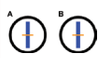
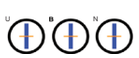
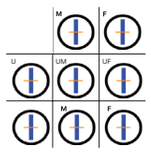
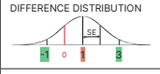
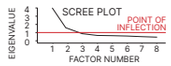
10 TOOLS

10 ATTRIBUTES

	COMPARE MEANS					ASSOCIATIONS			SCALE COMPOSITION	
	ONE-SAMPLE T	DEP-SAMPLES T	IND-SAMPLES T	ONE-WAY ANOVA F	TWO-WAY ANOVA F	CHI-SQUARE	CORRELATION	LINEAR REGRESSION F	EX. FACTOR ANALYSIS	RELIABILITY ANALYSIS
LEVELS OF MEASUREM.	TEST VARIABLE CONTINUOUS TEST VALUE [SINGLE #] POPULATION MEAN	TEST VARIABLE 1 CONTINUOUS TEST VARIABLE 2 CONTINUOUS	TEST VARIABLE CONTINUOUS FACTOR [2 GROUPS] CATEGORICAL	TEST VARIABLE [DV] CONTINUOUS FACTOR [IV, 2+ GROUPS] CATEGORICAL	TEST VARIABLE [DV] CONTINUOUS FACTOR 1 [IV, 2+ G.] CATEGORICAL / FACTOR 2 [IV, 2+ G.] CATEGORICAL	TEST VARIABLES [2] NOMINAL / TEST VARIABLES [2] ORDINAL	TEST VARIABLES [2] ORDINAL / TEST VARIABLES [2] CONTINUOUS	TEST VARIABLES CONTINUOUS	ANALYSIS VARIABLES CONTINUOUS	ANALYSIS VARIABLES CONTINUOUS
DIRECTION	-	-	-	ASSYMETRIC □ → □	ASSYMETRIC WITH MODERATION	SYMM □ ↔ □ / ASSYM □ → □ / SYMM □ ↔ □ / ASSYM □ → □	SYMMETRIC □ ↔ □	ASSYMMETRIC □ → □	-	-
STRENGTH	COHEN'S d = MEAN DIFFERENCE / STANDARD DEVIATION		COHEN'S d = 2*t / √df	ETA (η) = √(ETA² = SS BETWEEN / SS TOTAL)	ETA (η) = √(ETA² = SS ROW / SS C. TOTAL)	CRAMER'S V / PHI (φ)* / G & K'S TAU (τ) / GAMMA (γ) / SOMMER'S D	SPEARMAN'S RHO (ρ) / PEARSON'S r	BETA COEFFICIENT (b, b*) REGRESSION COEFFICIENT (PEARSON'S R) R-SQUARED (R²)	KMO	CRONBACH'S ALPHA (α)
FUNCTION	Checks if there is any signif-icant difference between the mean in the test scale and a given population mean. EXAMPLE TEST VARIABLE Age in, measured in years (integers). TEST VALUE Average age in, such as 45. 	Checks if there is any significant difference between the means from two scales belonging to the same unit of analysis (e.g, family, person). EXAMPLE 1 TEST VARIABLE 1 IQ scores of CEOs. TEST VARIABLE 2 IQ scores of lowest-level employees. EXAMPLE 2 TEST VARIABLE 1 Stats fear pre-course (1-7 scale). TEST VARIABLE 2 Stats fear post-course (1-7 scale). 	Checks if there is any significant difference between the means from two independent groups, measured in the same scale. EXAMPLE 1 TEST VARIABLE Extraversion (1-7 scale). FACTOR Male / Female. EXAMPLE 2 TEST VARIABLE Stats fear (1-7 scale). FACTOR Treatment / Control. 	Checks if there is any significant difference between the means from two or more inde-pendent groups, measured in the same scale. But this time, it's an F-Test. So we are assessessing whether there's any effect of X on Y (if at least one group's mean stands out from the others). Post hoc tests are a set of independent t-tests comparing all possible pairs of group means. EXAMPLE TEST VARIABLE Love for soccer. FACTOR US / Brazil / NL. 	Same as a One-Way ANOVA, but this time we're adding one extra factor as a moderator. This basically means we are increasing the number of groups to be compared. And the F-Test assesses each effects (each arrow) in the conceptual model. Post hoc tests remain the same as One-Way ANOVA, but now with way more pairs. EXAMPLE TEST VARIABLE Love for soccer. FACTOR 1 Male / Female. FACTOR 2 US / Brazil. 	Checks if there's any association between two categorical variables. We are building a pivot table, and checking if the total amount of participants per cell is surprising or not. If the observed counts are odd (a.k.a. too different than the expected values), we reject H0. EXAMPLE TEST VARIABLE 1 Favorite TV channel. TEST VARIABLE 2 Gender. MALE / FEMALE ESPN 20 6 MTV 6 20	Checks if there's any correlation between two variables. EXAMPLE TEST VARIABLE 1 Time spent watching TV (minutes). TEST VARIABLE 2 Time spent on the internet (minutes). 	Checks if the values in a variable or set of variables (independent) can predict the value of another variable (dependent). For a general overview, we look at the F-Test to check if the model (the combination of all variables) is a good fit. For specifics, we conduct one t-test for each predictor to see whether there's any effect. EXAMPLE INDEPENDENT VARIABLES → Neuroticism (1-7 scale). → # of bikes stolen in the past year. DEPENDENT VARIABLE → Bike insurance purchase int. (1-100 scale).  SIMPLE 1 IV / MULTIPLE 2+ IV	Finds similarities between and clusters items that seem to be measuring the same construct. EXAMPLE ANALYSIS VARIABLES → Personality statements (Big 5) 	Tests the reliability / internal consistency of items composing a factor. We use it to make inferences about the quality of the scale and its ability to consistently measure the construct of interest. EXAMPLE ANALYSIS VARIABLES → Extraversion items (Big 5) 
