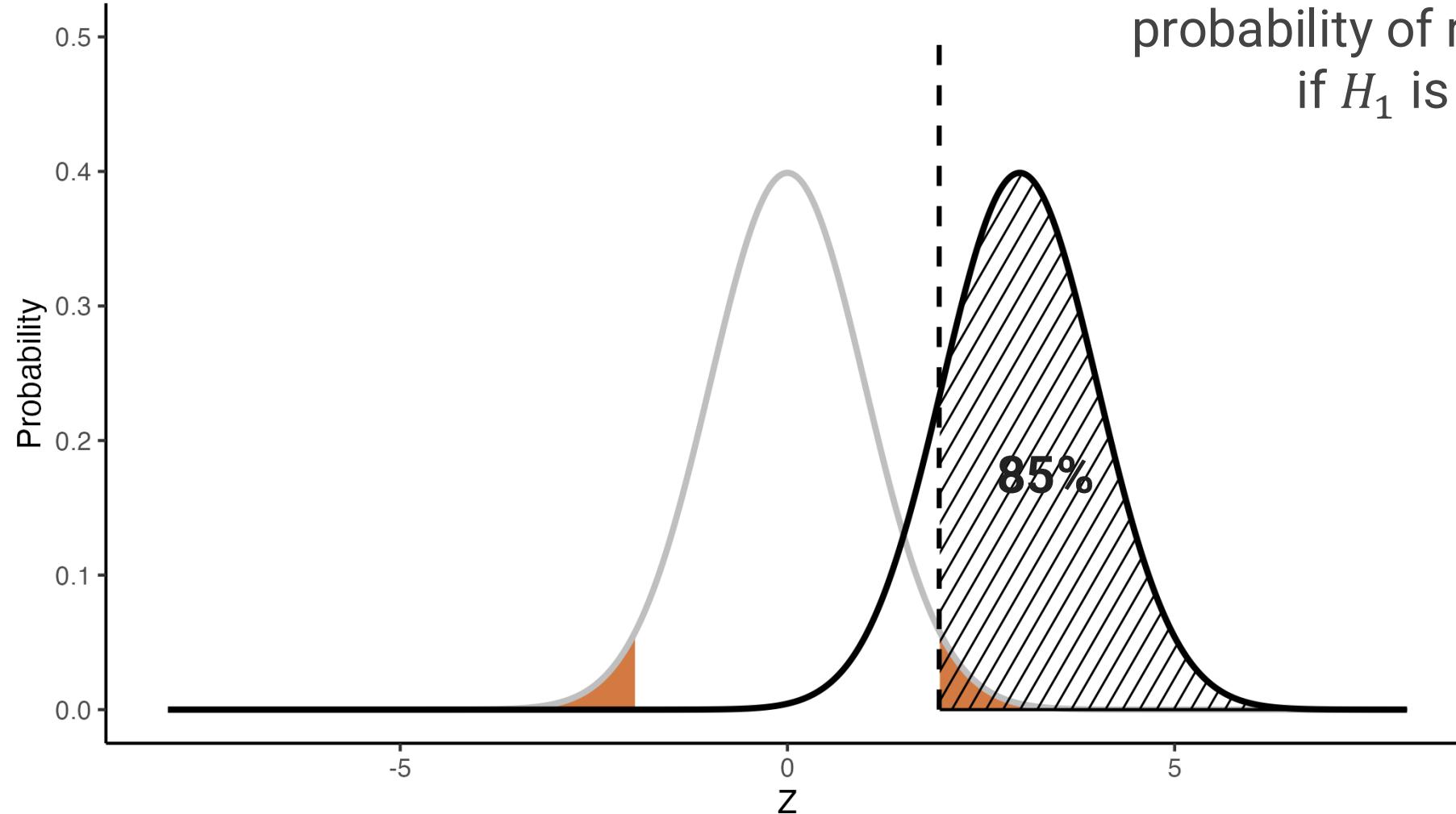


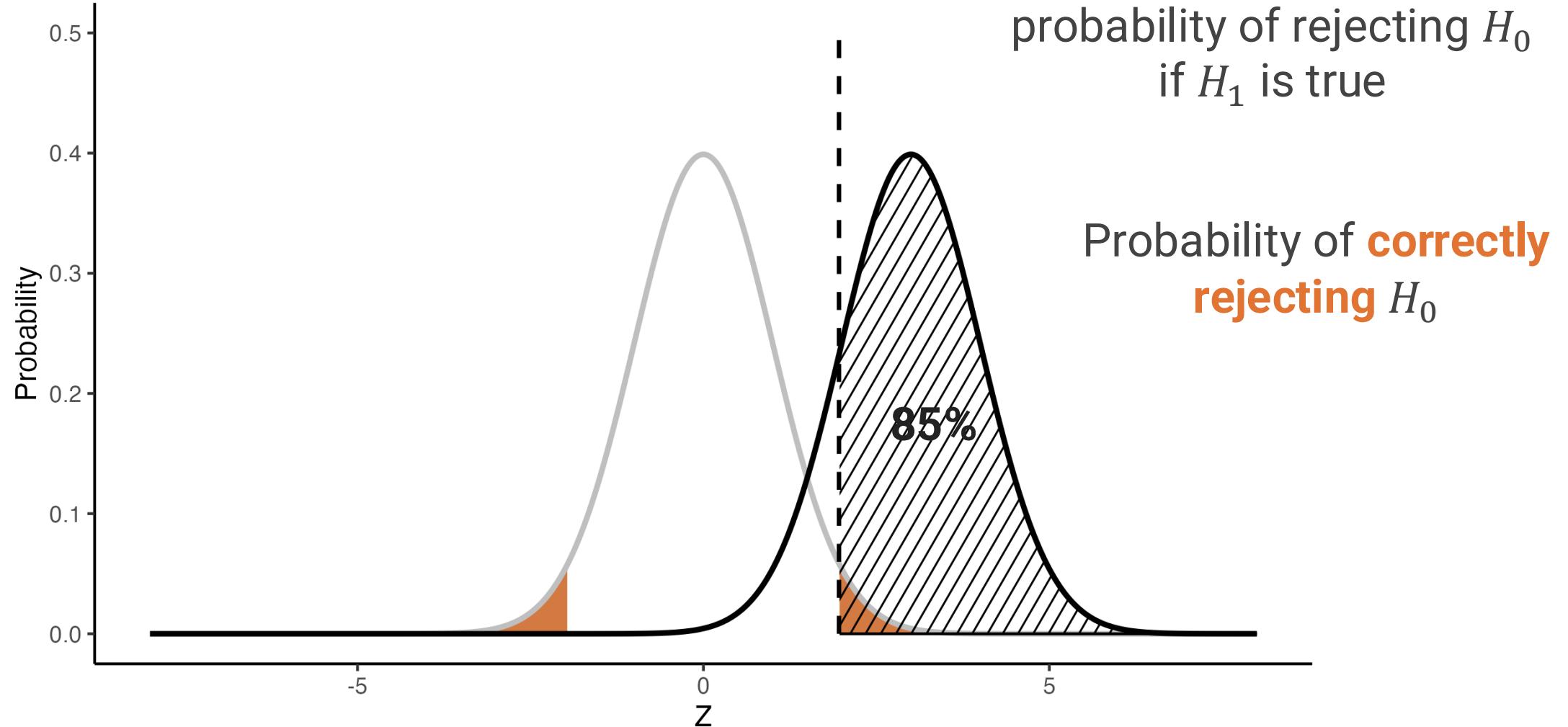
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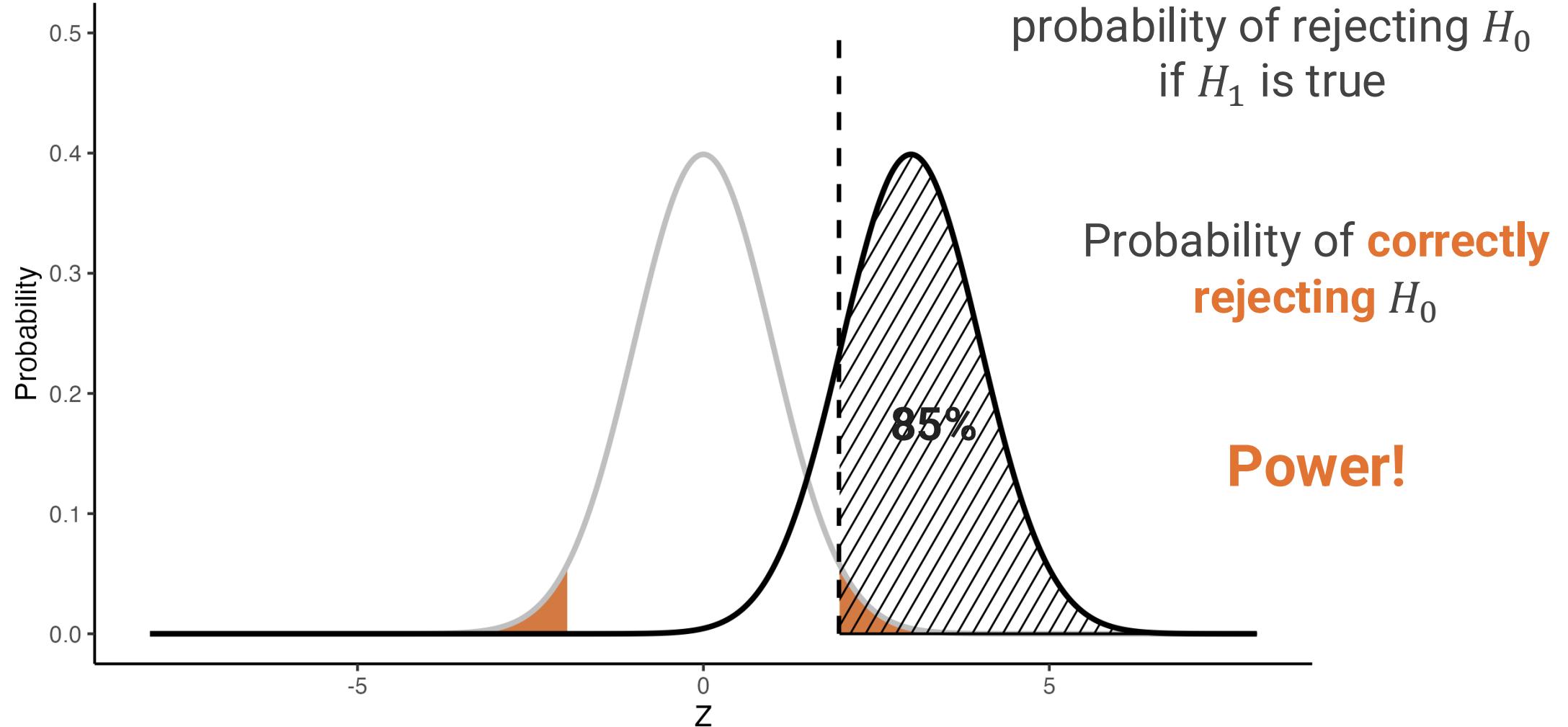


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	False	False negative	True positive

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Truth about H_0	True	True negative $1 - \alpha$	False positive α
	False	False negative $1 - \text{Power}$	True positive Power

