Because learning changes everything.®

Chapter 10

One-Sample Tests of Hypothesis

اختبار فرضيات

$\mu = 200$

عينه

$\bar{x} = 205$

Learning Objectives

LO10-1 Explain the process of testing a hypothesis.

LO10-2 Apply the six-step procedure for testing a hypothesis.

LO10-3 Distinguish between a one-tailed and a two-tailed test of hypothesis.

LO10-4 Conduct a test of a hypothesis about a population mean.

LO10-5 Compute and interpret a p-value.

LO10-6 Use a t-statistic to test a hypothesis.

Introduction

- We continue to apply statistics and statistical inference to the research process.
- In the research process, we often start with a hypothetical statement.
- Then we define a population to sample, collect data on the variables of interest, and then conduct statistical analysis.
- This analysis performs statistical tests of the hypothesis using the sample data.
- The results of the analysis provide the evidence used to make inferences about the population.

What is Hypothesis Testing?

فرضيه

معاملات المجتمع

Hypothesis A statement about a population parameter subject to verification. المراد اثباتها

- Select sample data.
- Use statistics to conduct the hypothesis test.
- Based on sample evidence, decide to reject or fail to reject the statement.

Hypothesis Testing A procedure based on sample evidence and probability theory to determine whether the hypothesis is a reasonable statement.

نختار عينه ونجري فحص (اختبار الفرضيه) ونستخدم الادله الناتجه.

هنا العينه نقرر → نرفض الفرضيه

→ نفشل في رفض الفرضيه

Six-Step Procedure for Testing a Hypothesis [1]

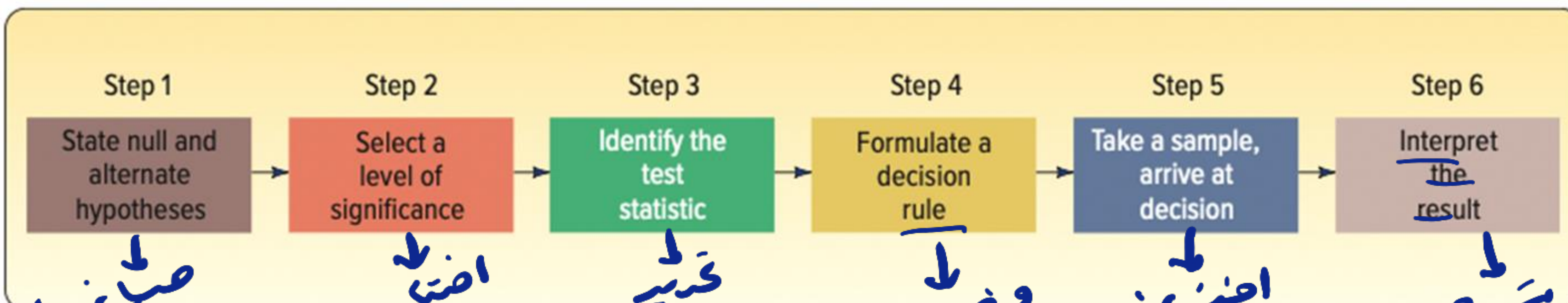
- Procedure that systematizes hypothesis testing.
- At step 6, interpret the results based on the decision to reject or no reject the hypothesis.

شرح معتمد على القرار

- No proof something is true.

اختبار الفرضيات اثبات وجود شك

- But ”proof beyond a reasonable doubt” like a court.



صياغة الفرضية الصفرية والبديلة

اختيار مستوى المعنوية α

تحديد اختبار الاحصائي

وضع قاعدة القرار

اخذ عينة للوصول الى القرار

شرح النتائج

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Six-Step Procedure for Testing a Hypothesis [2]

H_0 H_1

- Step 1: State the Null and Alternative hypothesis.

Null Hypothesis A statement about the value of a population parameter developed for the purpose of testing numerical evidence. افادة حول معاملات المجتمع من اجل الفحص والحصول على نتيجة رقمية

- Denoted H_0.
- The subscript of 0 denotes no change.
- If sample data provide convincing evidence it is false, then the null hypothesis is rejected.
- Otherwise reject the null hypothesis.

اذا العينة اعطت ادلة على كافية ليتم رفض هذه الفرضية

Six-Step Procedure for Testing a Hypothesis 3

- Step 1: State the Null and Alternative hypothesis.

H_1

Alternate Hypothesis A statement that is accepted if the sample data provide sufficient evidence that the null hypothesis is false.

فرضية يتم قبولها اذا قدمت العينة ادلة ان الفرضية الصفرية خاطئة

- Denoted H_1.

اسم آخر

- Research hypothesis.
- If the null hypothesis is rejected, we conclude the alternative is supported by the sample data.
- The = sign will not appear in the alternative.

الفرضية البديلة لا تحتوي علامة المساواة

Six-Step Procedure for Testing a Hypothesis 4

مستوى المعنوية

- Step 2: Select a Level of Significance.

Level of Significance The probability of rejecting the null hypothesis when it is true. احتمالية رفض الفرضية الصفرية وهي صحيحة

- Due to sampling, there is a risk the sample indicates the null is false when it is true.
- α denotes the probability of this error.
- Determine this error before proceeding.
- Traditionally, use 0.01, 0.05 and 0.10.

$\alpha = 0.01$

Six-Step Procedure for Testing a Hypothesis 5

- Step 3: Select the Test Statistic.

اختبار الاحصائيه

Test Statistic A value, determined from sample information, used to determine whether to reject the null hypothesis.

بستخدم قانون z عندما تكون σ معروف

- When testing a mean when σ is known: $z = \dfrac{\bar{x} - \mu}{\sigma / \sqrt{n}}$.
- Used because of the central limit theorem.
- The number of standard errors that separate the sample and population values.
- Determine probabilities the sample mean is within a specified number of standard errors.