NULL HYPOTHESIS	T-TEST The difference between the mean in the test variable and the given mean (test value of 45) is 0 in the population. Alternatively: μ test var. = 45.	T-TEST The difference between the mean in test variable 1 and the mean in test variable 2 is 0 in the population. Alternatively: μ test var. 1 = μ test v. 2.	T-TEST The difference between the mean of group 1 and the mean of group 2 is 0 in the population. Alternatively: μ group 1 = μ group 2.	F-TESTS (one for each arrow) The coefficient (for the effect of X on Y) is equal to 0 in the population. Alternatively: μ1 = μ2 = [...]. POST-HOC T-TESTS The difference between the mean A and mean B is 0 in the population.		CHI-SQUARE TEST The measure of association is equal to 0 in the popu-lation. Alternatively: There is no association between the variables in the population.	T-TEST The correlation coefficient is equal to 0 in the population. Alternatively: There is no correlation between the variables in the population.	F-TEST The R coefficient (for the effect of X on Y) is equal to 0 in the population. PREDICTOR'S T-TESTS The B coefficient is equal to 0 in the popula-tion, while all other coefficients are set to 0.	-	-
ASSUMPTION	→ Test variable is normally distributed → At least 30 partic./group, ideally 100 → Independence	→ Test variable is normally distributed → At least 30 partic./group, ideally 100 → Dependence	→ Test variable is normally distributed → At least 30 partic./group, ideally 100 → Independence → Equal variance in all groups (Levene's test)	→ Test variable is normally distributed → At least 30 participants/group, ideally 100 → Independence → Equal variance in all groups (Levene's test, 10%)	→ Test variable is normally distributed → At least 30 participants/group, ideally 100. → Equal variance in all groups (Levene's test, 10%)	→ All expected counts must be at least 1. → Max 20% of cells with expected counts <5 → Independence of variables	→ Scatter plot curve / → Scatter plot line → Test variables are normally distributed → At least 30 participants, ideally 100 → Independence of variables	→ Linear scatter plot → Test variables are normally distributed → At least 30 participants, ideally 100 → Independence of variables → No multi-collinearity → Homoscedasticity	→ Items are normally distributed → At least 30 partic., ideally 100 → Independence of variables → Uniqueness of each item → KMO (Sampling Adequacy) → Bartlett's Test (Sphericity)	→ Items are normally distributed → At least 30 partic., ideally 100 → Independence of variables → Uniqueness of each item
RUNNING	Analyze → Compare Means → One-Sample T → Assign test variable → Test value = [given mean]	Analyze → Compare Means → Paired-Samples T → Insert both variables in row 1	Analyze → Compare Means → Ind-Samples T → Assign test variable → Assign factor as grouping variable → Define groups... → Specify values for groups 1 and 2	Analyze → Compare Means → One-Way ANOVA → Assign test variable as dependent → Assign factor → Post Hoc... → ☑Bonferroni (if 3+ groups) → Options... → ☑Descriptives ☑Homogeneity ☑Means plot	Analyze → General Linear Model → Univariate → Assign test variable as dependent → Assign factors in any order → Post Hoc... → ☑Bonferroni (if 3+ groups) → Options... → ☑Descriptives ☑Homogeneity → Plots... → Assign main factor as "Horizontal Axis" → Assign moderator as "Separate Lines"	Analyze → Descriptive Stats → Crosstabs → Assign each test variable as row and column → Stats... → ☑ Chi Square → Cells... → ☑Expected → ☑Columns → ☑Rows  SYMMETRICS ABOVE	Analyze → Correlate → Bivariate → Assign variables → Coefficient → ☑R or ☑RHO → Test → ☑Two-tailed or ☑One-tailed	Analyze → Regression → Linear → Assign dependent & independent variables → Stats... → ☑Confidence Intervals	Analyze → Dimension Reduct. → Factor Analysis → Add items measuring construct → Descriptions... → ☑KMO+B → Extraction... → ☑Scree plot → ☑Principal axis factoring → Rotation... → ☑Direct Oblimin → Options... → ☑S. small coeff. → ☐ Below .30	Analyze → Scale → Reliability Analysis → Add items that compose each factor (one factor at a time) → Statistics... → ☑Scale if item deleted

