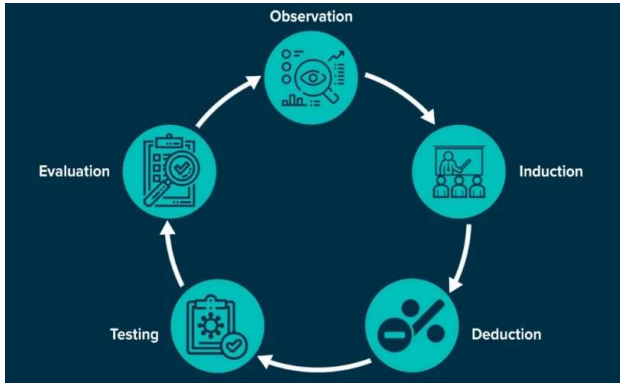
Empirical research in management and economics

Exercise

Thorsten Pachur, Linus Hof, Rebecca West, Sebastian Hellmann, Nuno Busch

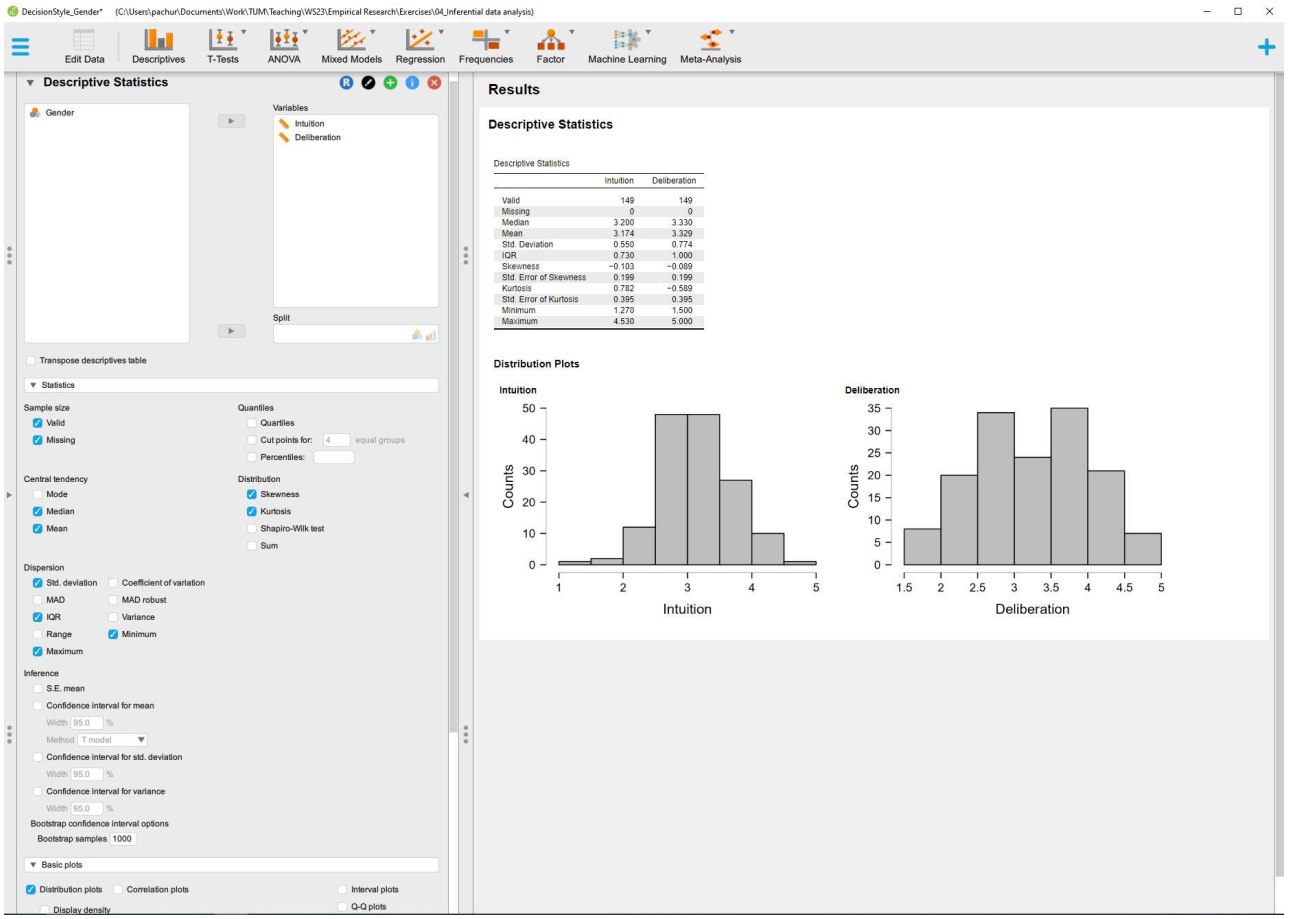
Technical University of Munich
School of Management
Chair of Behavioral Research Methods



