AP Statistics
Unit 07 – Day 05 Homework
Significance Tests: 2-Sample Means

Name Key
Period

1. Mary Jo Fitzpatrick is the Vice President for Nursing Services at St. Luke's Memorial Hospital. Recently she noticed in the job postings for nurses that those that are unionized seem to offer higher wages. She decided to investigate and gathered the following randomly collected sample information.

   Would it be reasonable for her to conclude that there is significant difference in earning between union and non-union nurses? Use a 0.01 significance level.

Group	Mean Wage	Sample Standard Deviation	Sample Size
Union	\$20.75	\$2.25	40
Nonunion	\$19.80	\$1.90	45

State: μ_1 = the true mean wage of union nurses (\$/hour)
μ_2 = the true mean wage of non-union nurses (\$/hour)

$H_0: \mu_1 = \mu_2$ $\quad \bar{x}_1 = \$20.75$ $\quad \alpha = 0.01$
$H_A: \mu_1 \neq \mu_2$ $\quad \bar{x}_2 = \$19.80$

Plan: random: the data come from 2 independent random samples ✓
10% condition: $n_1 = 40$ 400 < all union nurse wages
$n_2 = 45$ 450 < all non-union nurse wages
Normal/Large: $n_1 = 40 \geq 30$ ✓ $\quad n_2 = 45 \geq 30$ ✓

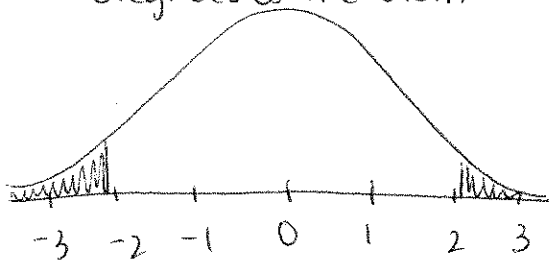
Because our conditions are met, we will perform a 2-sample t-test for the difference of 2 means $\mu_1 - \mu_2$.

Do: 2-SampTTest

$\bar{x}_1$: 20.75
Sx1: 2.25
n_1: 40
$\bar{x}_2$: 19.80
Sx2: 1.90
n_2: 45

$\mu_1 \neq \mu_2$
pooled: no
df: 76.77
test statistic: 2.089
p-value: 0.0400

t-distribution with 76.77 degrees of freedom



Conclude: Because our p-value = 0.0400 is greater than our significance level $\alpha = 0.01$, we fail to reject the null. There is not convincing evidence that the true mean wage of union nurses and nonunion nurses differ.

2. A manpower-development statistician is asked to determine whether the hourly wages of semiskilled workers are the same in two cities. The results of the random survey are presented in the following table:

City	Mean	Standard Deviation	Sample Size
Portland	$8.95	$0.40	200
Seattle	$9.10	$0.60	175

Does the statistician have a right to be concerned about the differences in wages between the two cities? Use a 0.05 significance level.

State: μ_1 = the true mean hourly wage of semiskilled workers in Portland
μ_2 = the true mean hourly wage of semiskilled workers in Seattle.

$H_0: \mu_1 = \mu_2$ $\quad \bar{x}_1 = \$8.95$ $\quad \alpha = 0.05$

$H_A: \mu_1 \neq \mu_2$ $\quad \bar{x}_2 = \$9.10$

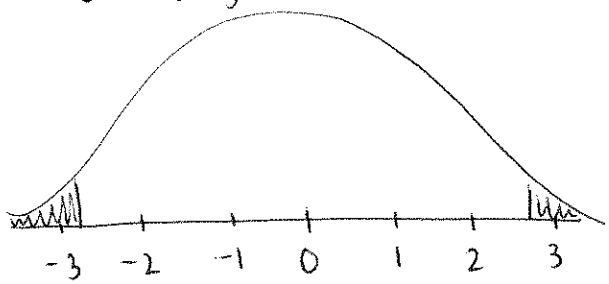
Plan: random: the data come from 2 independent random samples ✓
10% condition: $n_1 = 200$ 2000 < all semiskilled workers in Portland ✓
$n_2 = 175$ 1750 < all semiskilled workers in Seattle ✓
Normal/Large: $n_1 = 200 \geq 30$ ✓
$n_2 = 175 \geq 175$ ✓

Because our conditions are met, we will perform a 2-sample t-test for the difference of 2 means $\mu_1 - \mu_2$.

DO: 2-SampTTest

$\bar{x}_1$: 8.95 $\quad \mu_1 \neq \mu_2$
Sx_1: 0.40 $\quad$ pooled: no
n_1: 200 $\quad$ test statistic: -2.806
$\bar{x}_2$: 9.10 $\quad$ p-value: 0.005344
Sx_2: 0.60 $\quad$ df: 296.45
n_2: 175

t-distribution with 296.45 degrees of freedom



Conclude: Because our p-value = 0.005344 is less than our significance level $\alpha = 0.05$, we reject the null hypothesis. There is convincing evidence that there is a difference in true mean wage between semiskilled workers in Portland and Seattle.

