# EDUR 7130 Presentation 5c Independent Samples t-test

#### 1. Two-samples t-test

### 1a. Characteristics

Two independent samples t-test

- used to compare two groups on a quantitative dependent variable
- IV = categorical (nominal) variable with two groups, DV = quantitative variable (examples, IV = sex, DV = math scores; IV = location of instruction [on-line vs on campus], DV = level of confidence in class)
- t-ratio is formed by comparing group mean differences on the dependent variable (compare mean math scores between males and females), and this mean difference is divided by a standard error of that difference
- the larger the t-ratio (in absolute value), the more evidence that groups differ

### 1b. Reading t-test Results

Goodman et al. (2005). Mother expectation of bother and infant attachment behaviors as predictors of method and child communication at 24 months in children of methadone-maintained women. Infant Mental Health Journal, 26, 549-569.

TABLE 1.	Demographic Statistics of Methadone-Maintained and Comparison M	1 others
and Their	Children	

		Methadone Exposure				
	<i>Methadone</i> <sup>a</sup>		<i>Comparison<sup>b</sup></i>		Statistics	
Variable	М	SD	М	SD	$\chi^2$	t
Mothers <sup>c</sup>						
Race (%African American)	100.00		100.00			
Education (years)	11.10	1.56	11.40	1.33		.89
Hollingshead SES <sup>d</sup>	4.50	.68	4.33	.79		.94
Hollingshead SES: Mother's family of origin <sup>d</sup>	4.53	.73	4.48	.55		.38
WAIS IQ	88.43	9.28	89.43	12.23		.38
Married (%)	23.33		33.33		.85	
Expectation of bother <sup>d</sup>	15.35	4.33	11.75	4.00		3.26**
Children						
Birth weight (g)	2851.38°	596.81	3217.19	412.55		3.06**
Gender (% male)	46.67		57.14		.77	
Parity <sup>d</sup>	3.20	1.24	2.83	.91		1.45
Proximity	4.10	2.17	3.67	2.20		83
Contact	2.17	1.37	2.57	1.61		1.12
Avoidance <sup>d</sup>	2.83	1.95	2.24	1.54		-1.45
Disorganization <sup>d</sup>	2.40	2.06	1.24	.54		-3.09**

Note. N = 72. SES = socioeconomic status; WAIS = Wechsler Adult Intelligence Scale.

 $a_n = 30$ .  $b_n = 42$ . Mothers were 18–25 years old. Higher values denote poorer scores.  $c_n = 29$ .

### 1c. Worked Example 1: Heart Rate Comparison

Is there a change in mean heart rate per minute before and after taking blood pressure medication for a single individual? Below are data for this individual.

Heart Rate		Heart Rate		
Before			After	
57	59	50	0 62	
58	57	50	0 57	
56	53	48	8 49	
55	63	49	9 47	
55	54	44	4 54	
53	51	49	9 48	
53	51	45	5 44	

## 1c1. Null Hypothesis

What is the written null hypothesis?

Recall that the IV is blood pressure medication use (before and after using medication) and the DV is heart rate. There is no difference in mean heart rate before and after taking blood pressure medication.

What is the symbolic Ho?

Ho:  $\mu_{before} = \mu_{after}$ or Ho:  $\mu_{before} - \mu_{after} = 0.00$  (most commonly tested by statistical software)

#### 1c2. Excel t-test Spreadsheet

	U	м м		
Enter Data Belo	w (up to 300)			
Group One	Group Two		Group One	Group Two
57	50	Mean =	55.3571429	49.7142857
58	50	Standard Deviation =	3.29585154	4.99890098
56	48	Variance =	10.8626374	24.989011
55	49	Sample size, n =	14	14
55	44			
53	49	Pooled Variance =	17.9258242	
53	45	SE of Mean Difference =	1.60025999	Note: Standar
59	62	Mean Difference =	5.64285714	
57	57	degrees of freedom =	26	
53	49			
63	47	t -ratio =	3.52621273	
54	54	p-value for t =	0.001587	
E 1	10			

1c3. Reject or Fail to Reject Ho?

Use p-value to decide whether to reject or fail to reject Ho (no difference in heart rate before and after taking blood pressure medication). Use alpha of .05; recall alpha is the probability of making a Type 1 error in hypothesis testing (i.e., claiming there is a mean difference based upon sample results when there is no mean difference in the population).

Decision rule for p-values:

# If $p \le \alpha$ reject Ho; if $p > \alpha$ fail to reject Ho

The two red arrows in the screenshot above point to the t-ratio and the p-value for the t-ratio.

Insert p-value and alpha level:

## If .0015 ≤ .05 reject Ho; if .0015 > .05 fail to reject Ho

Since the p-value of .0015 is less than the alpha of .05, reject Ho and claim there is a mean difference in heart rates before and after taking medication.

## 1c4. Interpretation of Results

There is a statistically significant mean difference in heart rate before and after taking medication. Results show that the medication reduced heartrate by about 5.6 beats per minute.

# 1d. Worked Example 2: MPG Comparison

Below is a stratified random sample of 16 cars stratified by domestic and foreign classifications. Is there a difference in MPG for these cars based upon domestic classification?

MPG of	MPG of		
Domestic Cars	Foreign Cars		
22	21		
20	17		
18	26		
19	18		
24	14		
21	35		
28	18		
34	35		

## 1d1. Null Hypothesis

What is the written null hypothesis?

There is no difference in MPG between domestic and foreign cars.

Ho: μ<sub>domestic</sub> = μ<sub>foreign</sub> or <mark>Ho: μ<sub>domestic</sub> – μ<sub>foreign</sub> = 0.00</mark> (most commonly tested by statistical software)

#### 1d2. Excel t-test Spreadsheet

					-	
	Enter Data Below (up to 300)					
	Group One	Group Two			Group One	Group Two
	22	21	I	Mean =	23.25	23
	20	17		Standard Deviation =	5.36523199	8.17662173
	18	26		Variance =	28.7857143	66.8571429
	19	18		Sample size, n =	8	8
	24	14				
	21	35		Pooled Variance =	47.8214286	
	28	18		SE of Mean Difference =	3.45765197	Note: Standarc
	34	35		Mean Difference =	0.25	
				degrees of freedom =	14	
				t -ratio =	0.0723034	
				p-value for t =	0.943383	
1						

## 1d3. Reject or Fail to Reject Ho?

Use p-value to decide whether to reject or fail to reject Ho (no difference in MPG between domestic and foreign cars). Use alpha of .05; recall alpha is the probability of making a Type 1 error in hypothesis testing (i.e., claiming there is a mean difference based upon sample results when there is no mean difference in the population).

Decision rule for p-values:

## If $p \le \alpha$ reject Ho; if $p > \alpha$ fail to reject Ho

The two red arrows in the screenshot above point to the t-ratio and the p-value for the t-ratio.

Insert p-value and alpha level

If .943 ≤ .05 reject Ho; **if .943 > .05 fail to reject Ho** 

Since p-value of .943 is larger than alpha of .05, fail to reject the null hypothesis.

#### 1d4. Interpretation of Results

Results show there is not a statistically significant mean difference in MPG between domestic and foreign cars; both domestic and foreign cars in this sample obtain a mean MPG of about 23.