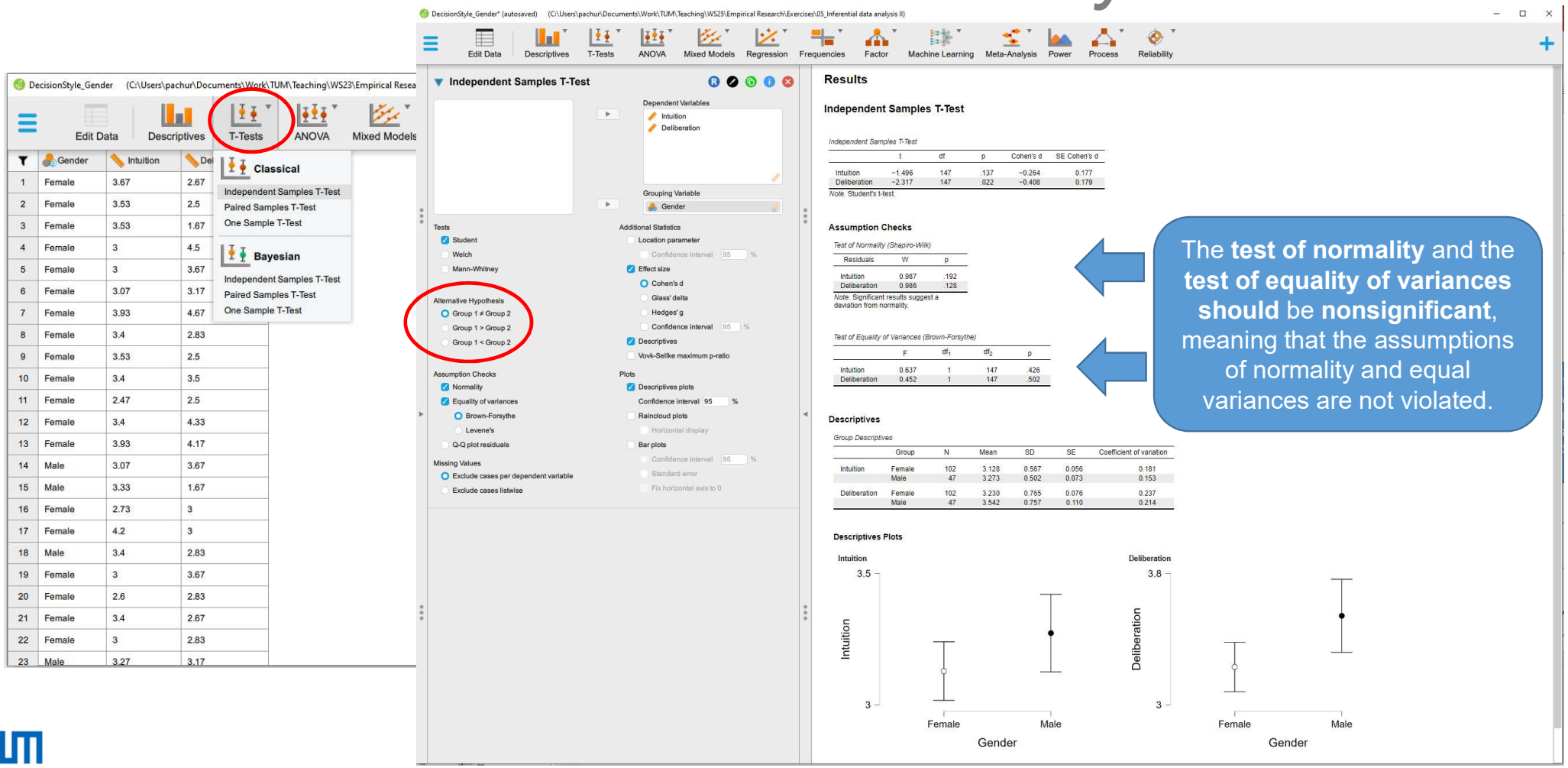
Exercise I: t-test

- Start JASP and open dataset “DecisionStyle_Gender.csv“
  → Scores of *N* = 149 (female and male) students on the intuitive decision style scale and on the deliberate decision style scale
- Do a descriptive data analysis
  - Central tendency, dispersion, distribution
  - Basic plots: Distribution plots
    → Describe the results for the different variables
- Do an inferential data analysis (independent samples t-test)