READING	ONE-SAMPLE STATISTICS
	N M SD SE
	AGE 72 38 ,49 ,50
	
	ONE-SAMPLE TEST
	TEST VALUE = 45
	DIFFERENCE
	t df Sig. M 95% CI ↓ ↑
	AGE -63 71 ,000 -7 -8 -6
		PAIRED SAMPLE STATISTICS
		M N SD SE
		IQ LLEs 112 44 15 5
		IQ CEOs 100 44 15 5
		
		PAIRED SAMPLES TEST
		DIFFERENCE
		M SD SE 95% CI ↓ ↑ t df Sig.
		PAIR 12 15 5 2 22 77 43 ,000
			GROUP STATISTICS
			N M SD SE
			MALE 82 4 1 1
			FEMALE 82 5 1 1
			
			INDEPENDENT SAMPLES TEST
			LEVENE'S F Sig. 0.20 ,675
			Levene's test determines which row to interpret in the difference table.
			SIGNIFICANT → CHECK SECOND ROW
			NOT SIGNIFICANT → CHECK FIRST ROW
			DIFFERENCE
			M SD SE 95% CI ↓ ↑ t df Sig.
			EVA 1 1 1 -1 3 ,50 81 ,250
			EVN
				DESCRIPTIVES
				N M SD SE
				US 67 2 1 1
				NL 66 6 1 1
				BR 68 7 1 1
				
				LEVENE'S
				SIG.
				BASED ON MEAN .923
				If Ns differ ≠10%, Levene's test must NOT significant.
				
				ANOVA
				SS df MS F Sig.
				BETWEEN G. 50 2 21 ,000
				WITHIN G. 186
				TOTAL 200
				
				POST HOC
				MULTIPLE COMP.
				MD SE Sig. 95% CI ↓ ↑
				US NL -4 1 ,010 -6 -2
				US BR -5 1 ,000 -7 -3
				NL BR 1 1 ,750 -1 3
					DESCRIPTIVES
					M SD N
					US F 6 1 66
					US M 3 1 67
					BR F 65
					BR M 7 1 68
					
					LEVENE'S
					SIG.
					BASED ON MEAN .897
					If Ns differ ≠10%, Levene's test must NOT significant.
					