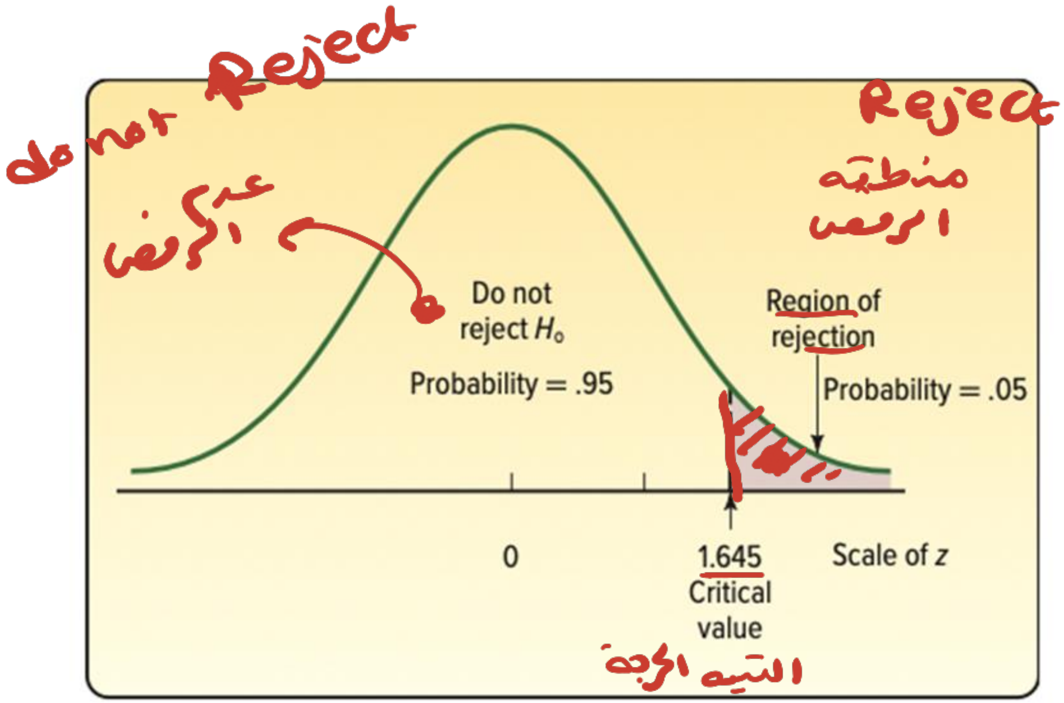
Six-Step Procedure for Testing a Hypothesis [6]

صياغة قاعدة القرار

- Step 4: Formulate the Decision Rule.

القيمة الحرجة

Critical Value The dividing point between the region where the null hypothesis is rejected and the region where it is not rejected.



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Six-Step Procedure for Testing a Hypothesis [7]

اتخاذ القرار

Step 5: Make a Decision.

Compute the value of the test statistic. Z محسوبة

Compare it to the critical value. Z جدولية

Make a decision.

الرفض

- Reject: Improbable the test statistic is large due to sampling error. Z المحسوبة كبيرة بالنسبة لخطأ العينة

نفشل في الرفض

- Fail to Reject H_0: A small test statistic attributed to sampling error.

تكون Z محسوبة صغيرة مقارنة مع الخطأ

It is possible to make one of two errors.

Six-Step Procedure for Testing a Hypothesis 8

انواع الخطأ

- Step 5: Make a Decision.

Type one Error Rejecting the null hypothesis, H_0, when it is true.

Type two Error Not rejecting the null hypothesis when it is false.

احتمالية رفض الفرضية الصفرية وهي صحيحة

- α: Probability of making a Type one error.
- β: Probability of making a Type two error.

احتمالية عدم رفض الفرضية الصفرية وهي خاطئة

Six-Step Procedure for Testing a Hypothesis [9]

عدم رفض

- Step 5: Make a Decision.

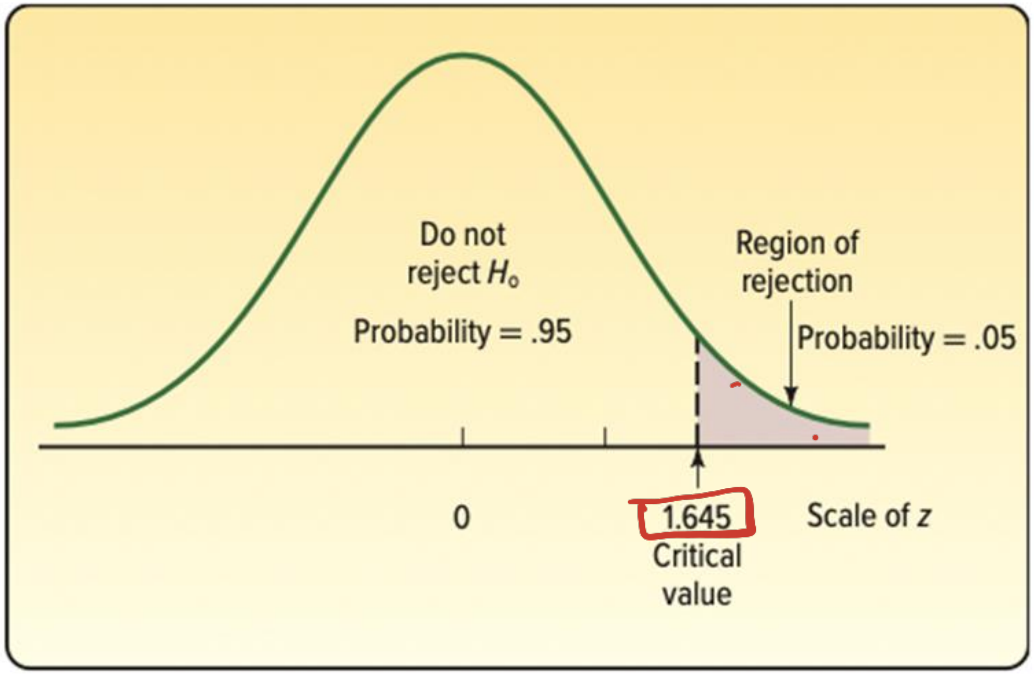
Null Hypothesis	Researcher DoesNot Reject H_0	Researcher Rejects H_0
H_0 is true	Correct decision	Type I error
H_0 is false	Type II error	Correct decision

رفض

- Step 6: Interpret the Result. شرح النتائج
- What can we say or report based on the results of the statistical test?