  →Do females and males differ in their decision style preference? Also compute the effect size.
  →Assume you wanted to test the hypothesis that females have a stronger preference for intuition than males. How would you need to adjust the analysis?

Inferential data analysis

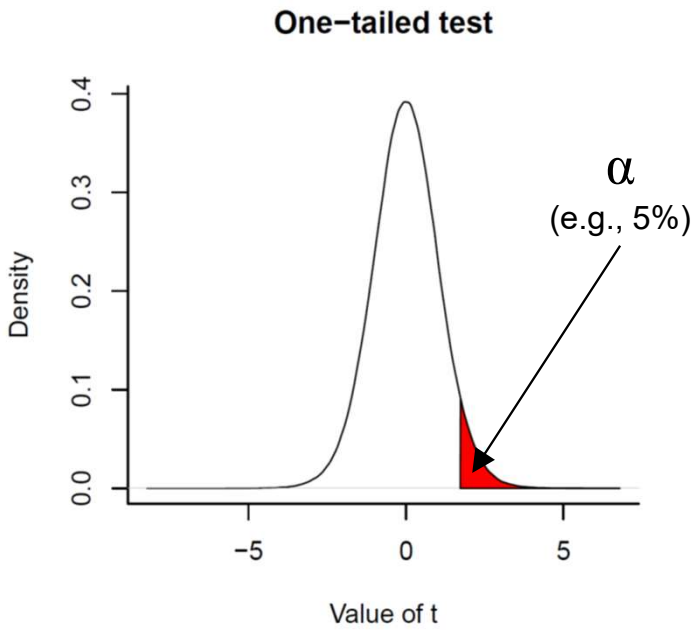


Inferential data analysis

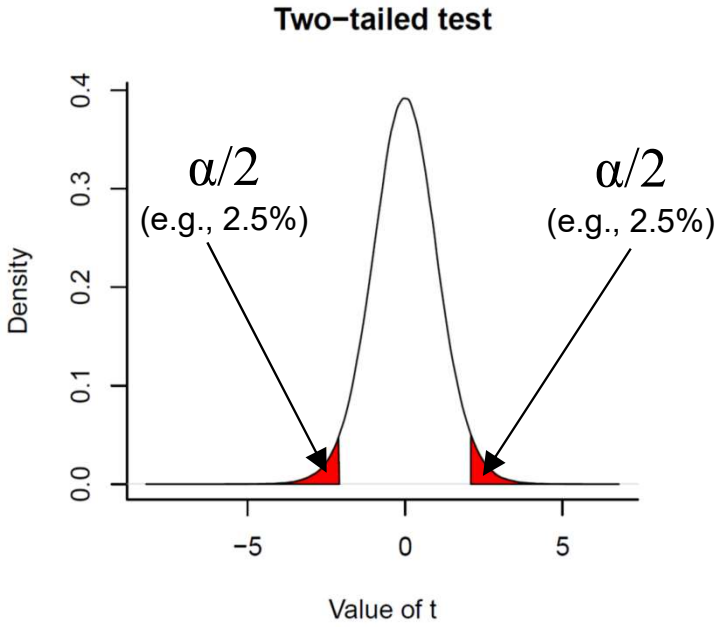


Two-tailed vs. one-tailed test

Directional hypothesis
(e.g., $M_{X1} > M_{X2}$)