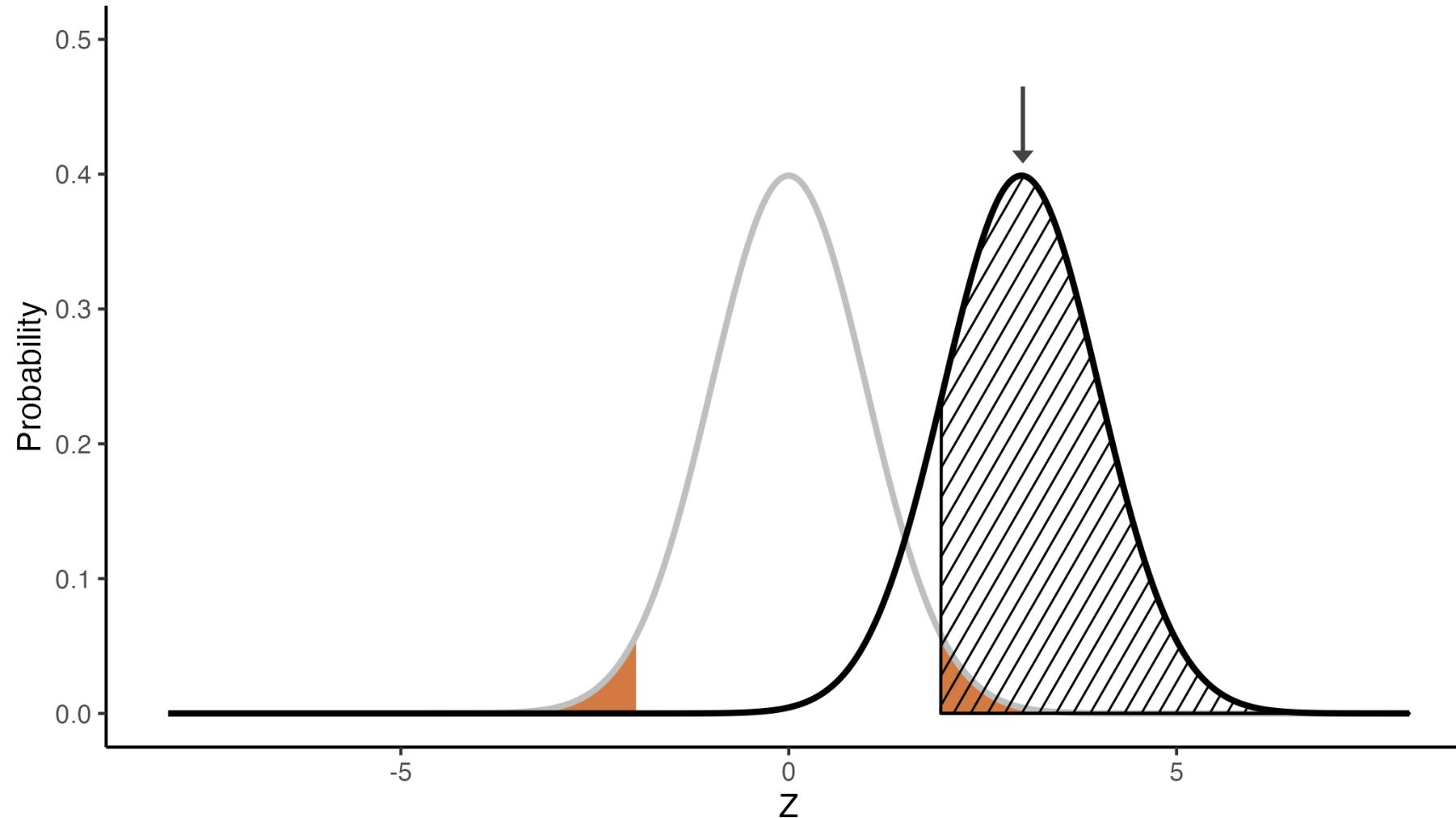
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Power is the probability of **correctly rejecting** the null hypothesis. It is the chance that we find something interesting, given that it is there.

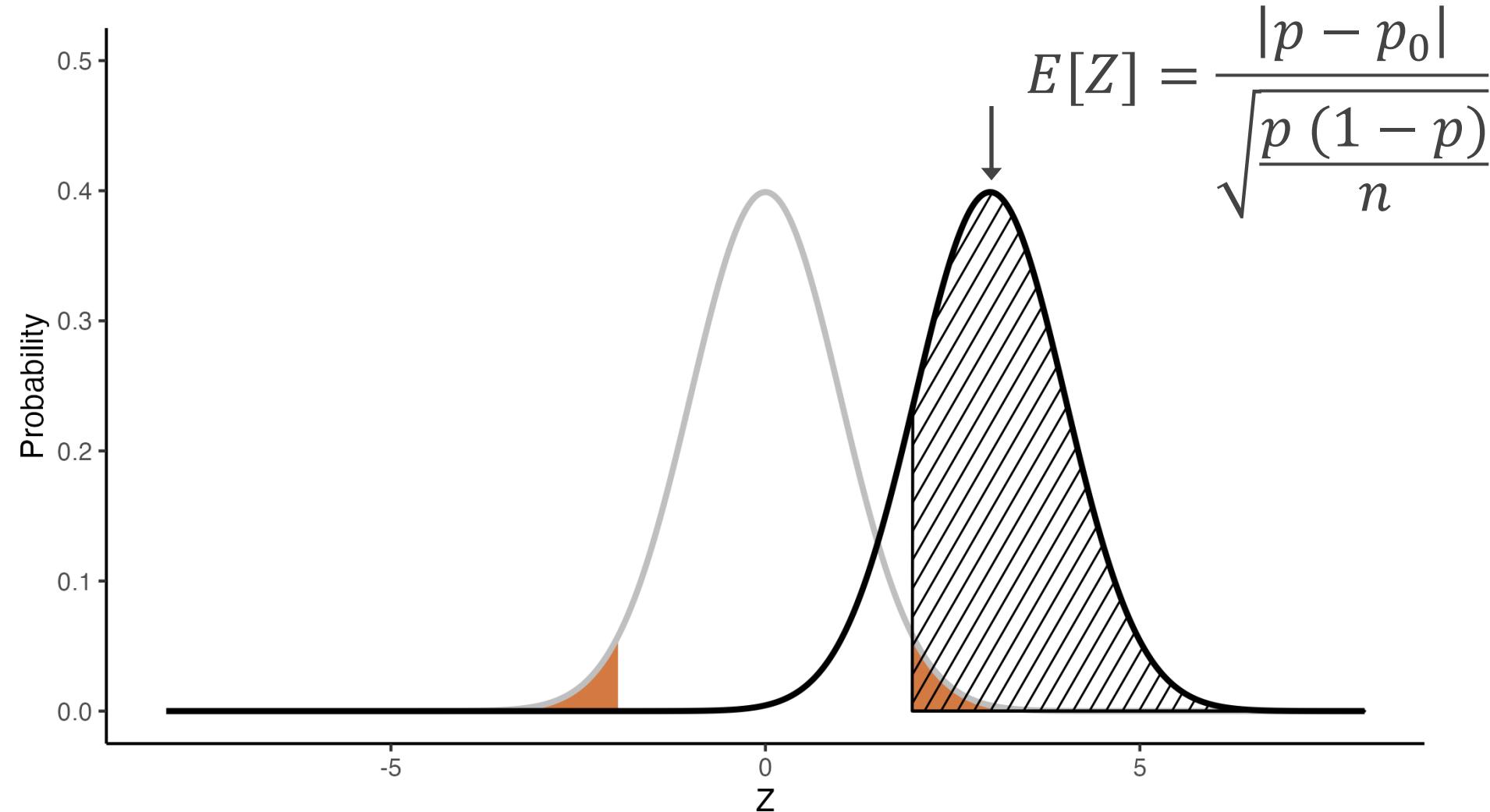
		Conclusion about H_0	
		Fail to reject	Reject
Truth about H_0	True	True negative $1 - \alpha$	False positive α
	False	False negative β	True positive $1 - \beta$