One-Tailed and Two-Tailed Hypothesis Tests [1]

اذا حسبت
z وكانت
اكبر من z
جدول
(critical)
ترفض الفرضية
الصفرية



One Tailed
test
Right

درجات الطلاب في
جميع مدارس المملكة
$\mu = 75$
يدعي مدرس ان
درجات الطلاب اكبر
من ذلك

$H_0: \mu \leq 75$
$H_1: \mu > 75$

- This is an example of a one-tailed test.
- The rejection region is only in one tail (right).
- Corresponds to > in the alternative.

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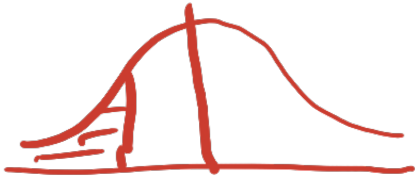
One-Tailed and Two-Tailed Hypothesis Tests [2]

- The rejection region is only in the left tail.
- Corresponds to < in the alternative.



left tailed test

درجات الطلاب في جميع مدارس المملكة

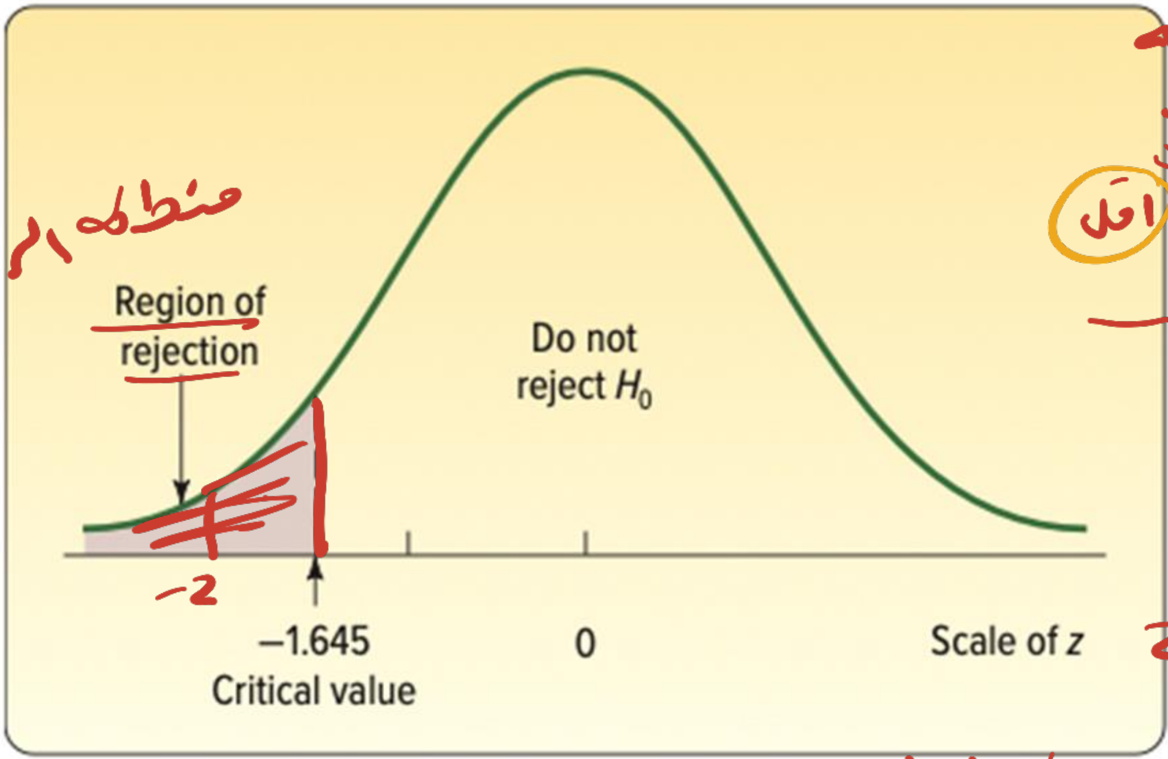
$\mu = 75$

يدعي مدرس ان درجات الطلاب اقل من ذلك

$H_0 : \mu \geq 75$

$H_1 : \mu < 75$

اذا كانت Z محسوبة اقل من critical value ترفض الفرضية الصفرية



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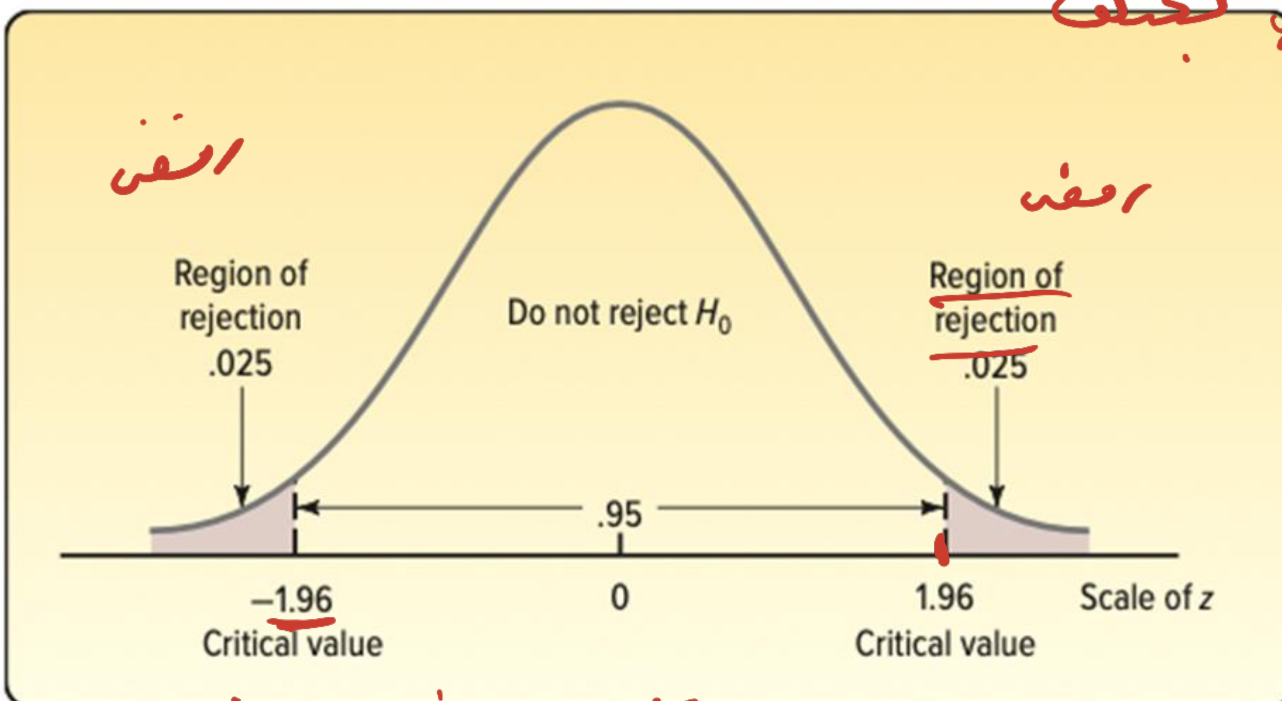
One-Tailed and Two-Tailed Hypothesis Tests [3]

