Hypothesis Testing
Two-Sample

Course: Statistics 1

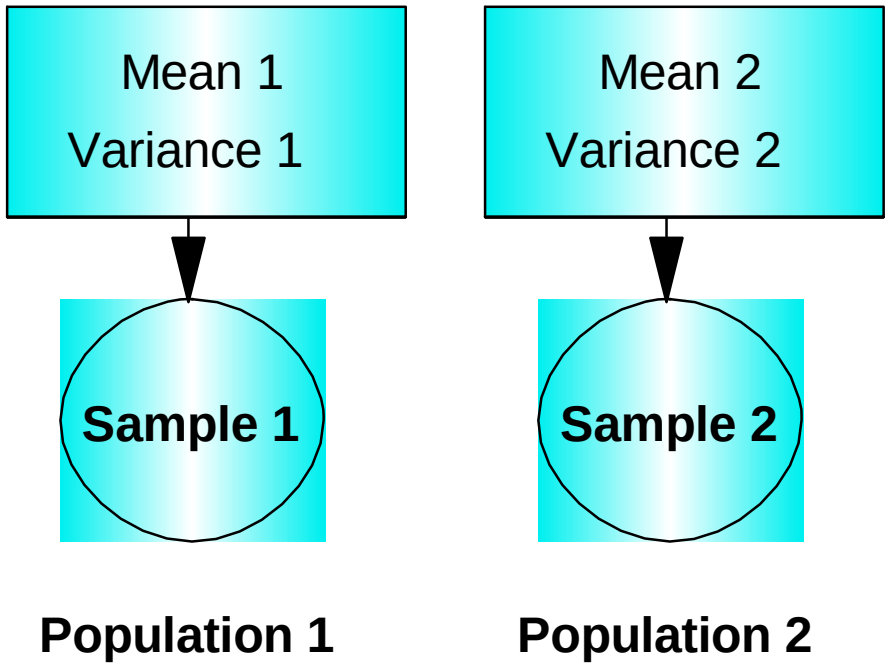
Lecturer: Dr. Courtney Pindling

Two-Sample Overview

- Use two samples to hypotheses about two populations (compare two samples means)
- Underlying *t*-distribution
- H_0: the samples mean difference = 0
- Cases:
  - Independent Samples: Same variance
  - Independent Samples: Not same variance
  - Dependent Samples: Assumed Correlated or Related

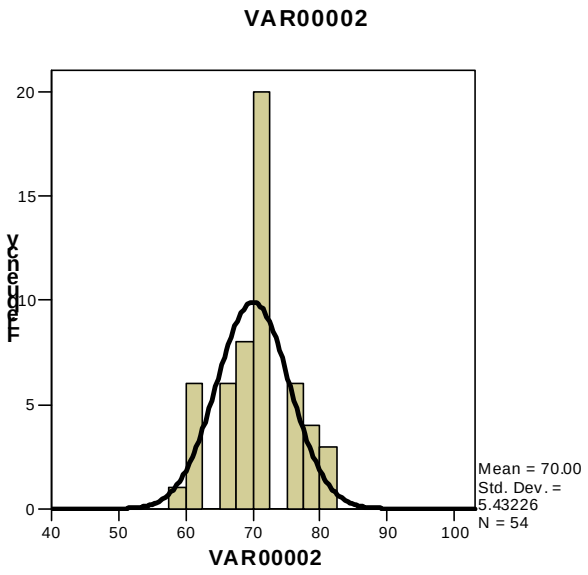
- Test Statistics: $t = \frac{\text{sample mean difference}}{\text{estimated standard error}} = \frac{(M_1 - M_2)}{s_{(M_1 - M_2)}}$

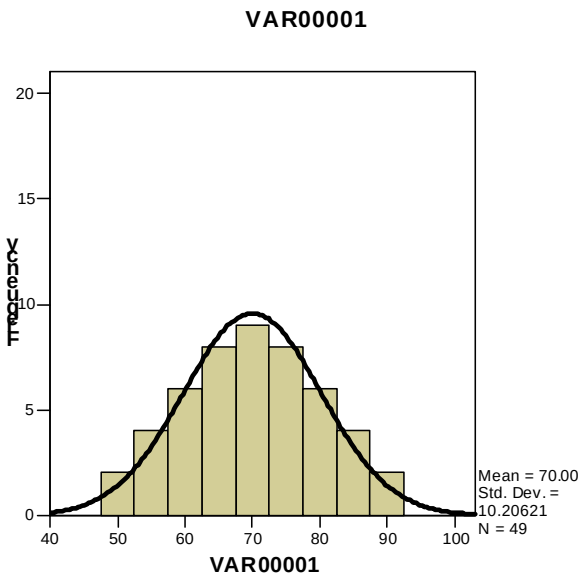
Two Independent Samples



Examples: Male – Female, Drug A – Drug B, Blacks - Whites

Variances: Independent Samples





Homogeneity of Variance: Are variance the same?