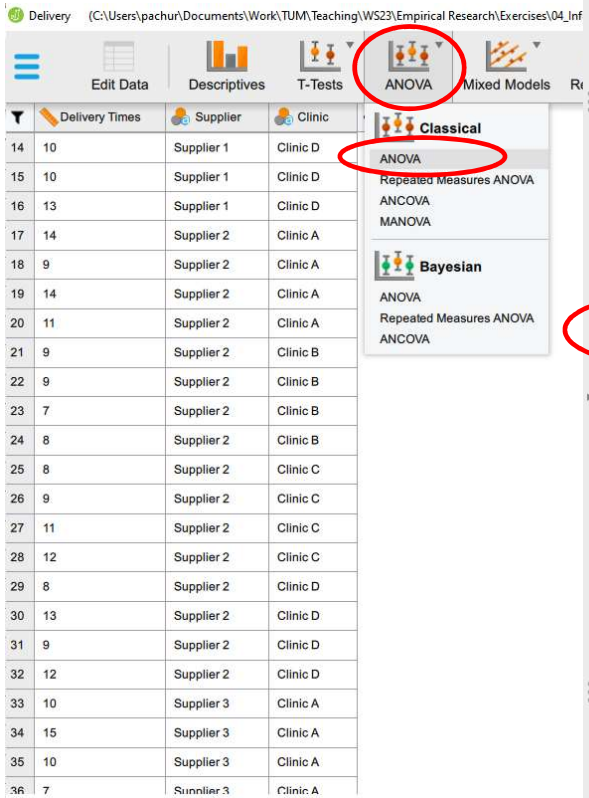


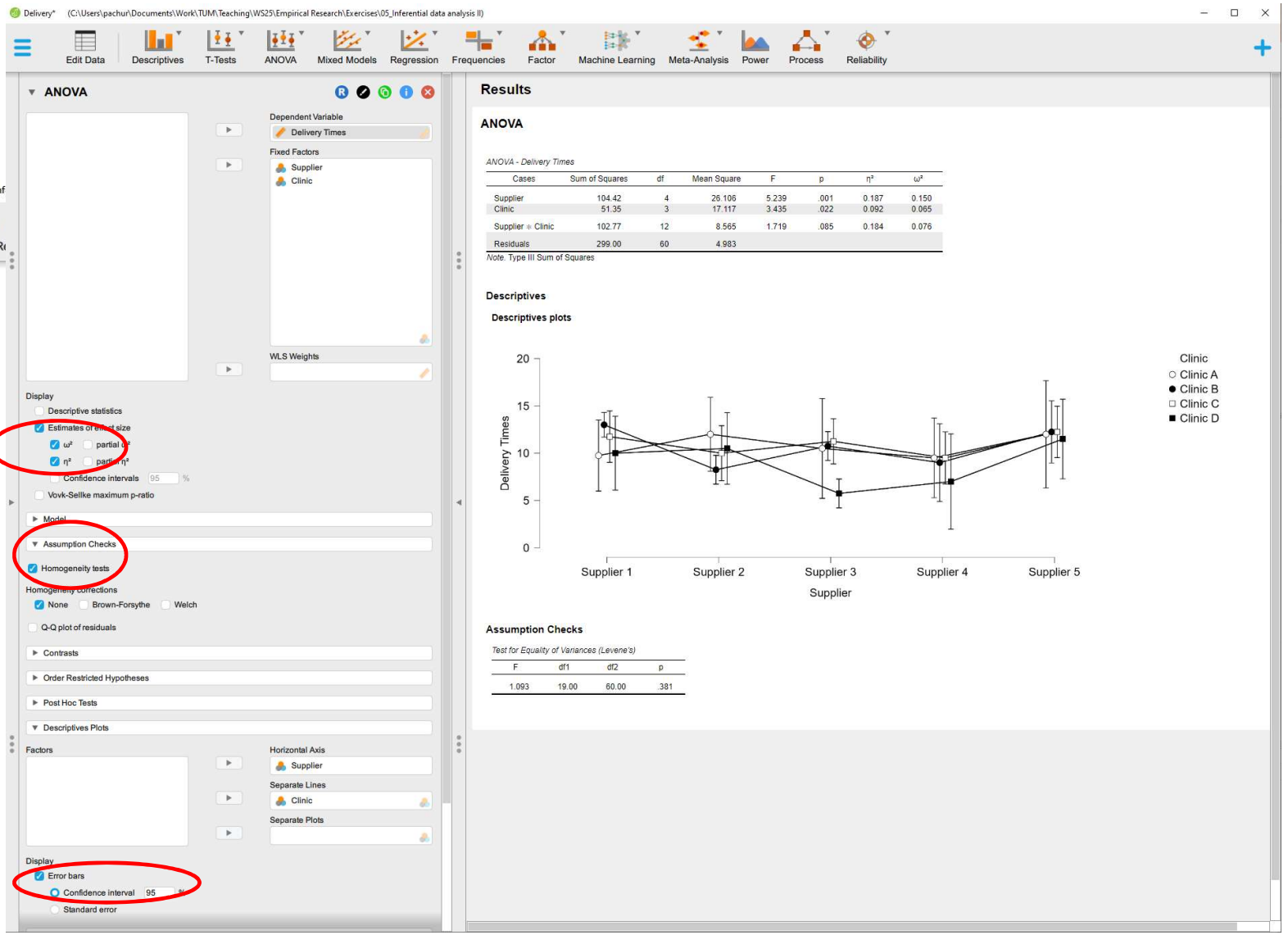
Non-directional hypothesis
(i.e., $M_{X1} \neq M_{X2}$)