اختبار من الطرفين

- Two-tailed test: The rejection region is both tails.
- Corresponds to ≠ in the alternative.

درجات الطلاب في
جميع مدارس المملكة
$\mu = 75$
يدعي مدرس ان
درجات الطلاب تختلف
عن ذلك



من (-1.96 − 1.96) تقبل الفرضية الصفرية
اقل من -1.96 او اكبر من 1.96 ترفض الفرضية الصفرية

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Hypothesis Testing for a Population Mean: Known Population Standard Deviation 1

- Example 1: Jamestown Steel Company manufactures and assembles desks and other office equipment at several plants in New York State.
- At the Fredonia plant, the weekly production of the Model A325 desk follows a normal distribution with a mean of 200 and a standard deviation of 16.
- New production methods have been introduced and the vice president of manufacturing would like to investigate whether there has been a change in weekly production of the Model A325.

هل يوجد
اختلاف او لا

- Is the mean number of desks produced different from 200 at the .01 significance level?

Two tailed

تم اختيار عينة مقدارها 50 وكان المتوسط $\bar{x} = 203.5$

① صيغه الفرضيات

$H_0: \mu = 200$

$H_1: \mu \neq 200$

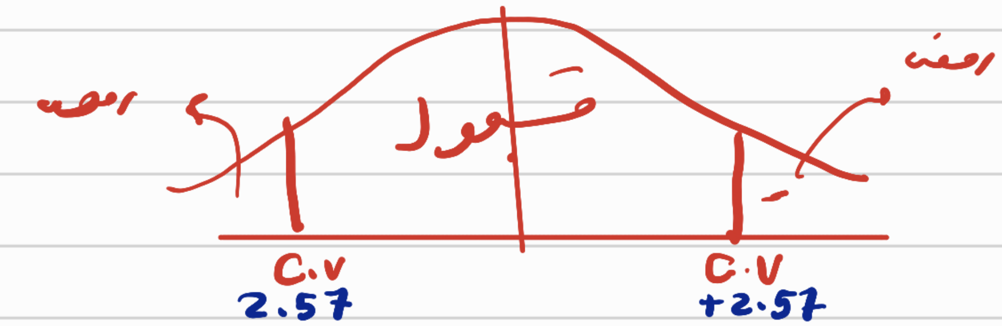
② تحديد قيمه α

$$\boxed{\alpha = 0.01}$$

③ حساب قيمه Z

$$Z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = \frac{203.5 - 200}{16 \div \sqrt{50}} = 1.547$$

④ صيغه قاعده القرار (حساب Critical value)



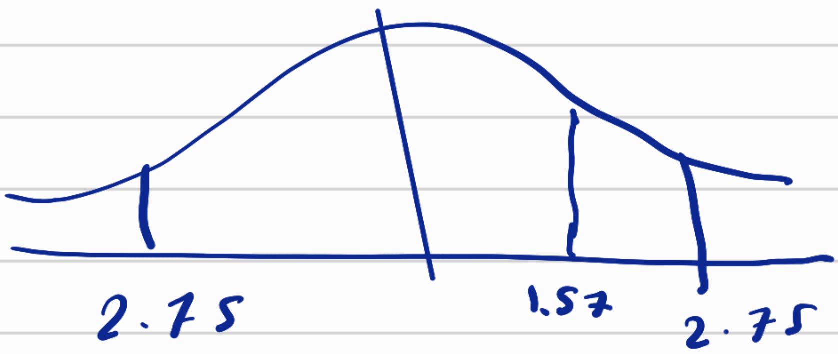
اذا عرفت α نستطيع تحديد C.V

α level	One-tailed (left)	One-tailed (right)	Two-tailed
	α= area of critical region, -z*	α= area of critical region, z*	α= area of critical region, -z*, z*
α = 0.05	z = -1.645	z = 1.645 او 1.65	z = ± 1.96
α = 0.01	z = -2.33	z = 2.33	z = ± 2.57
α = 0.001	z = -3.08	z = 3.08	z = ± 3.32
α = 0.1	-1.28	1.28	1.645

قاعدة القرار اذا وقعت Z المحسوبه في منطقة القبول $(-2.57 - 2.57)$ تقبل الفرضيه H_0

اذا كانت Z اكبر من 2.57
اقل من -2.57
لا نستطيع رفض الفرضيه الصفريه

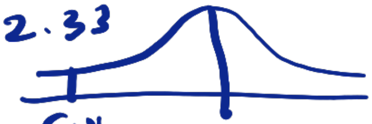
⑤ اتخاذ القرار



do not reject Ho

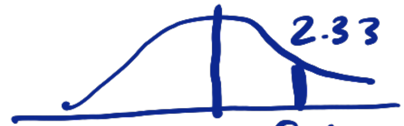
⑥ لا يوجد اختلافات في متوسط الانتاج
بين الطريقه الاصليه و الطريقه الجديده