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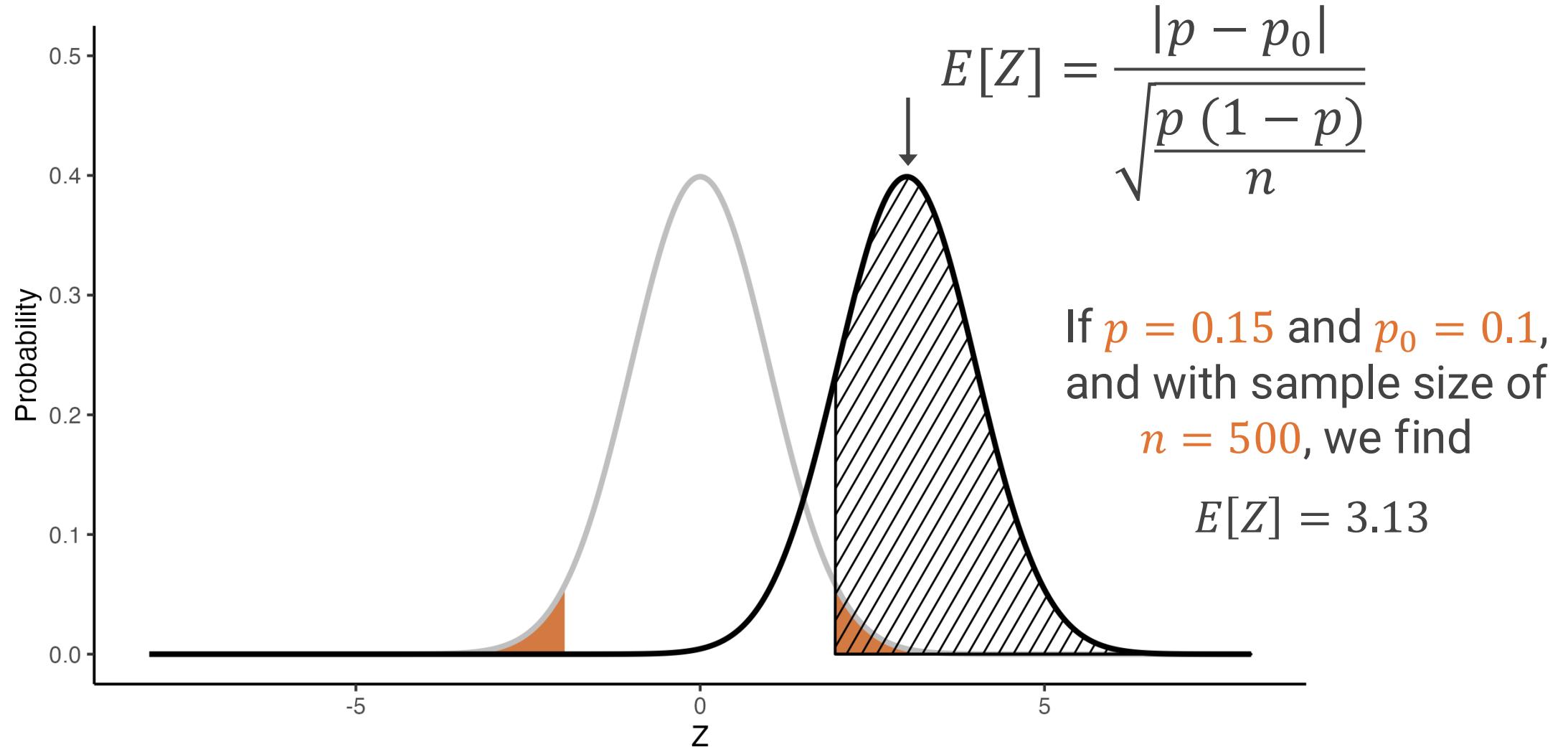
How do we calculate power?