Dependent Samples

Paired-Samples or Correlated Sample

240 lbs

145 lbs

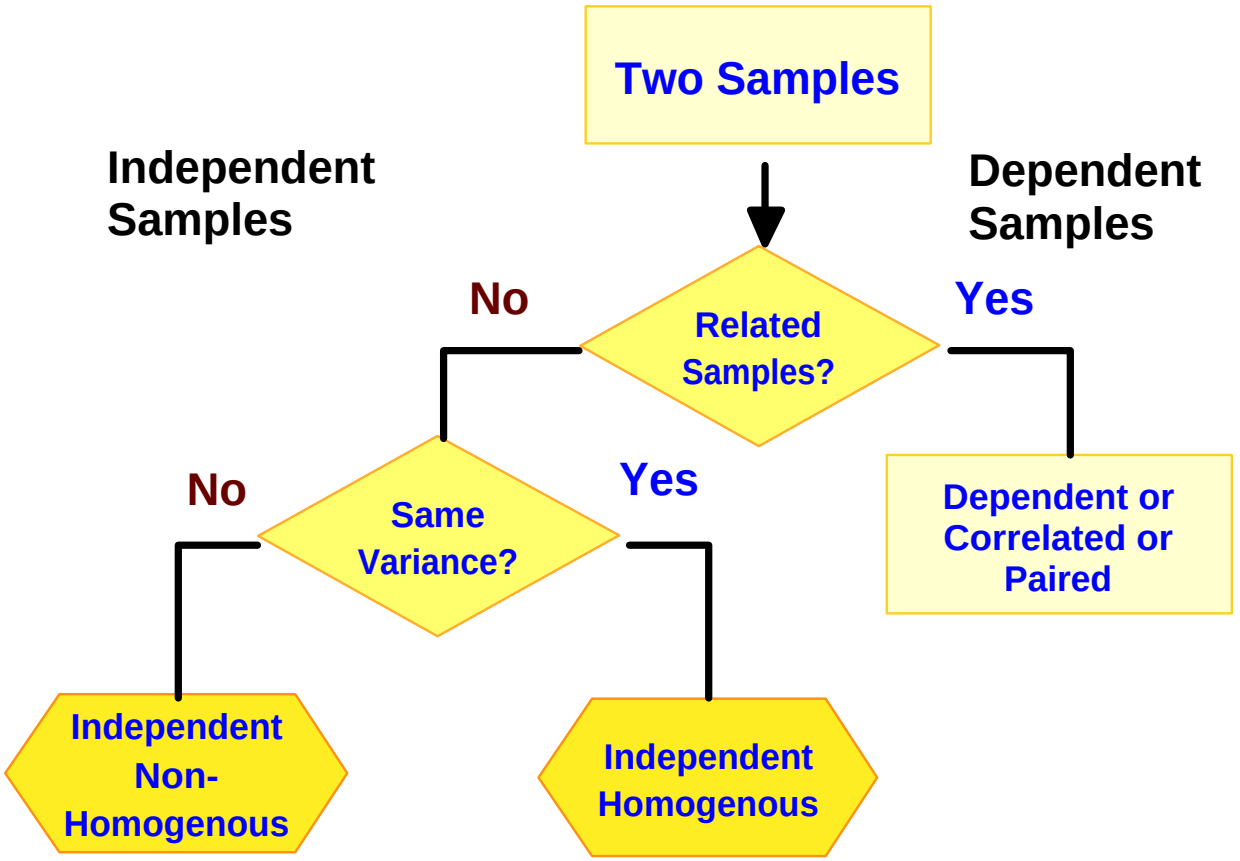
Examples:

Before - After,

Twins,

Husband - Wife

Decision Tree



Hypotheses

- Null, H_0 (***no difference in means***)

  $\mu_1 - \mu_2 = 0$

- Alternative, H_a

  $\mu_1 - \mu_2 \neq 0$

  $\mu_1 > \mu_2$

  $\mu_1 < \mu_2$

df varies with cases of two-sample mean test

Standard Error

- The amount of error expected when a sample difference is used to represent a population difference, $S_{(M1-M2)}$
- Each sample error is pooled or combined to provide an estimated standard error for both