-2.33



C.V

2.33



C.V

$\alpha = 0.01$

$= 0.5 - \alpha$

$= 0.5 - 0.01$

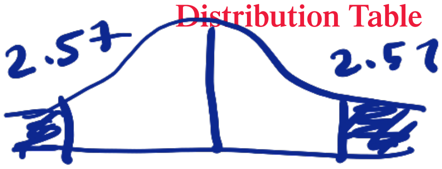
$= 0.49$

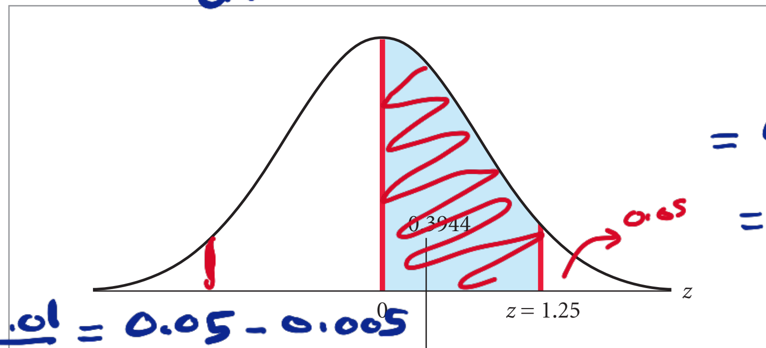
2.33

APPENDIX D

Standard Normal Distribution Table

2.57 2.57





$= 0.5 - \frac{\alpha}{2} = 0.5 - \frac{0.01}{2} = 0.05 - 0.005$

0.495

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

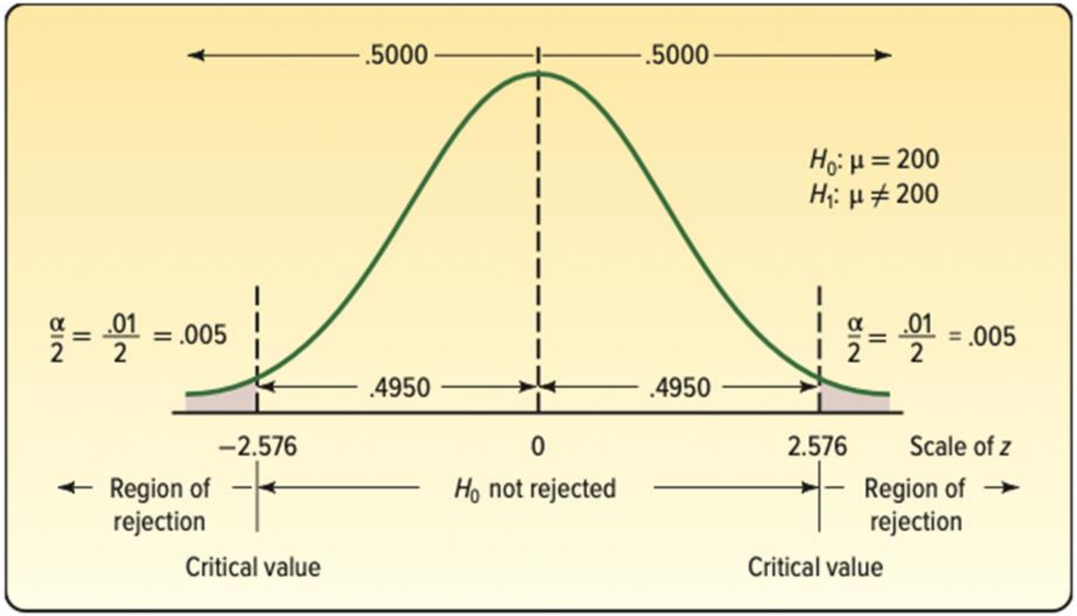
$0.5 - 0.05 = 0.45$

1.65

1.645 ≈

Hypothesis Testing for a Population Mean: Known Population Standard Deviation 2

- Example continued.
- Step 1: $H_0 : \mu = 200 \text{ vs } H_1 : \mu \neq 200.$
- Step 2: $\alpha = 0.01; \text{Step } 3 : z = \dfrac{\bar{x} - \mu}{\sigma / \sqrt{n}}.$
- Step 4:



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Hypothesis Testing for a Population Mean: Known Population Standard Deviation 3

Example continued.

Step 5: $z = \dfrac{\bar{x} - \mu}{\sigma / \sqrt{n}} = \dfrac{203.5 - 200}{16 / \sqrt{50}} = 1.547.$

- 1.547 is in between -2.576 and 2.5760.
- Do not reject H_0.

Step 6: We fail to reject the null hypothesis, so we did not show that the population mean has changed from 200 desks per week.

- The difference between the population mean of 200 per week and the sample mean of 203.5 could simply be due to chance.
- The sample information fails to indicate that the new production methods resulted in a change in the 200-desks-per-week production rate.