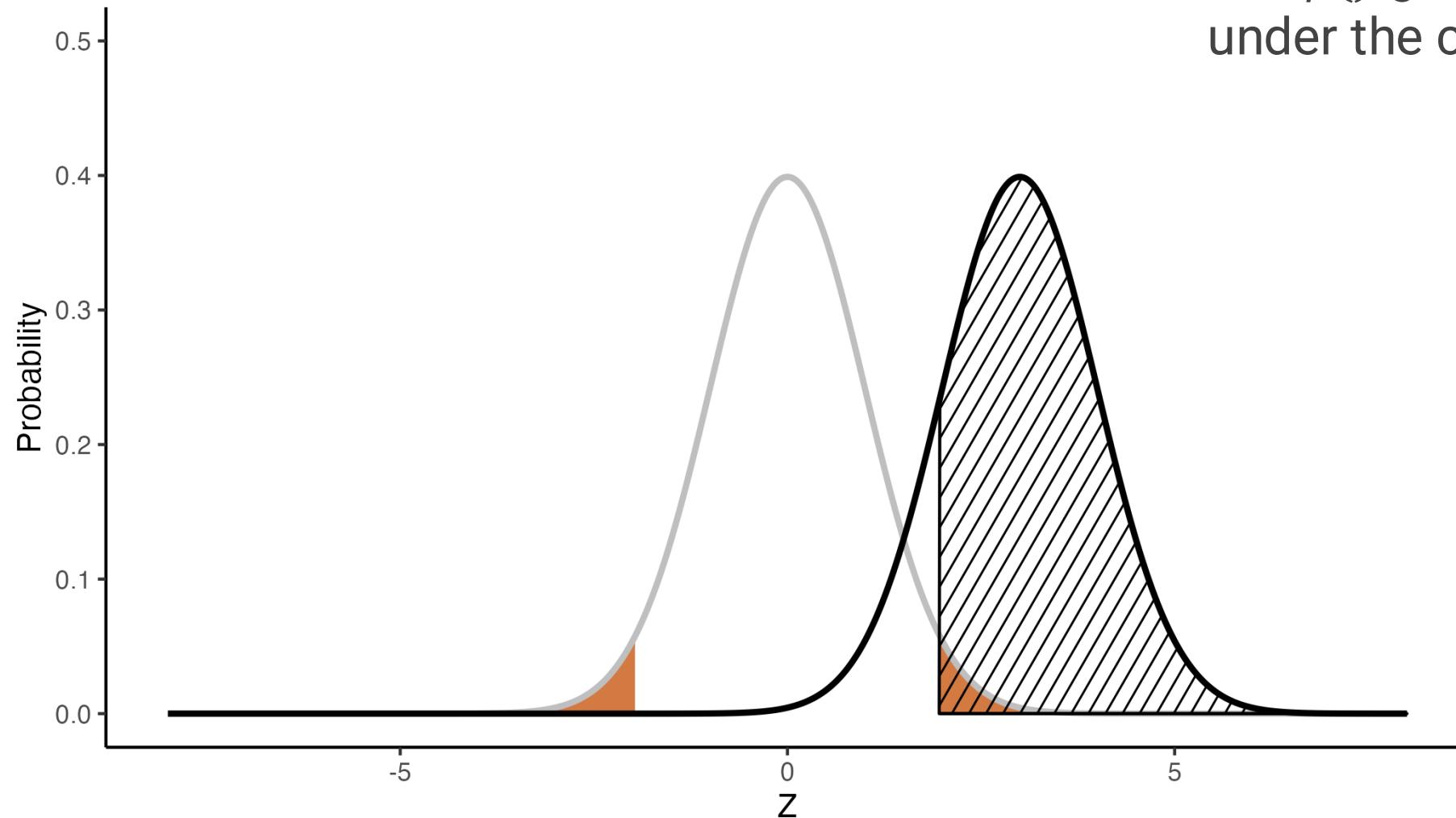
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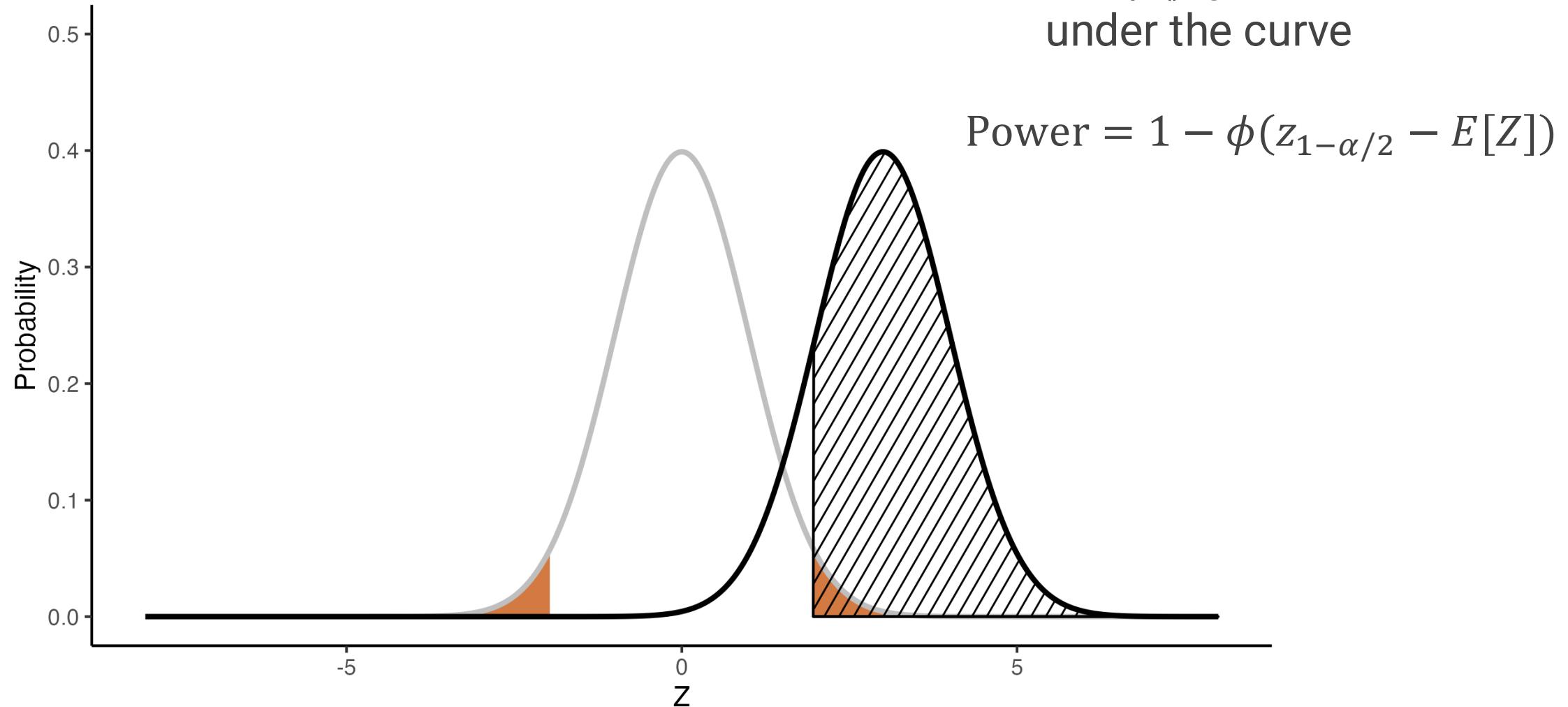
