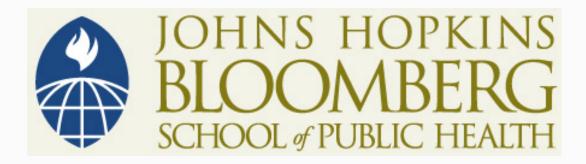
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Section F (Optional)

Non-Parametric Analogue to the Two Sample t-test

# Alternative to the Two Sample T-Test

- Nonparametric test for comparing two groups
- "Non-parametric" refers to a class of tests that do not assume anything about distribution of the data
- Nonparametric test for comparing two groups
  - Mann-Whitney Rank Sum Test (Wilcoxon Rank Sum Test)
  - Also called Mann-Whitney-Wilcoxon (a mouthful)
- Tries to answer the following question:
  - Are the two population distributions different?

# Advantages

- Does not assume populations being compared are normally distributed
  - The two-sample t-test requires that assumption with very small samples sizes
- Uses only ranks
- Not sensitive to outliers

## Disadvantage of the Nonparametric Test

- Nonparametric methods are often less sensitive (powerful) for finding true differences because they throw away information (they use only ranks)
- Need full data set, not just summary statistics
- Results do not include any confidence intervals quantifying range of possibility for true difference between populations

- Evaluate an intervention to educate high school students about health and lifestyle over a two-month period
- 10 students randomized to "intervention" or "control" group
- x = post test score pre-test score is outcome to compare between the intervention and control groups

x = post- pretest score for both groups

- Intervention (I)
  5
  0
  7
  2
  19
- Control (C) 6 -5 -6 1 4
  - Only five individuals in each sample!!!
  - We want to compare the control and intervention groups to assess whether the "improvement" (post-pre) in scores are different, taking random sampling error into account

- With such a small sample size, we need to be sure score improvements are normally distributed if we want to use t-test (BIG assumption)
- Possible approach:
  - Mann-Whitney-Wilcoxon non-parametric test!

First step—rank the pooled data (ignore groupings)

Second step—"reattach" group status

```
-6 -5 0 1 2 4 5 5 7 19

— Rank 1 2 3 4 5 6 7 8 9 10

— Group C C I C I C I C I I
```

- Find the average rank in each of the two groups
- Intervention group average rank

$$\frac{3+5+6+9+10}{5} = 6.8$$

Control group average rank

$$\frac{1+2+4+6+8}{5} = 4.2$$

- Statisticians have developed formulas and tables to determine the probability of observing such an extreme discrepancy in ranks (6.8 vs. 4.2) by chance alone
  - This is the p-value
- In the health education study, the p-value was .17
  - The interpretation is that the Mann-Whitney test did not show any significant difference in test score "improvement" between the intervention and control group (p = .17)

## Notes

- The two-sample t-test would give a different answer (p = .14)
- Different statistical procedures can give different p-values
- If the largest observation, 19, was changed, the p-value based on the Mann-Whitney test would not change but the two-sample t-test would change

## Notes

- The t-test or the nonparametric test?
  - Statisticians will not always agree, but there are some guidelines
  - Use non-parametric test if sample size is small and you have no reason to believe data is "well behaved" (normally distributed)
  - Only "ranks" available

# Using Stata to Perform Mann-Whitney-Wilcoxon

## Data, as entered

. list diff int\_cntrl

	<b></b>				
	1	diff	int_cn~l		
1.	1	4	0		
2.	1	1	0 1		
3.	1	-6	0		
4.	1	-5	0		
5.	1	6	0 1		
6.	1	19	1		
7.	1	2	1		
8.	1	7	1		
9.	1	0	1		
10.	1	5	1		
	+		+		

# Using Stata to Perform Mann-Whitney-Wilcoxon

- "ranksum" command
  - Syntax:
    - ranksum varname, by(group\_var)

```
. ranksum diff, by( int_cntrl)
```

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

int_cntrl	obs	rank sum	expected
0	_	21 34	27.5 27.5
combined	10	55	55

```
unadjusted variance 22.92 adjustment for ties 0.00 ------- adjusted variance 22.92
```

```
Ho: diff(int_cn~l==0) = diff(int_cn~l==1)

z = -1.358

Prob > |z| = 0.1745
```

# Using Stata to Perform Mann-Whitney-Wilcoxon

- "ranksum" command
  - Syntax:
    - ranksum varname, by(group\_var)

# Using Stata to Perform t-test

- "ttest" command without "i" on end when data already in Stata
   Syntax:
  - ttest varname, by(group\_var)

```
. ttest diff, by( int_cntrl)
```

Two-sample t test with equal variances

•	0bs				-	_		
0 1	I 5	0 6.6	2.387467 3.325658	5.338539	-6.628672	6.628672		
combined	10   10	3.3	2.221361		-1.725068	8.325068		
diff			4.093898		-16.04055	2.840545		
Ha: diff < 0 Pr(T < t) = 0.0728		Ha: diff != 0 Pr( T  >  t ) = 0.1456			Ha: $diff > 0$ Pr(T > t) = 0.9272			

# Summary: Educational Intervention Example

### Statistical methods

- 10 high school students were randomized to either receive a two-month health and lifestyle education program (or no program)
- Each student was administered a test regarding health and lifestyle issues prior to randomization (and after the two-month period)

# Summary: Educational Intervention Example

### Statistical methods

- Differences in the two test scores (after-before) were computed for each student
- Mean and median test score changes were computed for each of the two study groups
- A Mann-Whitney rank sum test was used to determine if there was a statistically significant difference in test score change between the intervention and control groups at the end of the two-month study period

# Summary: Educational Intervention Example

#### Result

- Participants randomized to the educational intervention scored a median five points higher on the test given at the end of the two-month study period, as compared to the test administered prior to the intervention
- Participants randomized to receive no educational intervention scored a median one point higher on the test given at the end of the two-month study period
- The difference in test score improvements between the intervention and control groups was not statistically significant (p = .17)