9.2 - Testing a Claim About Two Means (independent)

EXAMPLE 1 IQ and Lead Exposure Data Set 5 in Appendix B lists IQ scores for a random sample of subjects with low lead levels in their blood and another random sample of subjects with high lead levels in their blood. The statistics are summarized below. Use a 0.05 significance level to test the claim that the mean IQ score of people with low lead levels is higher than the mean IQ score of people with high lead levels.

Low Lead Level: $n_1 = 78$, $\overline{x}_1 = 92.88462$, $s_1 = 15.34451$

High Lead Level: $n_2 = 21$, $\overline{x}_2 = 86.90476$, $s_2 = 8.988352$

let's assume normality.

$H_0: \mu_1 = \mu_2$

$H_a: \mu_1 > \mu_2$ claim

$\alpha = 0.05$

$P = 0.013 \Rightarrow$ Reject H_0

```
NORMAL FLOAT AUTO REAL RADIAN MP
2-SampTTest
Inpt:Data Stats
x̄1:92.88462
Sx1:15.34451
n1:78
x̄2:86.90476
Sx2:8.988352
n2:21
μ1:≠μ2 <μ2 >μ2
↓Pooled:No Yes
```

```
NORMAL FLOAT AUTO REAL RADIAN MP
2-SampTTest
μ1>μ2
t=2.282155574
p=0.0131888149
df=54.91695084
x̄1=92.88462
x̄2=86.90476
Sx1=15.34451
↓Sx2=8.988352
```

Hypothesis Test for Two Means from Statistics

	Var1	Var2
Sample Means=	92.8846	86.9048
Standard Deviations=	15.3445	8.9884
Variances=	235.4540	80.7905
Sample Size=	78	21
Degrees of Freedom=	54.9170	not pooled
Difference of Means=	5.9799	
Hypothesized Difference=	0	
Type:	Ha: μ1 > μ2	
t-statistic=	2.2822	
P-Value=	0.0132	

There is enough evidence to support the claim that the mean IQ is higher in individuals with lower lead levels

90% Confidence Interval:

```
NORMAL FLOAT AUTO REAL RADIAN MP
        2-SampTInt
 Inpt:Data Stats
 x̄1:92.88462
 Sx1:15.34451
 n1:78
 x̄2:86.90476
 Sx2:8.988352
 n2:21
 C-Level:0.9
↓Pooled:No Yes
```

```
NORMAL FLOAT AUTO REAL RADIAN MP
        2-SampTInt
 (1.5959,10.364)
 df=54.91695084
 x̄1=92.88462
 x̄2=86.90476
 Sx1=15.34451
 Sx2=8.988352
 n1=78
 n2=21
```

Hypothesis Test for Two Means from Statistics

	Var1	Var2
Sample Means=	92.8846	86.9048
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Type:	Ha: μ1 > μ2	
t-statistic=	2.2822	

P-Value= 0.0132

Confidence Interval	
Confidence Level	0.9
1.5947	10.3650

We are 90% confident the mean difference in IQ is between 1.6 and 10.4.

EXAMPLE 2 Heights of Supermodels Listed below are the heights (inches) for the simple random sample of supermodels Lima, Bundchen, Ambrosio, Ebanks, Iman, Rubik, Kurkova, Kerr, Kroes, and Swanepoel. Data Set 1 in Appendix B includes the heights of a simple random sample of 40 women from the general population, and here are the statistics for those heights: n = 40, x = 63.7815 in., and s = 2.59665 in. Use a 0.01 significance level to test the claim that the supermodels have heights with a mean that is greater than the mean height of women in the general population.

70 71 69.25 68.5 69 70 71 70 70 69.5

First calculate the statics for the models

Models	General Population
$\bar{x}_1 = 69.825$	$\bar{x}_2 = 63.7815$
$s_1 = 0.7997$	$s_2 = 2.59665$
$n_1 = 10$	$n_2 = 40$

$H_0: \mu_1 = \mu_2$

$H_a: \mu_1 > \mu_2$ claim

$\alpha = 0.05$

$P = +0$ reject H_0

Hypothesis Test for Two Means from Statistics

	Var1	Var2
Sample Means=	69.8250	63.7815
Standard Deviations=	0.7997	2.5967
Variances=	0.6395	6.7426
Sample Size=	10	40
Degrees of Freedom=	45.7010	not pooled
Difference of Means=	6.0435	
Hypothesized Difference=	0	
Type:	Ha: μ1 > μ2	
t-statistic=	12.5332	
P-Value=	0.0000	

There is enough evidence to support the claim that the mean height of super models is greater than the mean height of the general female population.

EXAMPLE 3 A company states their test-prep program can increase a math placement score by more than 20 points. A group of 100 new students were randomly sampled into two groups. Group A with 46 students, took the placement test without the test-prep program and had a mean of 214.2 and standard deviation 22.7. Group B, with 54 students, took the two-week test-prep program and scored a mean of 241.5 with a standard deviation of 19.4. Test the companies claim that the program increased the mean score by more than 20 points. Note: the claim is of the form $\mu_1 - \mu_2 > 20$ (assuming the test-prep sample mean is $\bar{x}_1$).

Test Prep	No Prep
$n_1 = 54$	$n_2 = 46$
$\bar{x}_1 = 241.5$	$\bar{x}_2 = 214.2$
$s_1 = 19.4$	$s_2 = 22.7$

$H_0: \mu_1 - \mu_2 = 20$

$H_1: \mu_1 - \mu_2 > 20$ claim

$\alpha = 0.05$ $P = 0.045$

$P < \alpha$ reject H_0

TI84 since $\mu_1 - \mu_2 > 20 \Rightarrow$
$\mu_1 - 20 > \mu_2$

$\Rightarrow$ subtract 20 from $\bar{x}_1$

```
NORMAL FLOAT AUTO REAL RADIAN MP
2-SampTTest
Inpt:Data Stats
x̄1:221.5
Sx1:19.4
n1:54
x̄2:214.2
Sx2:22.7
n2:46
μ1:≠μ2 <μ2 >μ2
↓Pooled:No Yes
```

$\bar{x}_1 - 20$

```
NORMAL FLOAT AUTO REAL RADIAN MP
2-SampTTest
μ1>μ2
t=[illegible]
p=0.0451424448
df=[illegible]
x̄1=221.5
x̄2=214.2
Sx1=19.4
↓Sx2=22.7
```

There is enough evidence to support the claim that test-prep can increase the mean placement score by at least 20 points.

Hypothesis Test for Two Means from Statistics

	Var1	Var2
Sample Means=	241.5000	214.2000
Standard Deviations=	19.4000	22.7000
Variances=	376.3600	515.2900
Sample Size=	54	46
Degrees of Freedom=	89.1233	not pooled
Difference of Means=	27.3000	
Hypothesized Difference=	20	
Type:	Ha: μ1-μ2 > 20	
t-statistic=	1.7125	
P-Value=	0.0451	