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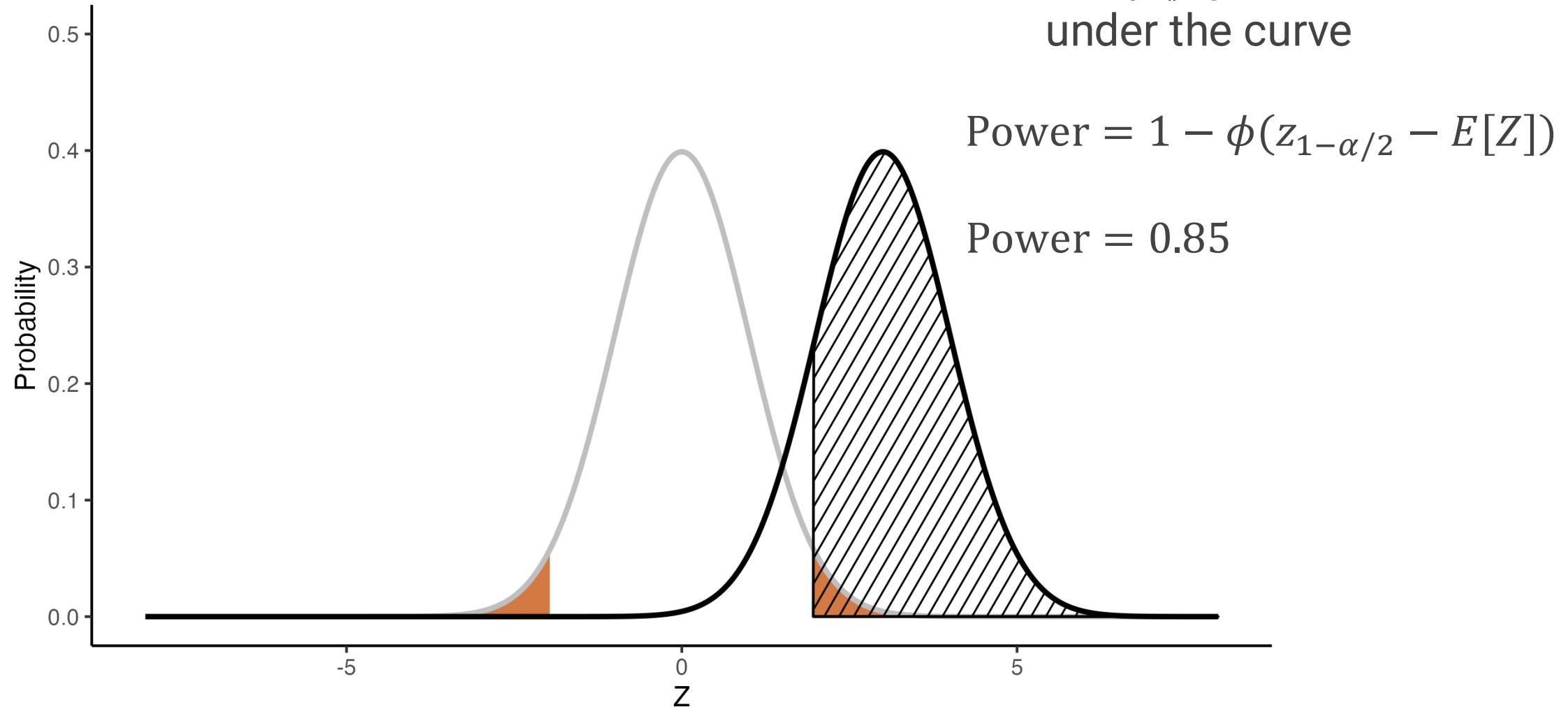
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How do we calculate power?