Hypothesis Testing for a Population Mean: Known Population Standard Deviation 4

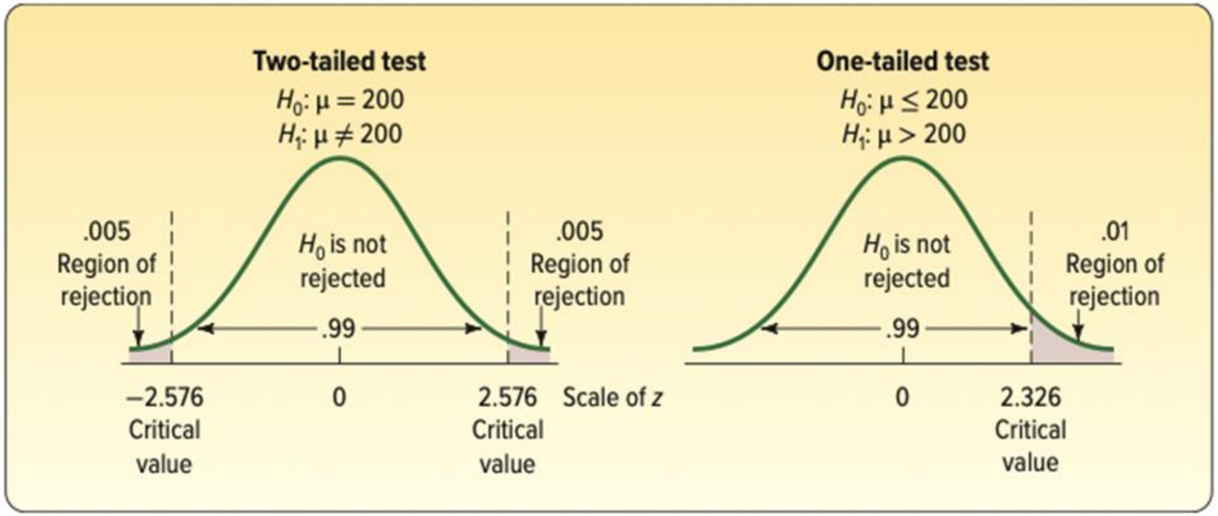
- In failing to reject the null hypothesis, did we prove that the assembly rate is still 200 per week?
- Absolutely not.
- We did NOT prove it was true.
- The result does not support any conclusion about the null hypothesis.
- The sample data simply do not support the alternate hypothesis.
- Could use a confidence interval approach.
- Example: If the interval captured 200, do not reject H_0.

Hypothesis Testing for a Population Mean: Known Population Standard Deviation 5

The previous example demonstrated a two-tailed test to determine if the mean differed from 200.

We could have tested to see if there was an increase.

- $H_0 : \mu \leq 200.$
- $H_1 : \mu > 200.$



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P اختبار الفرضيات

p-Value in Hypothesis Testing [1]

- The critical value approach provides a good description of the procedure. احتمالية ملاحظة العينات متطرفة او اكثر تطرفا من العينة

p-Value The probability of observing a sample value as extreme as, or more extreme than the value observed, given that the null hypothesis is true. احتمالية محددة بشرط ان تكون الفرضية الصفرية صحيحة

- p-value is less than α, reject H_0.
- p-value is greater than α, do not reject H_0.
- A p-value also gives additional insight about the strength of that decision.

خطوات استخدام اختبار P-valu

نكتب P-value

$P < \alpha$ نرفض Ho

$P > \alpha$ لانرفض Ho

p-Value in Hypothesis Testing 2

If the p-value is less than.

a) 0.10, some evidence *H sub* $_0$ is not true.

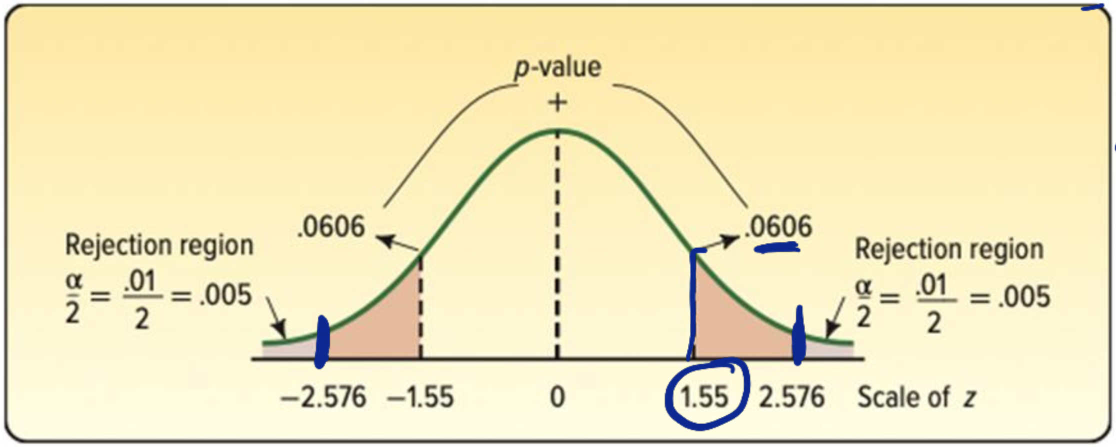
b) 0.05, strong evidence *H sub* $_0$ is not true.

c) 0.01, very strong evidence *H sub* $_0$ is not true.

d) 0.001, extremely strong evidence *H sub* $_0$ is not true.

Example: The p-value of 0.060 is greater than 0.01.

ادلة ضعيفة ان الفرضية الصفرية غير صحيحة لا نستطيع رفضها



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Hypothesis Testing for a Population Mean: Population Standard Deviation Unknown [1]

- Example 2: The Myrtle Beach International Airport provides a cell phone parking lot where people can wait for a message to pick up arriving passengers.
- To decide if the cell phone lot has enough parking places, the manager of airport parking needs to know if the mean time in the lot is more than 15 minutes. $\mu > 15$
- A sample of 12 recent customers showed they were in the lot the following lengths of time, in minutes.

30	24	28	22	14	2	39	23	23	28	12	31

$n = 12$ $\bar{x} = 23$ $s = 9.835$

- At the .05 significance level, is it reasonable to conclude that the mean time in the lot is more than 15 minutes?

