

TOPIC: HYPOTHESIS TESTS FOR MEAN

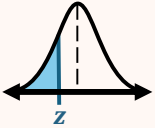
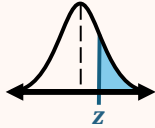

Standard Deviation (σ) Known

◆ Recall: To run a hypothesis test 1) Write Hypotheses, 2) Calc. Test Statistic, 3) Find P -Value, & 4) State Conclusion.

► In Step 2, when σ is **known**, we use the ___ test statistic.

EXAMPLE

A lighting company advertises their LED bulbs to last on average 25,000 hr. Past data shows the bulbs' lifespans have a normal dist. with $\sigma = 1,200$ hr. A separate agency suspects the lifespan is actually lower. From a random sample of 36 bulbs, they find $\bar{x} = 24,600$ hr. Use $\alpha = 0.10$ to test the claim that the true mean lifespan is 25,000 hr.

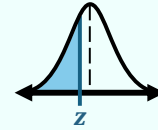
New		Hypothesis Tests for Mean (σ Known)	
1) Hyp	$H_0: \mu = \underline{\hspace{2cm}}$	$H_a: \mu [< > \neq] \underline{\hspace{2cm}}$	
2) Test Stat	σ Known $z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$	σ Unknown $t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$	$\bar{x} = \underline{\hspace{1cm}} \quad \sigma = \underline{\hspace{1cm}} \quad n = \underline{\hspace{1cm}}$ $z = \underline{\hspace{1cm}}$
3) P -Value	Area "beyond" z		$P\text{-Value} = \underline{\hspace{2cm}}$
	If $H_a: \mu <$ 	If $H_a: \mu >$ 	If $H_a: \mu \neq$ 
4) Conclusion	Because P -value [< >] α , we [REJECT FAIL TO REJECT] H_0 . There is [ENOUGH NOT ENOUGH] evidence to suggest...		
Criteria	Random Samples? <input type="checkbox"/> X is Normal OR $n > 30$ <input type="checkbox"/>		

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EXAMPLE

Perform the hypothesis test using $\sigma = 6$, $n = 36$, and $\alpha = 0.10$. Test the claim that $\mu = 50$ using...

(A) Left-Tailed Test: $\bar{x} = 47$

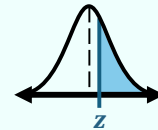


Recall

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

(σ Known)

(B) Right-Tailed Test: $\bar{x} = 51$



PRACTICE

Test the claim about the population mean μ at the given level of significance. Assume the population is normally distributed. Find the P -value and determine whether you should reject or fail to reject the null hypothesis.

Claim: $\mu \neq 1020$, $\alpha = 0.01$, $\sigma = 85$

Sample: $\bar{x} = 990$, $n = 40$

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EXAMPLE

A company has historically priced one of its best-selling products at \$48.00. A manager suspects that the average price of this product across retail outlets has changed. A random sample of 32 stores showed an average selling price of \$46.90. The population standard deviation is known to be \$3.50. At the $\alpha = 0.05$ significance level, test the claim that the average price is different from \$48.00.

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EXAMPLE

City officials claim that the average annual salary of all full-time workers in a particular city is \$51,000. A local labor expert believes that the average salary has increased since then. A random sample of 18 full-time workers is taken and the results are shown below. The population is approximately normal with a known standard deviation of \$4,500. Test this claim using a significance level of $\alpha = 0.05$.

48,000	52,100	50,500	53,000	54,200	51,300	55,000	52,700	50,900
51,800	53,100	49,500	52,300	51,100	50,700	53,200	54,000	52,400

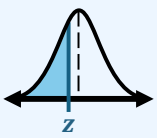
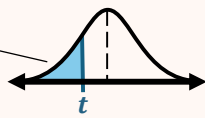
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Standard Deviation (σ) Unknown

◆ To run a hypothesis test when σ is **unknown**, use ___ instead of ___ & the **t distribution** instead of **normal**.

EXAMPLE

A tech company claims that the average battery life of their new smartphone model is 12 hr, but you suspect it might actually be less. Test this claim given a sample of 40 phones with mean battery life of 11.4 hr, standard deviation of 1.2 hr & significance level of 0.05.

Recall	σ Known	New	Hypothesis Tests for Mean (σ Unknown)
1) Hyp	$H_0: \mu = \#$ $H_a: \mu < > \neq \#$	$H_0: \mu = \underline{\hspace{2cm}}$	$H_a: \mu [< > \neq] \underline{\hspace{2cm}}$
2) Test Stat	$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$	$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$	$\bar{x} = \underline{\hspace{2cm}}$ $s = \underline{\hspace{2cm}}$ $n = \underline{\hspace{2cm}}$ $t = \underline{\hspace{2cm}}$
3) P-Value			$df = n - 1 = \underline{\hspace{2cm}}$ $P\text{-Value} = \underline{\hspace{2cm}}$
4) Conclusion	Because P-value...	Because P-value [< >] α , we [REJECT FAIL TO REJECT] H_0 . There is [ENOUGH NOT ENOUGH] evidence to suggest...	
Criteria	Random samples? <input type="checkbox"/> X is normal <input type="checkbox"/> OR $n > 30$? <input type="checkbox"/>	Random samples? <input type="checkbox"/> X is normal <input type="checkbox"/> OR $n > 30$? <input type="checkbox"/>	

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PRACTICE

Test the claim about the population mean μ at the given level of significance. Assume the population is normally distributed. Find the P -value and determine whether you should reject or fail to reject the null hypothesis.