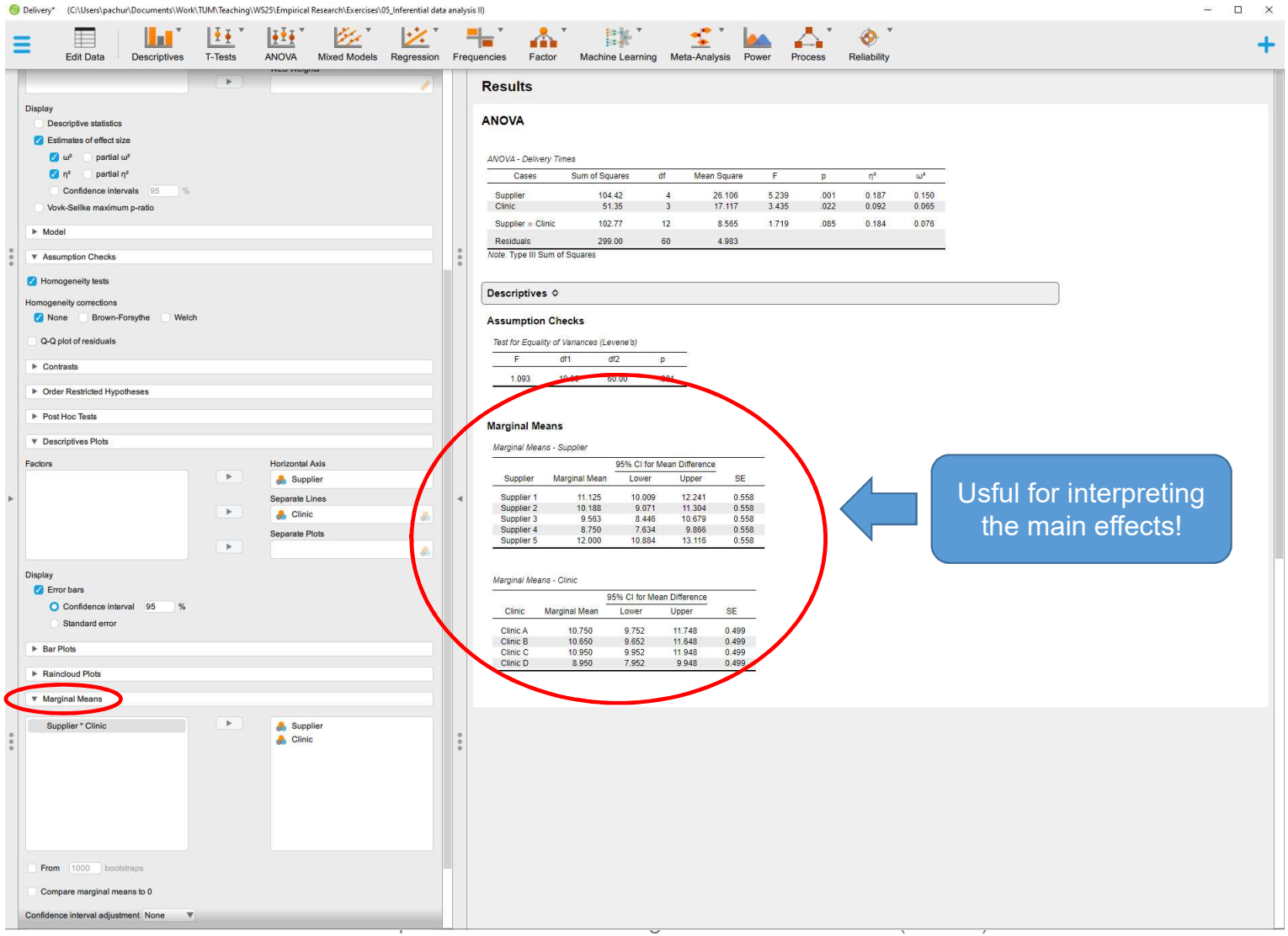


Exercise II: ANOVA

- A health maintenance organization orders weekly medical supplies for its four clinics from five different suppliers. Delivery times (in days) for 4 recent weeks are in the file “Delivery.csv”. Open the file.
- Test whether there are main effects for the factors “Clinics“ and “Supplier“—that is, whether delivery times differ between the four clinics and between the different supplies—and also test whether there is an interaction between the two factors.
  - Factorial ANOVA (2 factors, with 4 and 5 levels, respectively)
  - Also compute effect sizes


Delivery (C:\Users\pachur\Documents\Work\TUM\Teaching\WS23\Empirical Research\Exercises\04_Inf
Edit Data
Descriptives
T-Tests
ANOVA
Mixed Models
Delivery Times
Supplier
Clinic
14 10 Supplier 1 Clinic D
15 10 Supplier 1 Clinic D
16 13 Supplier 1 Clinic D
17 14 Supplier 2 Clinic A
18 9 Supplier 2 Clinic A
19 14 Supplier 2 Clinic A
20 11 Supplier 2 Clinic A
21 9 Supplier 2 Clinic B
22 9 Supplier 2 Clinic B
23 7 Supplier 2 Clinic B
24 8 Supplier 2 Clinic B
25 8 Supplier 2 Clinic C
26 9 Supplier 2 Clinic C
27 11 Supplier 2 Clinic C
28 12 Supplier 2 Clinic C
29 8 Supplier 2 Clinic D
30 13 Supplier 2 Clinic D
31 9 Supplier 2 Clinic D
32 12 Supplier 2 Clinic D
33 10 Supplier 3 Clinic A
34 15 Supplier 3 Clinic A
35 10 Supplier 3 Clinic A
36 7 Supplier 3 Clinic A
Classical
ANOVA
Repeated Measures ANOVA
ANCOVA
MANOVA
Bayesian
ANOVA
Repeated Measures ANOVA
ANCOVA


