Biostatistics
Z -Test

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Using *P*-values for a *z*-Test

The **z-test for the mean** is a statistical test for a population mean. The z-test can be used when the population is normal and σ is known, or for any population when the sample size n is at least 30.

The **test statistic** is the sample mean $\bar{x}$ and the **standardized test statistic** is z.

$$z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}} \qquad \frac{\sigma}{\sqrt{n}} = \text{standard error} = \sigma_{\bar{x}}$$

When $n \geq 30$, the sample standard deviation s can be substituted for σ.

Using P-values for a z-Test

Using P-values for a z-Test for a Mean μ

In Words	*In Symbols*
1. State the claim mathematically and verbally. Identify the null and alternative hypotheses.	State H_0 and H_a.
2. Specify the level of significance.	Identify α.
3. Determine the standardized test statistic.	$z = \dfrac{\bar{x} - \mu}{\sigma / \sqrt{n}}$
4. Find the area that corresponds to z.	

Continued.

Using P-values for a z-Test

Using P-values for a z-Test for a Mean μ

In Words	*In Symbols*
5. Find the P-value. a. For a left-tailed test, $P =$ (Area in left tail). b. For a right-tailed test, $P =$ (Area in right tail). c. For a two-tailed test, $P = 2$(Area in tail of test statistic).	
6. Make a decision to reject or fail to reject the null hypothesis. 7. Interpret the decision in the context of the original claim.	Reject H_0 if P-value is less than or equal to α. Otherwise, fail to reject H_0.

Hypothesis Testing with *P*-values

Example:

A manufacturer claims that its rechargeable batteries are good for an average of more than 1,000 charges. A random sample of 100 batteries has a mean life of 1002 charges and a standard deviation of 14. Is there enough evidence to support this claim at $\alpha = 0.01$?

H_0: $\mu \leq 1000$

H_a: $\mu > 1000$ (Claim)

The level of significance is $\alpha = 0.01$.

The standardized test statistic is

$$z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}} = \frac{1002 - 1000}{14 / \sqrt{100}}$$

$$\approx 1.43$$

Continued.

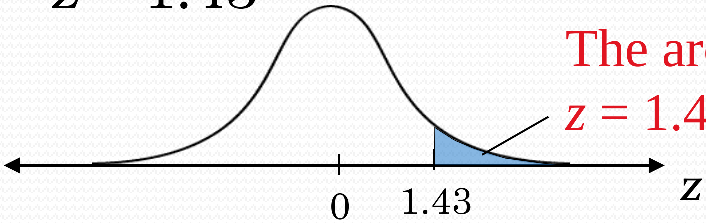
Hypothesis Testing with *P*-values

Example continued:

A manufacturer claims that its rechargeable batteries are good for an average of more than 1,000 charges. A random sample of 100 batteries has a mean life of 1002 charges and a standard deviation of 14. Is there enough evidence to support this claim at $\alpha = 0.01$?

H_0: $\mu \le 1000$ H$_a$: $\mu > 1000$ (Claim)

$z = 1.43$



The area to the right of $z = 1.43$ is $P = 0.0764$.

P-value is greater than $\alpha = 0.01$, fail to reject H_0.

At the 1% level of significance, there is not enough evidence to support the claim that the rechargeable battery has an average life of at least 1000 charges.