How do we calculate power?



Power as a function of sample size



$$\text{Power} = 1 - \phi(z_{1-\alpha/2} - E[Z])$$

Power as a function of sample size



$$\text{Power} = 1 - \phi \left(z_{1-\alpha/2} - \frac{|p - p_0|}{\sqrt{\frac{p(1-p)}{n}}} \right)$$

Power as a function of sample size

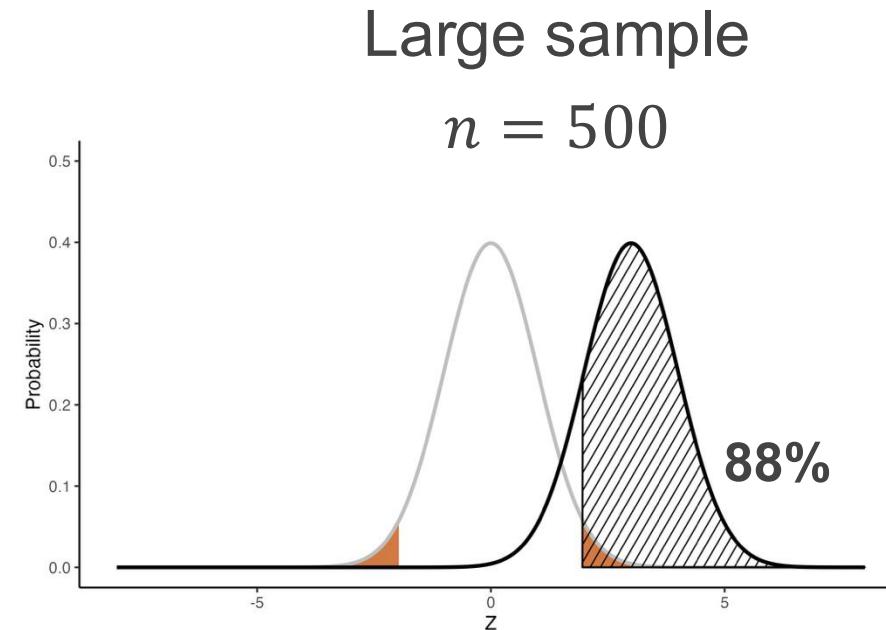
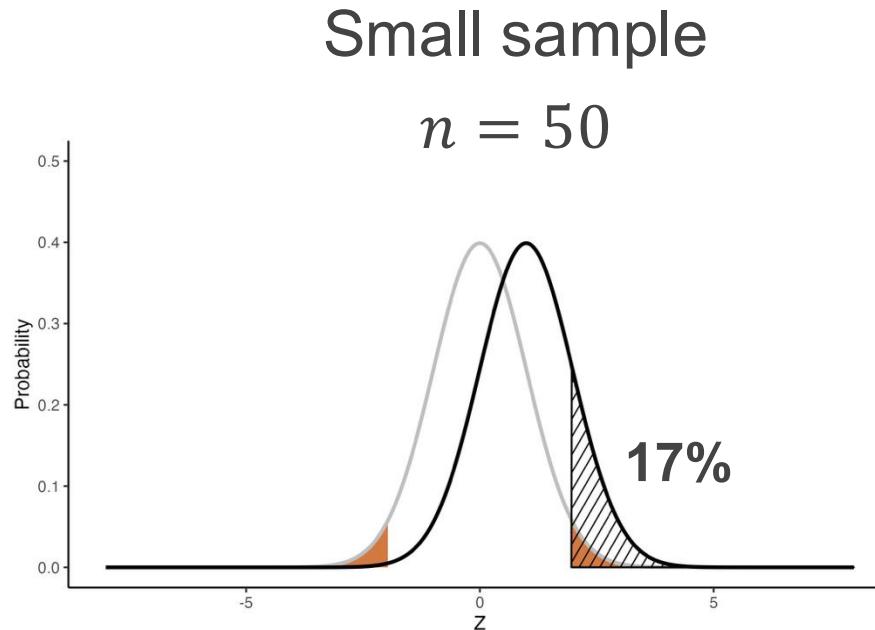
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Power varies as a function
of sample size