① صياغة الفرضيات

$H_0: \mu \leq 15$

$H_1: \mu > 15$

② تحديد مستوى المعنوية $\alpha = 0.05$

اختبار الفرض

t:

$t = \dfrac{\bar{x} - \mu}{s/\sqrt{n}}$

الانحراف للمجتمع غير معروف

z:

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

الانحراف للمجتمع معروف

③ حساب t statistics

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

$$t = \frac{23 - 15}{9.835/\sqrt{12}} = 2.818$$

④ حساب P-value من جدول t

one tailed test

$df = 11$ $(n-1)$

α 0.05

1.796

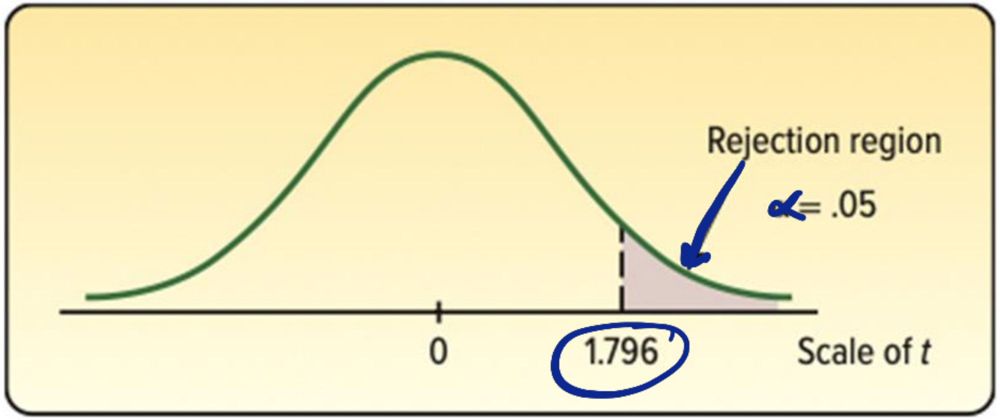
Critical value (scale t) = 1.796

t وقعت في منطقة الرفض

الشرح رفضت الفرضية الصفرية الوقت في الكراج اكبر من 15 دقيقة

Hypothesis Testing for a Population Mean: Population Standard Deviation Unknown 2

- Example continued.
- Step 1: $H_0: \mu \leq 15 \text{ } vs \text{ } H_1: \mu > 15.$
- Step 2: $\alpha = 0.05.$
- Step 3: $t = \dfrac{\bar{x} - \mu}{s / \sqrt{n}}.$
- Step 4: *df* = 11 and the critical value is *t* = 1.796.



Access the text alternative for slide images.

Hypothesis Testing for a Population Mean: Population Standard Deviation Unknown 3

Example continued.

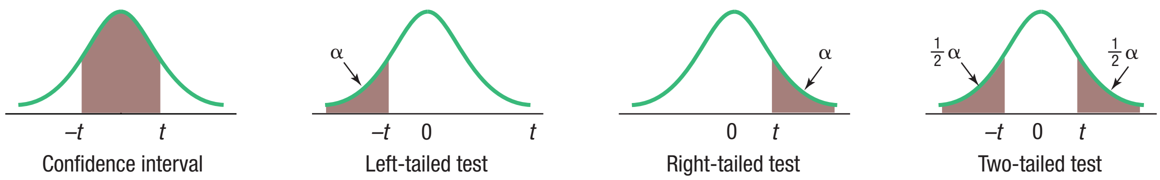
Step 5: $\bar{x} = 23$, s = 9.835, n = 12 so that.

- $t = \dfrac{\bar{x} - \mu}{s / \sqrt{n}} = \dfrac{23 - 15}{9.835 / \sqrt{12}} = 2.818.$
- 2.818 is larger than 1.796.
- Reject the null hypothesis.

Step 6:

- We conclude that the mean time customers spend in the lot is more than 15 minutes.
- This result indicates that the airport may need to add more parking places.

B.2 Student's *t* Distribution



	Confidence Intervals, *c*					
	80%	90%	95%	98%	99%	99.9%
	Level of Significance for One-Tailed Test, α					
df	0.10	0.05	0.025	0.01	0.005	0.0005
	Level of Significance for Two-Tailed Test, α					
	0.20	0.10	0.05	0.02	0.01	0.001
1	3.078	6.314	12.706	31.821	63.657	636.619
2	1.886	2.920	4.303	6.965	9.925	31.599
3	1.638	2.353	3.182	4.541	5.841	12.924
4	1.533	2.132	2.776	3.747	4.604	8.610
5	1.476	2.015	2.571	3.365	4.032	6.869
6	1.440	1.943	2.447	3.143	3.707	5.959
7	1.415	1.895	2.365	2.998	3.499	5.408
8	1.397	1.860	2.306	2.896	3.355	5.041
9	1.383	1.833	2.262	2.821	3.250	4.781
10	1.372	1.812	2.228	2.764	3.169	4.587
11	1.363	1.796	2.201	2.718	3.106	4.437
12	1.356	1.782	2.179	2.681	3.055	4.318
13	1.350	1.771	2.160	2.650	3.012	4.221
14	1.345	1.761	2.145	2.624	2.977	4.140
15	1.341	1.753	2.131	2.602	2.947	4.073
16	1.337	1.746	2.120	2.583	2.921	4.015
17	1.333	1.740	2.110	2.567	2.898	3.965
18	1.330	1.734	2.101	2.552	2.878	3.922
19	1.328	1.729	2.093	2.539	2.861	3.883
20	1.325	1.725	2.086	2.528	2.845	3.850
21	1.323	1.721	2.080	2.518	2.831	3.819
22	1.321	1.717	2.074	2.508	2.819	3.792
23	1.319	1.714	2.069	2.500	2.807	3.768
24	1.318	1.711	2.064	2.492	2.797	3.745
25	1.316	1.708	2.060	2.485	2.787	3.725
26	1.315	1.706	2.056	2.479	2.779	3.707
27	1.314	1.703	2.052	2.473	2.771	3.690
28	1.313	1.701	2.048	2.467	2.763	3.674
29	1.311	1.699	2.045	2.462	2.756	3.659
30	1.310	1.697	2.042	2.457	2.750	3.646
31	1.309	1.696	2.040	2.453	2.744	3.633
32	1.309	1.694	2.037	2.449	2.738	3.622
33	1.308	1.692	2.035	2.445	2.733	3.611
34	1.307	1.691	2.032	2.441	2.728	3.601
35	1.306	1.690	2.030	2.438	2.724	3.591