Claim: $\mu > 52$, $\alpha = 0.10$

Sample: $\bar{x} = 53.1$, $s = 4.7$, $n = 20$

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EXAMPLE

A city government claims that the average monthly rent for a one-bedroom apartment in the downtown area is \$1,450. A housing advocacy group believes that figure may be outdated and has changed recently. They collect a random sample of 18 apartments finding a sample mean of \$1,525 and sample standard deviation of \$135. Test the claim using $\alpha = 0.05$.

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Performing Hypothesis Tests: Mean Using TI-84

◆ To perform a Hyp. Test for a pop. mean using a calculator, use the **1: Z-Test** or **2: T-Test** function.

EXAMPLE

Do a Left-Tail Hyp. Test for $\mu = 16.7$ with $\alpha = 0.05$ using...

(A) $\bar{x} = 15.27$, $\sigma = 5.72$, $n = 150$,

H_0 : _____ H_a : _____ P -value: _____

Because P -value [< | >] α , we [**REJECT** | **FAIL TO REJECT**] H_0 ,
there is [**ENOUGH** | **NOT ENOUGH**] evidence to suggest...

(B)

Sample Data							
12.1	12.4	13.2	12.4	15.6	12.98	19.9	20.11
13.1	14.5	25.3	13.85	19.1	22.68	16.7	24.59

H_0 : _____ H_a : _____ P -value: _____

Because P -value [< | >] α , we [**REJECT** | **FAIL TO REJECT**] H_0 ,
there is [**ENOUGH** | **NOT ENOUGH**] evidence to suggest...



HOW TO: Hyp. Test for Mean On TI-84

1) If given data, enter in **L 1**

(**STAT**, **1: EDIT...**)

2) (**STAT**, **>**) **TESTS**

If given σ : **1: Z-Test**

If not given σ : **2: T-Test**

3) If given data: | If given \bar{x}_1, n_1, \dots :

DATA

STATS

μ_0 :

μ_0 :

σ : (*z-test only*)

σ OR **Sx1**:

List: L1

Freq: 1

\bar{x} :

n:

μ : $\neq \mu_0$ $< \mu_0$ $> \mu_0$

Calculate **Draw**

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PRACTICE

BeanZone Coffee is testing a new brand of espresso beans that the supplier claims will increase average customer satisfaction, which is currently 7.8 (out of 10). A sample of 35 stores using the new beans reports an average satisfaction score of 8.1 & standard deviation 0.5.

(A) Use $\alpha = 0.05$ to test if the true mean satisfaction score increased.

$$H_0: \underline{\hspace{2cm}} \quad H_a: \underline{\hspace{2cm}}$$

$$\bar{x} = \underline{\hspace{2cm}} \quad n = \underline{\hspace{2cm}} \quad s = \underline{\hspace{2cm}}$$

Because P -value = $\underline{\hspace{2cm}}$ [< | >] $\alpha = \underline{\hspace{2cm}}$,

we [**REJECT** | **FAIL TO REJECT**] H_0 , there is [**ENOUGH** | **NOT ENOUGH**] evidence to suggest...

(B) Should BeanZone switch espresso bean suppliers at all stores?

PRACTICE

A company manufactures precision metal bolts designed to have a diameter of 10.00mm. The quality control department periodically tests samples from the production line. A random sample of 12 bolts is measured, with the results shown below. Assume $\sigma = 0.04$.

Bolt Diameters					
9.96	10.05	10.02	9.98	10.08	10.01
10.03	9.94	10.00	10.07	9.99	10.04

(A) Use $\alpha = 0.05$ to test if the mean diameter is different from 10.00 mm.

$$H_0: \underline{\hspace{2cm}} \quad H_a: \underline{\hspace{2cm}}$$

Because P -value = $\underline{\hspace{2cm}}$ [< | >] $\alpha = \underline{\hspace{2cm}}$,

we [**REJECT** | **FAIL TO REJECT**] H_0 , there is [**ENOUGH** | **NOT ENOUGH**] evidence to suggest...

(B) Should management pause production to investigate?

HOW TO: Hyp. Test for Mean On TI-84

1) If given data, enter in **L1**
 (**STAT**, 1: **EDIT...**)

2) (**STAT**, > **TESTS**)
 If given σ : 1: **Z-Test**
 If not given σ : 2: **T-Test**

3) If given data: | If given \bar{x}_1, n_1, \dots :

DATA	STATS
μ_0 :	μ_0 :
σ : (z-test only)	σ OR Sx1 :
List : L1	\bar{x} :
Freq : 1	n:

μ : $\neq \mu_0$ < μ_0 > μ_0

Calculate Draw