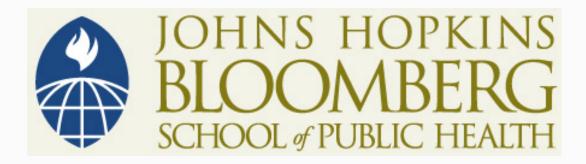
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Section D

Two Sample t-test, Two Choices

FYI: Equal Variances Assumption

- The "traditional" t-test assumes equal variances in the two groups
 - This can be formally tested with another hypothesis test!
 - But why not just compare observed values of s1 to s2?
- There is a slight modification to allow for unequal variances—this modification adjusts the degrees of freedom for the test, using slightly different SE computation (the formula I give you)
- If you want to be truly "safe" (desert island choice of t-test)
 - More conservative to use test that allows for unequal variance
- Makes little to no difference in large sample

FYI: Equal Variances Assumption

- Actually, the following occurs:
 - If underlying population level standard deviations are equal:
 - Both approaches give valid confidence intervals but intervals by approach assuming unequal standard deviations slightly wider (and p-values slightly larger)
 - If underlying population level standard deviations are not equal:
 - ► The approach assuming equal variances does not give valid confidence intervals and can severely under-cover the goal of 95%

Unequal SD Approach: Diet Type/ Weight Loss Example

Command syntax:

- ttesti n_1 \overline{x}_1 s_1 n_2 \overline{x}_2 s_2 , unequal

```
. ttesti 64 -5.7 8.6 68 -1.8 3.9, unequal
```

Two-sample t test with unequal variances

	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	. Interval]
х У	l 64 l 68	-5.7 -1.8	1.075	8.6 3.9	-7.848216 -2.744001	-3.551784
combined	132	-3.690909	.5978226	6.868458	-4.873545	-2.508273
diff			1.174437		-6.234436	-1.565564
diff = mean(x) - mean(y) $t = -3.3207$ Ho: $diff = 0$ Satterthwaite's degrees of freedom = 86.6941						
	iff < 0) = 0.0007	Pr(Ha: diff !=			diff > 0

Equal SD Approach: Diet Type/ Weight Loss Example

Command syntax:

- ttesti $n_1 \ \overline{x}_1 \ s_1 \ n_2 \ \overline{x}_2 \ s_2$

```
. ttesti 64 -5.7 8.6 68 -1.8 3.9
```

Two-sample t test with equal variances

				Std. Dev.	-	. Interval]
х	64 68	-5.7 -1.8	1.075 .4729445	8.6	-7.848216 -2.744001	
combined	132	-3.690909	.5978226	6.868458	-4.873545	-2.508273
diff		-3.9			-6.177191	-1.622809
diff =	= mean(x) = 0	- mean(y)		degrees	t s of freedom	= -3.3882 = 130
	iff < 0) = 0.0005	o Pr(Ha: diff !	= 0 0.0009		diff > 0 a) = 0.9995

Unequal SD Approach: LDL/ Treatment Example

Command syntax:

- ttesti n_1 \overline{x}_1 s_1 n_2 \overline{x}_2 s_2 , unequal

```
. ttesti 11 -1.41 .55 12 -.32 .65, unequal
```

Two-sample t test with unequal variances

	l Obs	Mean	Std. Err.	Std. Dev.	[95% Conf	. Interval]
х У	11 12	-1.41 32	.1658312	.55 .65	-1.779495 7329903	-1.040505 .0929903
combined	1 23	8413043	.1692296	.8115967	-1.192265	4903436
diff	1	-1.09	.2504163		-1.61095	5690505
	= mean(x)		Satterthwait		t	= -4.3528
	iff < 0) = 0.0001	Pr(Ha: diff !=			diff > 0 t) = 0.9999

Equal SD Approach: LDL/Treatment Example

Command syntax:

- ttesti n_1 \overline{x}_1 s_1 n_2 \overline{x}_2 s_2 , unequal

```
. ttesti 11 -1.41 .55 12 -.32 .65
```

Two-sample t test with equal variances

	Obs	Mean	Std. Err.	Std. Dev.	[95% Con	f. Interval]
х	l 11 l 12		.1658312 .1876388			-1.040505 .0929903
combined	. 23		.1692296			4903436
diff			.2523107			5652911
diff =	= mean(x) = 0	- mean(y)		degree	s of freedo	t = -4.3201 m = 21
	iff < 0) = 0.0002	Pr(Ha: diff !=			diff > 0 t) = 0.9998