3. Two research laboratories have independently produced drugs that provide relief to arthritis sufferers. The first drug was tested on a group of 90 randomly selected arthritis sufferers and produced an average of 8.5 hours of relief, and a sample standard deviation of 1.8 hours. The second drug was testing on 80 randomly selected arthritis sufferers, producing an average of 7.9 hours of relief, and a sample standard deviation of 2.1 hours. At a 0.05 significance level, does the second drug proved a significantly shorter time period of relief?

State: μ_1 = the true mean amount of time that drug #1 provides arthritis relief, in hours.

μ_2 = the true mean amount of time that drug #2 provides arthritis relief, in hours.

$H_0: \mu_1 = \mu_2$ $\quad \bar{x}_1 = 8.5$ hours $\quad \alpha = 0.05$

$H_A: \mu_1 > \mu_2$ $\quad \bar{x}_2 = 7.9$ hours

Plan: random: the data come from 2 independent random samples ✓

10% condition: $n_1 = 90$ $\quad 900 <$ all arthritis sufferers ✓

$n_2 = 80$ $\quad 800 <$ all arthritis sufferers ✓

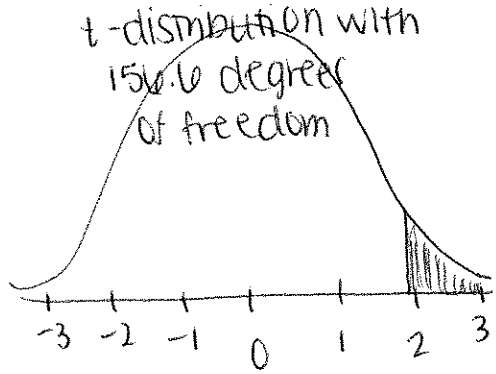
Normal/Large: $n_1 = 90 \geq 30$ ✓ $\quad n_2 = 80 \geq 30$ ✓

Because our conditions are met, we will perform a 2-sample t-test for the difference in 2 means $\mu_1 - \mu_2$.

DO: 2-SampTTest

$\bar{x}_1$: 8.5
Sx_1: 1.8
n_1: 90
$\bar{x}_2$: 7.9
Sx_2: 2.1
n_2: 80

$\mu_1 > \mu_2$
pooled: no
df: 156.6
test statistic: 1.988
p-value: 0.0243



Conclude: Because our p-value = 0.0243 is less than our significance level $\alpha = 0.05$, we reject the null hypothesis. There is convincing evidence that the second drug proved a significantly shorter time period of relief.

4. Notwithstanding the Equal Pay Act of 1963, in 1993 it still appeared that men earned more than women in similar jobs. A random sample of 38 male garbage men found a mean hourly wage of $11.28, and a sample standard deviation was $1.84. A random sample of 45 female garbage ladies found their mean wage to be $8.42, and a sample standard deviation was $1.31. On the basis of these samples, is it reasonable to conclude (at a = 0.01) that the male garbage men are earning over $2.00 more per hour than their female counterparts?

State: μ_1 = the true mean hourly wage of garbagemen ($)
μ_2 = the true mean hourly wage of garbagewomen ($), plus $2 per hour

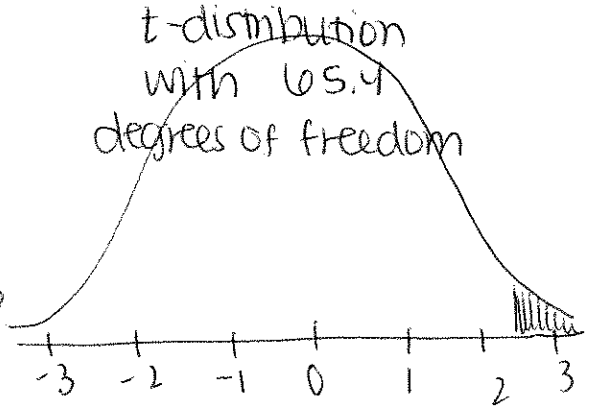
$H_0: \mu_1 = \mu_2$ $\quad \bar{x}_1 = \$11.28$ $\quad \alpha = 0.01$

$H_A: \mu_1 > \mu_2$ $\quad \bar{x}_2 = \$8.42 + \$2 = \$10.42$

Plan: random: the data come from 2 independent random samples ✓
10% condition: $n_1 = 38$ $38 < $ all male garbagemen ✓
$n_2 = 45$ $450 <$ all female garbagewomen ✓
Normal/large: $n_1 = 38 \geq 30$ ✓ $\quad n_2 = 45 \geq 30$ ✓
Because our conditions are met, we will perform a 2-sample t-test for the difference of 2 means $\mu_1 - \mu_2$.

DO: 2-SampTTest

$\bar{x}_1$: 11.28	$\mu_1 > \mu_2$
$Sx1$: 1.84	pooled: no
n_1: 38	df: 65.4
$\bar{x}_2$: 10.42	test statistic: 2.411
Sx_2: 1.31	p-value: 0.00936
n_2: 45	



Conclude: Because our p-value = 0.00936 is less than our significance level $\alpha = 0.01$, we reject the null hypothesis. There is convincing evidence that the mean hourly wage of garbagemen is over $2 more per hour than their female counterpart.