Delivery* (C:\Users\pachur\Documents\Work\TUM\Teaching\WS25\Empirical Research\Exercises\05_Inferential data analysis II)
Edit Data
Descriptives
T-Tests
ANOVA
Mixed Models
Regression
Frequencies
Factor
Machine Learning
Meta-Analysis
Power
Process
Reliability
ANOVA
Dependent Variable
Delivery Times
Fixed Factors
Supplier
Clinic
WLS Weights
Display
Descriptive statistics
Estimates of effect size
ω²
partial ω²
η²
partial η²
Confidence intervals 95 %
Vovk-Sellke maximum p-ratio
Model
Assumption Checks
Homogeneity tests
Homogeneity corrections
None
Brown-Forsythe
Welch
Q-Q plot of residuals
Contrasts
Order Restricted Hypotheses
Post Hoc Tests
Descriptives Plots
Factors
Horizontal Axis
Supplier
Separate Lines
Clinic
Separate Plots
Display
Error bars
Confidence interval 95 %
Standard error
Results
ANOVA
ANOVA - Delivery Times
Cases Sum of Squares df Mean Square F p η² ω²
Supplier 104.42 4 26.106 5.239 .001 0.187 0.150
Clinic 51.35 3 17.117 3.435 .022 0.092 0.065
Supplier ✳ Clinic 102.77 12 8.565 1.719 .085 0.184 0.076
Residuals 299.00 60 4.983
Note. Type III Sum of Squares
Descriptives
Descriptives plots
Delivery Times
Supplier
Supplier 1
Supplier 2
Supplier 3
Supplier 4
Supplier 5
Clinic
Clinic A
Clinic B
Clinic C
Clinic D
Assumption Checks
Test for Equality of Variances (Levene's)
F df1 df2 p
1.093 19.00 60.00 .381


Delivery* (C:\Users\pachur\Documents\Work\TUM\Teaching\WS25\Empirical Research\Exercises\05_Inferential data analysis II)
Edit Data
Descriptives
T-Tests
ANOVA
Mixed Models
Regression
Frequencies
Factor
Machine Learning
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Descriptive statistics
Estimates of effect size
ω² partial ω²
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Confidence intervals 95 %
Vovk-Sellke maximum p-ratio
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Homogeneity tests
Homogeneity corrections
None Brown-Forsythe Welch
Q-Q plot of residuals
Contrasts
Order Restricted Hypotheses
Post Hoc Tests
Descriptives Plots
Factors
Horizontal Axis
Supplier
Separate Lines
Clinic
Separate Plots
Display
Error bars
Confidence interval 95 %
Standard error
Bar Plots
Raincloud Plots
Marginal Means
Supplier * Clinic
Supplier
Clinic
From 1000 bootstraps
Compare marginal means to 0
Confidence interval adjustment None
Results
ANOVA
ANOVA - Delivery Times
Cases Sum of Squares df Mean Square F p η² ω²
Supplier 104.42 4 26.106 5.239 .001 0.187 0.150
Clinic 51.35 3 17.117 3.435 .022 0.092 0.065
Supplier ✳ Clinic 102.77 12 8.565 1.719 .085 0.184 0.076
Residuals 299.00 60 4.983
Note. Type III Sum of Squares
Descriptives
Assumption Checks
Test for Equality of Variances (Levene's)
F df1 df2 p
1.093 60.00
Marginal Means
Marginal Means - Supplier
Supplier Marginal Mean 95% CI for Mean Difference Lower Upper SE
Supplier 1 11.125 10.009 12.241 0.558
Supplier 2 10.188 9.071 11.304 0.558
Supplier 3 9.563 8.446 10.679 0.558
Supplier 4 8.750 7.634 9.866 0.558
Supplier 5 12.000 10.884 13.116 0.558
Marginal Means - Clinic
Clinic Marginal Mean 95% CI for Mean Difference Lower Upper SE
Clinic A 10.750 9.752 11.748 0.499
Clinic B 10.650 9.652 11.648 0.499
Clinic C 10.950 9.952 11.948 0.499
Clinic D 8.950 7.952 9.948 0.499
Usful for interpreting the main effects!