Homogeneity of Variance

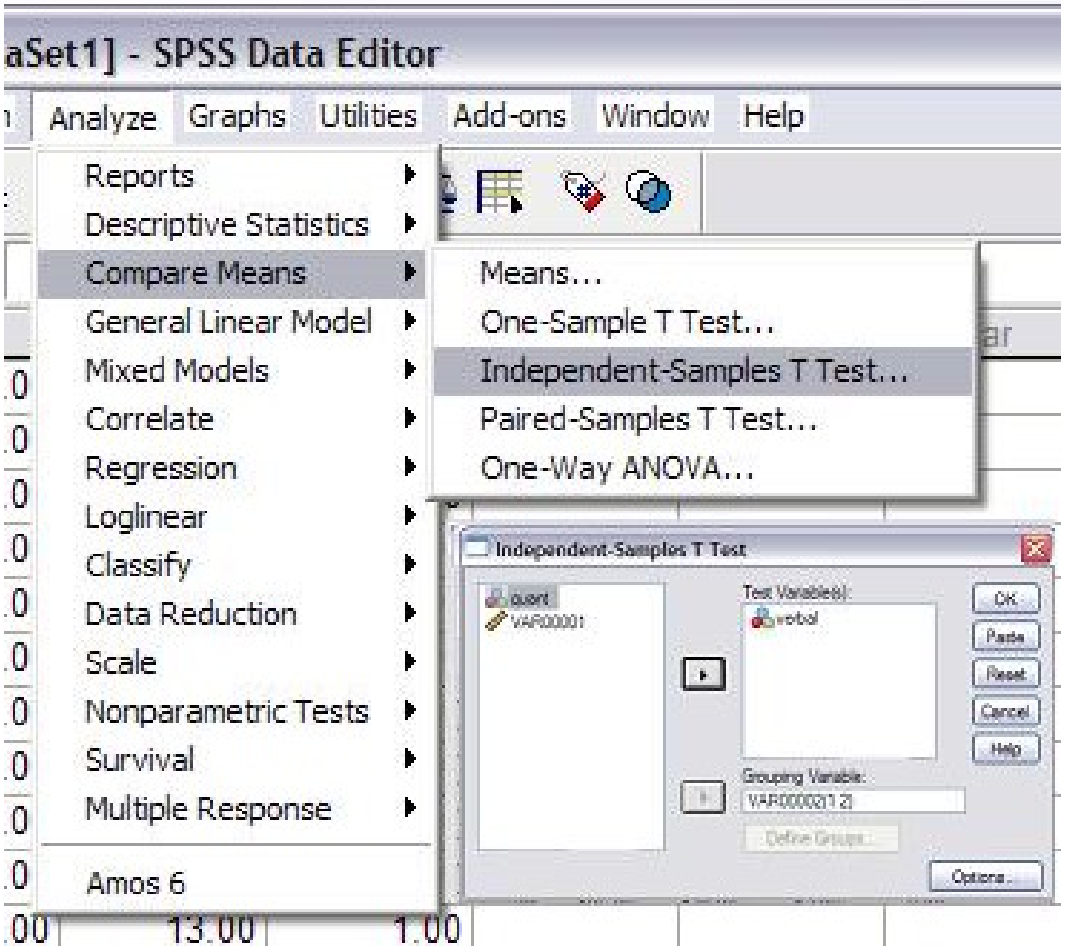
- Hartley's *F*-max Test
- *F*-max Procedure:
  - Compute sample variances: s^2
  - Select largest and smallest variances and compute,

$$F\text{–max} = \frac{s^2(\text{largest})}{s^2(\text{smallest})}$$

  - Look up critical value for F_{cv} (Given *df* and a)
  - Reject H_0 that variances are same if:
    - *F*-max >= F_{cv}

SPSS: Independent Samples

Variable	Group
12	1
13	2
11	1
12	1
9	2



SPSS Output: Independent Samples

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
verbal	Equal variances assumed	.000	1.000	-1.096	16	.289	-6.33333	5.78072	-18.58790	5.92124
	Equal variances not assumed			-1.096	15.973	.289	-6.33333	5.78072	-18.58955	5.92289

Null hypothesis: variance are same or homogenous (p-value > 0.05 or a)
Decide of Homogeneity of Variance from the significance or p-value of the Levene's F-test

SPSS: Dependent Samples

Subjects	Sample 1	Sample 2
1	11	23
2	12	26
3	11	21
4	11	20
5	10	18