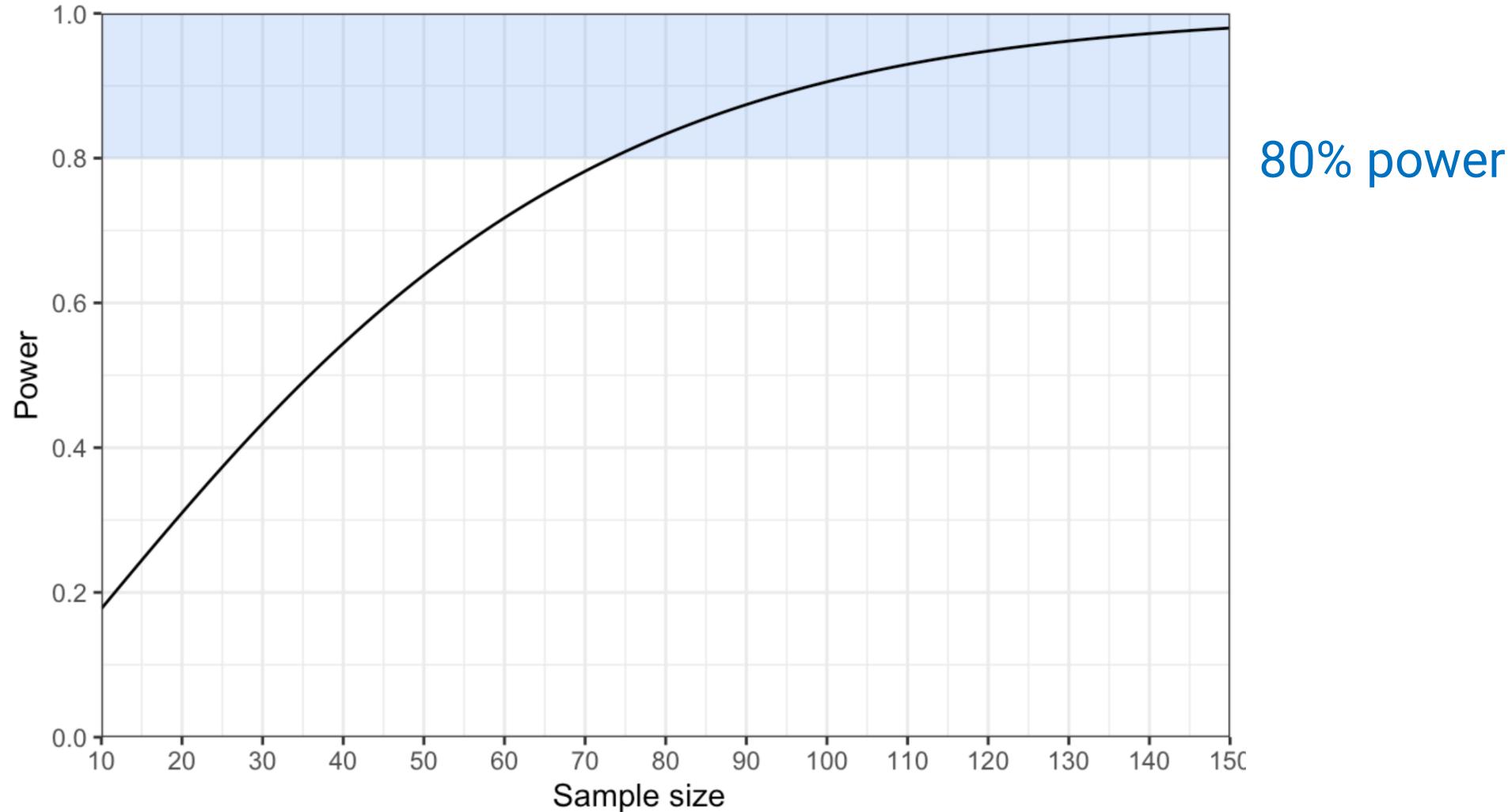
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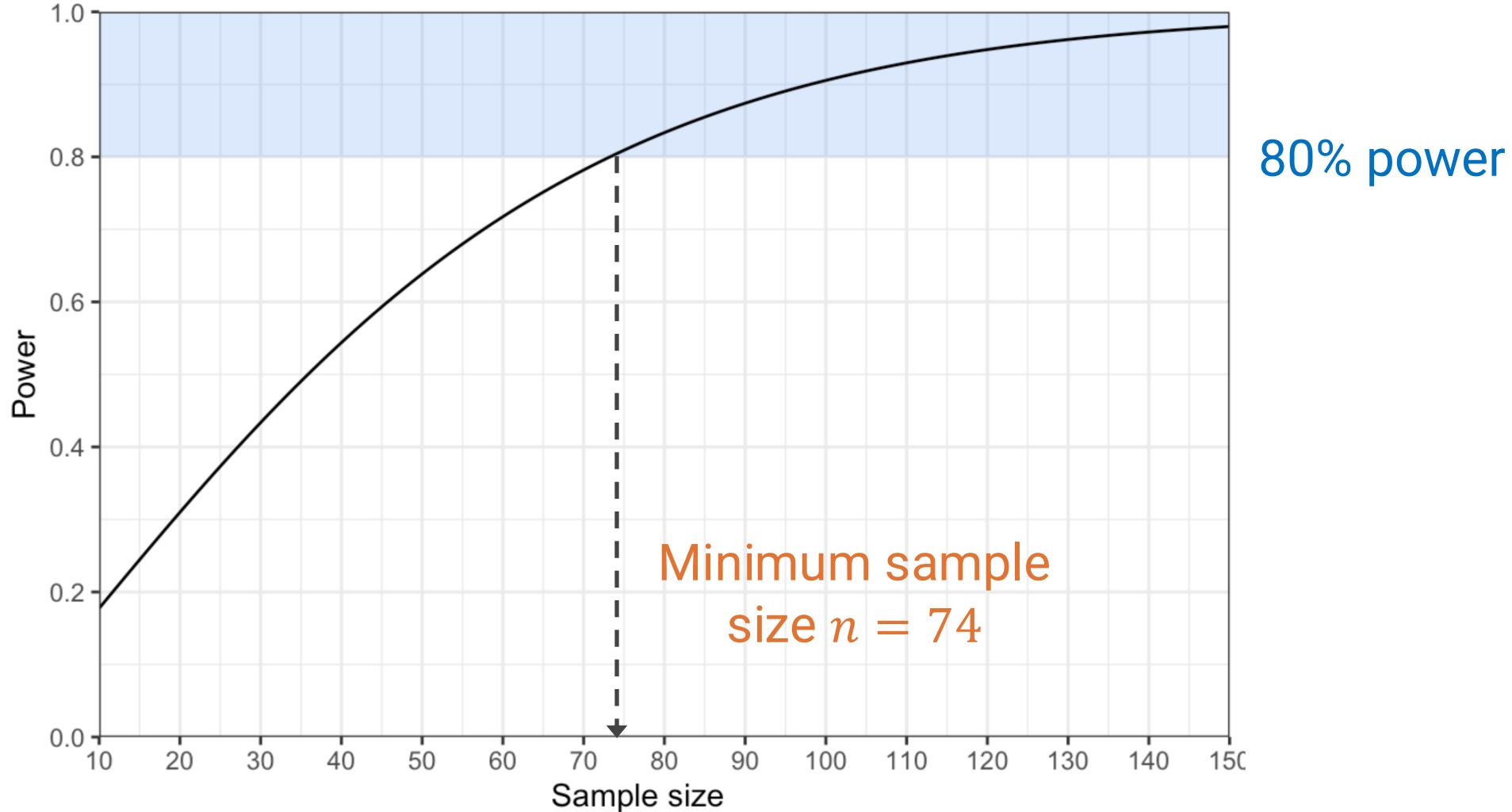
Power varies as a function
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Power curves



Power curves



$$\text{Power} = 1 - \phi \left(z_{1-\alpha/2} - \frac{|p - p_0|}{\sqrt{\frac{p(1-p)}{n}}} \right)$$

Can we reverse-engineer this to find the value of n that achieves a target power?

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Can we reverse-engineer this to find the value of n that achieves a target power?

$$n = \left(z_{1-\beta} + z_{1-\frac{\alpha}{2}} \right)^2 \frac{p(1-p)}{(p - p_0)^2}$$

For 80% power, we find $z_{1-\beta} = 0.84$

- **Power** is the true positive rate. It is the chance of **correctly rejecting the null hypothesis**.
- Power increases with **sample size**. We can use power curves or sample size formulae to choose a value of n

Format: Interactive R code, accessed through the web

- Test for change in prevalence
- Using power curves and sample size tables
- Test for detection of rare *pfk13* variant



[Workshop materials](#)

https://mrc-ide.github.io/MMS-SD_workshop/