					TEST OF BETWEEN-SUBJECTS EFFECTS
					SS df MS F Sig.
					COUNTRY 50 2 21 ,000
					SEX 2 1 1 ,300
					SEX*COUNTRY 30 1 6 ,010
					ERROR 186
					COR. TOTAL 200
					
					POST HOC
					MULTIPLE COMPARISONS
						PIVOT TABLE
						MALE FEMALE TOTAL
						ESPN COUNT 20 6 26
						EXPEC. 13 13
						MTV COUNT 6 20 26
						EXPEC. 13 13
						TOTAL 26 26
						
						CHI-SQUARED TESTS
						VALUE df Sig.
						P CHI-SQUARE 43.00 4 ,000
						N OF VALID CASES 55
						* 0 cells (0,0%) have expected counts less than 5. The minimum expected count is 8.
						
						MEASURES OF ASSOCIATION
						VALUE
						G & K's TAU CHANNEL DEP ,024
						SEX DEP ,023
						This table will vary according to which measure of association you've selected.
							CORRELATIONS
							TIME INT
							TIME TV PEARSON CORR. ,400
							Sig. (2-TAILED) ,000
								MODEL SUMMARY
								R R² ADJ. R² SE OF EST.
								MODEL 1 .80 .60 .50 22
								
								ANOVA
								SS df MS F Sig.
								REGRESSION 2 6 ,020
								RESIDUAL 7
								MODEL OVERVIEW
								
								PREDICTOR SPECIFICS
								(BETA) COEFFICIENTS
								b SE b* t Sig. 95% CI (B) ↓ ↑
								(CONST) 15 5 20 ,000 5 15
								NEUROT. 20 5 .30 20 ,010 10 30
								# BIKES 30 5 .50 60 ,000 20 40
								y = b₁ * x₁ + b₂ * x₂ + c
									TOTAL VARIANCE EXPLAINED
									TOTAL
									KMO MEASURE .800
									BARTLETT'S Sig. ,000
									
									PATTERN MATRIX
									FACTOR 1 2
									I AM EXCITED .000
									I AM SOCIAL .600
									I AM TALKATIVE .800
									I AM ASSERTIVE .700
									I AM EXPRESSIVE .700 .500
									I AM CREATIVE .800
									I AM IMAGINAT. .800
									I AM CURIOUS .700
									
									TOTAL VARIANCE EXPLAINED
									FCTR TOTAL % VAR CM %
									1 4.00 40 40
									2 1.50 10 50
										RELIABILITY STATISTICS
										CRONBACH'S α N OF ITEMS
										.90 22
										
										ITEM-TOTAL STATISTICS
										CRONB'S α IF ITEM DELETED
										EXCITED .80
										SOCIAL .87
										TALKATIVE .85
										ASSERTIVE .93
										EXPRESSIVE .78