	Confidence Intervals, *c*					
	80%	90%	95%	98%	99%	99.9%
	Level of Significance for One-Tailed Test, α					
df	0.10	0.05	0.025	0.01	0.005	0.0005
	Level of Significance for Two-Tailed Test, α					
	0.20	0.10	0.05	0.02	0.01	0.001
36	1.306	1.688	2.028	2.434	2.719	3.582
37	1.305	1.687	2.026	2.431	2.715	3.574
38	1.304	1.686	2.024	2.429	2.712	3.566
39	1.304	1.685	2.023	2.426	2.708	3.558
40	1.303	1.684	2.021	2.423	2.704	3.551
41	1.303	1.683	2.020	2.421	2.701	3.544
42	1.302	1.682	2.018	2.418	2.698	3.538
43	1.302	1.681	2.017	2.416	2.695	3.532
44	1.301	1.680	2.015	2.414	2.692	3.526
45	1.301	1.679	2.014	2.412	2.690	3.520
46	1.300	1.679	2.013	2.410	2.687	3.515
47	1.300	1.678	2.012	2.408	2.685	3.510
48	1.299	1.677	2.011	2.407	2.682	3.505
49	1.299	1.677	2.010	2.405	2.680	3.500
50	1.299	1.676	2.009	2.403	2.678	3.496
51	1.298	1.675	2.008	2.402	2.676	3.492
52	1.298	1.675	2.007	2.400	2.674	3.488
53	1.298	1.674	2.006	2.399	2.672	3.484
54	1.297	1.674	2.005	2.397	2.670	3.480
55	1.297	1.673	2.004	2.396	2.668	3.476
56	1.297	1.673	2.003	2.395	2.667	3.473
57	1.297	1.672	2.002	2.394	2.665	3.470
58	1.296	1.672	2.002	2.392	2.663	3.466
59	1.296	1.671	2.001	2.391	2.662	3.463
60	1.296	1.671	2.000	2.390	2.660	3.460
61	1.296	1.670	2.000	2.389	2.659	3.457
62	1.295	1.670	1.999	2.388	2.657	3.454
63	1.295	1.669	1.998	2.387	2.656	3.452
64	1.295	1.669	1.998	2.386	2.655	3.449
65	1.295	1.669	1.997	2.385	2.654	3.447
66	1.295	1.668	1.997	2.384	2.652	3.444
67	1.294	1.668	1.996	2.383	2.651	3.442
68	1.294	1.668	1.995	2.382	2.650	3.439
69	1.294	1.667	1.995	2.382	2.649	3.437
70	1.294	1.667	1.994	2.381	2.648	3.435

(*continued*)

Chapter 10 Practice Problems

Question 1

Question 3

Question 5

Question 7

LO10-2,3,4

A recent national survey found that high school students watched an average (mean) of 6.8 movies per month with a population standard deviation of 1.8. The distribution of number of movies watched per month follows the normal distribution. A random sample of 36 college students revealed that the mean number of movies watched last month was 6.2. At the .05 significance level, can we conclude that college students watch fewer movies a month than high school students?

① $H_0: \mu \geq 6.8$

$H_1: \mu < 6.8$

② Z → $\alpha = 0.05$
→ one tailed

Z جدول $= -1.65$

③ Reject Ho $Z < -1.65$

Question 9

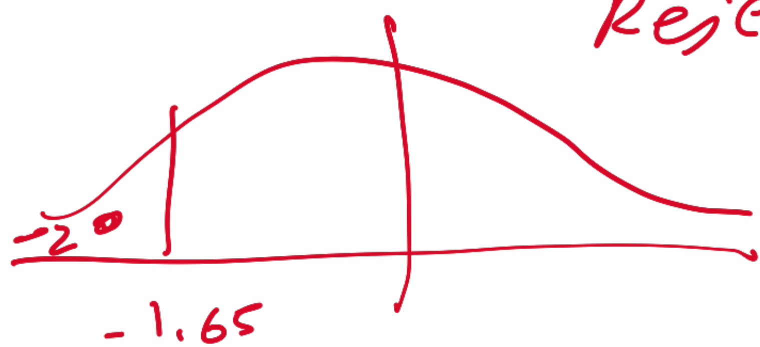
(4) $$Z = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

$$= \frac{6.2 - 6.8}{\frac{1.8}{\sqrt{36}}}$$

$$= -2$$

(5)

Reject Ho



Question 11

Question 13

نستخدم اختبار

LO10-2,3,4,6

μ The mean income per person in the United States is $60,000, and the distribution of incomes follows a normal distribution. A random sample of 10 residents of Wilmington, Delaware, had a mean of $70,000 with a standard deviation of $10,000. At the .05 level of significance, is that enough evidence to conclude that residents of Wilmington, Delaware, have $\boxed{\text{more}}$ income than the national average?

$\bar{x}$

① $H_0: \mu \le 60000$

$H_1: \mu > 60000$

② t → $\alpha = 0.05$ → one tailed → $df = 10-1 = 9$

$t = 1.833$

Reject H_0 $t > 1.833$

R .

Question 15

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} = \frac{70000 - 60000}{\frac{10000}{\sqrt{10}}}$$

$$= 3.16$$

$$\underset{\text{تجريبية}}{t} > \underset{\text{جدول}}{t}$$

Reject H_0

Question 17

Question 19

LO10-2,3,4,5,6

A Washington, D.C., "think tank" announces the typical teenager sent 67 text messages per day in 2017. To update that estimate, you phone a sample of 12 teenagers and ask them how many text messages they sent the previous day. Their responses were:

51	175	47	44	54	145	203	21	59	42	100	49

At the .05 level, can you conclude that the mean number is greater than 67? Compute the $\boxed{p\text{-value}}$ and describe what it tells you.

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متوسط واوزان العينه

$\bar{x} = 82.5$

$S = 59.49$

$H_0 : \mu \leq 67$

$\mu > 67$

محسوبه

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

$$\frac{82.5 - 67}{\frac{59.49}{\sqrt{12}}} = 0.903$$

جدول

t جدول

→ 0.05

→ $df = 12 - 1 = 11$

→ one tailed

$t = 1.796$

$t_{\text{محسوبه}} < t_{\text{جدول}}$

fail to reject H_0

Pvalue من الجدول $\boxed{0.2 - 0.1}$

Pvalue = 0.1931