INTERPRETING	0.8 = STRONG 0.5 = MODERATE 0.2 = WEAK d	0.5 = STRONG 0.3 = MODERATE < 0.3 = WEAK						V, φ, τ, γ, D, η, ρ, r, R, b*	0.8 = GOOD / EXCELLENT 0.7 = AVERAGE 0.5 = TERRIBLE / MEDIOCRE <0.5 = UNACCEPTABLE KMO	0.9 = EXCELLENT 0.8 = GOOD 0.6 = OK/QUESTIONABLE < 0.6 = UNACCEPTABLE α
REPORTING	H0 T-TEST The difference between the mean in and the mean in (45) is 0 in the population. INTRO A one-sample t test was conducted to test if the mean age in the Dutch population, measured by the test variable, differed significantly from the given German population mean (45 years). T-TEST Results showed that the aver-age age in was significantly lower than 45 with a strong effect size (M=38.00, SD=0.50), t(71)=-63.00, p<.001, d=-14.00, 95% CI[-8, -6]. The null hypoth-esis is rejected. DIFFERENCE DISTRIBUTION 	H0 T-TEST The difference between the average IQ of low employees and the average IQ of CEOs is 0 in the population. INTRO A dependent-sample t test was con-ducted to test if the mean IQ of CEOs, differed significantly from the mean IQ of low employees in the population. T-TEST A dependent t-test showed that the mean IQ of CEOs (M = 100.00, SD = 15.00) was significantly lower than the mean IQ of low employees with a strong effect size (M = 112.00, SD = 15.00), t(43) = 77.00, p < .001, d=0.80, 95% CI [2.00, 22.00]. The null hypoth-esis is rejected. DIFFERENCE DISTRIBUTION 	H0 T-TEST The difference between the average extraversion of males and the average of females is 0 in the population. Alternatively: μ Females = μ Males. H0 LEVENE'S TEST Variances are equal in both groups. INTRO An independent-sample t test was conducted to test if the mean extra-version of males, differed significantly from the mean extraversion of females in the population. EQUALITY OF VARIANCES Levene's test for equality of variances was not significant, F=0.20, p=.675. The null hypothesis is retained. T-TEST Results showed no significant differ-ences between average extraversion in males (M=4.00, SD=1.00), and average extraversion in females with a weak effect size (M=5.00, SD=1.00), t(81) = 0.50, p<.001, d=0.11, 95%CI [-1.00, 3.00]. The null hypothesis is retained. DIFFERENCE DISTRIBUTION 	H0 F-TEST The coefficient Eta (for the effect of nationality on love for soccer) is equal to 0 in the popula-tion. Alternatively: μUS = μBR = μNL. H0s POST-HOC T-TESTs The diff. of mean and mean is 0 in the pop. The diff. of mean and mean is 0 in the pop. The diff. of mean and mean is 0 in the pop. H0 LEVENE'S TEST Variances are equal in all groups. INTRO A one-way ANOVA was conducted to check the effect of nationality on love for soccer in the population. F-TEST The analysis of variance showed a significant strong effect of nationality on love for soccer, F(2,186)=21.00, p<.001, η²=.25. The null hypothesis is rejected. POST HOC TESTS Post hoc comparisons (Bonferroni corrected) indicated a significant difference between (M=2.00, SD=1.00) and (M=6.00, SD=1.00, p=.010) and between and (M=7.00, SD=1.00, p<.001) but not between and (p =.750). The null hypothesis is rejected for and pairs, but retained for -. VARIANCE Nationality explained 25% of the variance in love for soccer.	H0s F-TESTs (SHORTENED, SAME FORMAT AS 1-WAY) Eta (for Nation.→ is 0 in the pop. Alt: μ... Eta (for Sex → is 0 in the pop. Alt: μ... Eta (for N*S → is 0 in the pop. Alt: μ... (Same format as One-Way ANOVA) INTRO A two-way ANOVA was conducted to examine the effect of sex and nationality on love for soccer in the population. F-TESTS (MAIN EFFECTS) The analysis of variance showed a significant strong effect of nationality on love for soccer, F(2,186)=21.00, p<.001, η²=.25. The null hy-pothesis is rejected. There was no significant effect of sex on love for soccer, F(1186)=1.00, p=.300, η²=.01. The null hypothesis is retained. F-TEST (INTERACTION EFFECT) The analysis shows a significant moderate interaction effect between sex and nationality, F(1186)=6.00, p=.010, η²=.15. The effect of nationality on love for soccer is different for males and females. The null hypothesis is rejected. VARIANCE Nationality explained 25% of the variance in love for soccer. The interaction effect (N*S) explained 15% of the variance in love for soccer.	H0 CHI-SQUARE TEST The measure of association Goodman and Kruskal's Tau (τ) for the association between favorite TV chan-nel and sex is equal to 0 in the population. INTRO A chi-square analysis was conducted to check wether there is any association between chosen favorite TV channel and sex in the population. CHI-SQUARE TEST We found a significant but weak association between channel (dependent variable) and sex (independent variable), χ^2[4, N=55)=43.00, p<.001, τ=.02. The null hypothesis is rejected.	H0 T-TEST The correlation coefficient for the relation-ship between time watching TV and time on internet is equal to 0 in the population. INTRO We checked for the correlation between time spent watching TV and time spent on the internet. T-TEST The results revealed a significant moderate positive relationship between the time on TV and time on internet, r= .40, p<.001. The null hypothesis is rejected.	INTRO We conducted a linear regression to test the effect of neuroticism and # of bikes stolen (independent variables) on bike insurance purchase intention (dependent variable). F-TEST (MODEL) The regression model was significant and strong, F(2, 7)=6.00, p=.020. VARIANCE Together the variables explain 60% of the variance in purchase intention, reflecting a strong prediction (R^2 = .60). THE BETA COEFFICIENTS Neuroticism is a significant moderate pre-dictor of purchase intention, b=20.00, t=20, p=.010, 95% CI [10.00, 30.00]. Also, # of bikes stolen is a significant strong predictor, b=30.00, t=60, p<.001, 95% CI [20.00, 40.00]. For every unit increase in neuroticism, purchase intention goes up by 20 points. For every unit increase in # of bikes stolen, purchase intention goes up by 30 points. For all these effects other independent variables are assumed to be held constant. DISTRIBUTION FOR b NEUR. 	INTRO A principal axis factor analysis with Direct Oblimin rotation was conducted with 8 items that measure personality traits. ASSUMPTIONS KMO's measure of sampling adequacy is good and Bartlett's test of sphericity is significant (p<.001). ANALYSIS The scree plot shows that two factors are above the point of inflection, with Eigenvalues above 1 (factor 1 is 4.00, and factor 2 is 1.50). Factor 1 is consisted of 5 items measuring extraversion. Factor 2 is consisted of 3 items and measures open-mindedness. VARIANCE In total, the factors explained 50% of the variance in the 8 items, with factor 1 accounting for 40% of the variance explained, and factor 2 adding 10% of explained variance.  SCREE PLOT POINT OF INFLECTION EIGENVALUE FACTOR NUMBER	INTRO A reliability analysis was conducted to assess the internal consistency of factor 1 measuring "extraversion". RELIABILITY Internal consistency of factor 1 is excellent, α=.90.
FAQ	ALT. CONFIDENCE INTERVAL The CI above shows the differ-ence between both means. If we want to find the CI for the Dutch age average, we add the test value to the initial CI, end-ing up with CI[37.00, 39.00].			POST HOC REPORTS IN APA (1) Mention M+SD after every group. (2) Mention p-value at end of every pair. (3) Do not repeat M+SD if already mentioned. → GROUP 1 (M, SD) vs. GROUP 2 (M, SD, p) → GROUP 1 vs. GROUP 3 (M, SD, p) → GROUP 2 vs. GROUP 3 (p) LOOK AT ETA FOR STRENGTH, REPORT ETA²	WHICH ONE IS THE MODERATOR? The order of fixed factors does not alter the results. That is, there is no need to specify which of the two factors is the moderator be-cause mathematically it makes no difference. HIT ADD WHEN GENERATING PLOT! LOOK AT ETA FOR STRENGTH, REPORT ETA²	COLLAPSING CATEGORIES? If you do not manage to meet the assumptions, you can try decreasing the number of categories. For example, instead of school, college, master's, phd as options, you can regroup them into high and low education. → When asymmetric, clearly state which variable is dependent and which is independent.		NAMING b means "Unstandardized Beta Coefficient", b* means "Standardized Beta Coefficient". NEGATIVE BETA COEFFICIENT? If your b is negative, the interpretation changes to: for every unit increase in X, Y "goes down by #" —always measured in the unit of the dependent variable.	NEGATIVE FACTOR LOADINGS Negative loadings often indicate items that requires reverse coding. A SUBJECTIVE ANALYSIS You might have to make choices allocating or deleting items that do not seem to be valid. Simply make sure to state your rationale when reporting.	REVERSE CODING Make sure all the negatively loaded items are reverse codes prior to running your reliability analysis. MORE ITEMS OVER HIGHER α Prioritize having more items over improving α. Never delete items if α>.8

HIERARCHY
CONTINUOUS: RATIO, INTERVAL
CATEGORICAL: ORDINAL, NOMINAL

DEPENDENT
RESPONDING
Y-AXIS

MANIPULATING
INDEPENDENT
X-AXIS

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