Exercise III: Chi-square test

Dataset “LectureSurvey.csv“

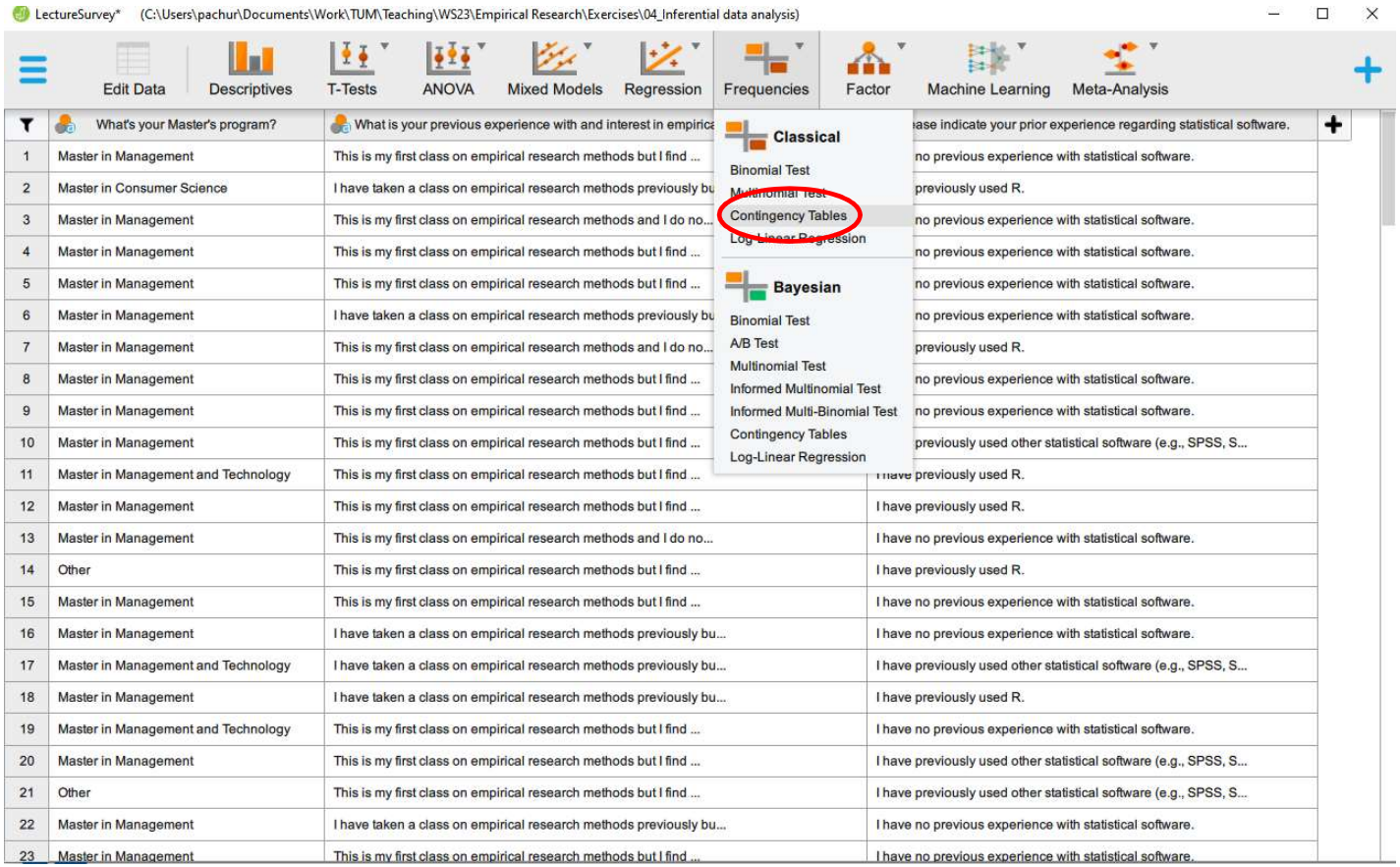
→ Experience with statistical software and experience with and interest in empirical research methods for students from different Master‘s programs

Inferential data analysis

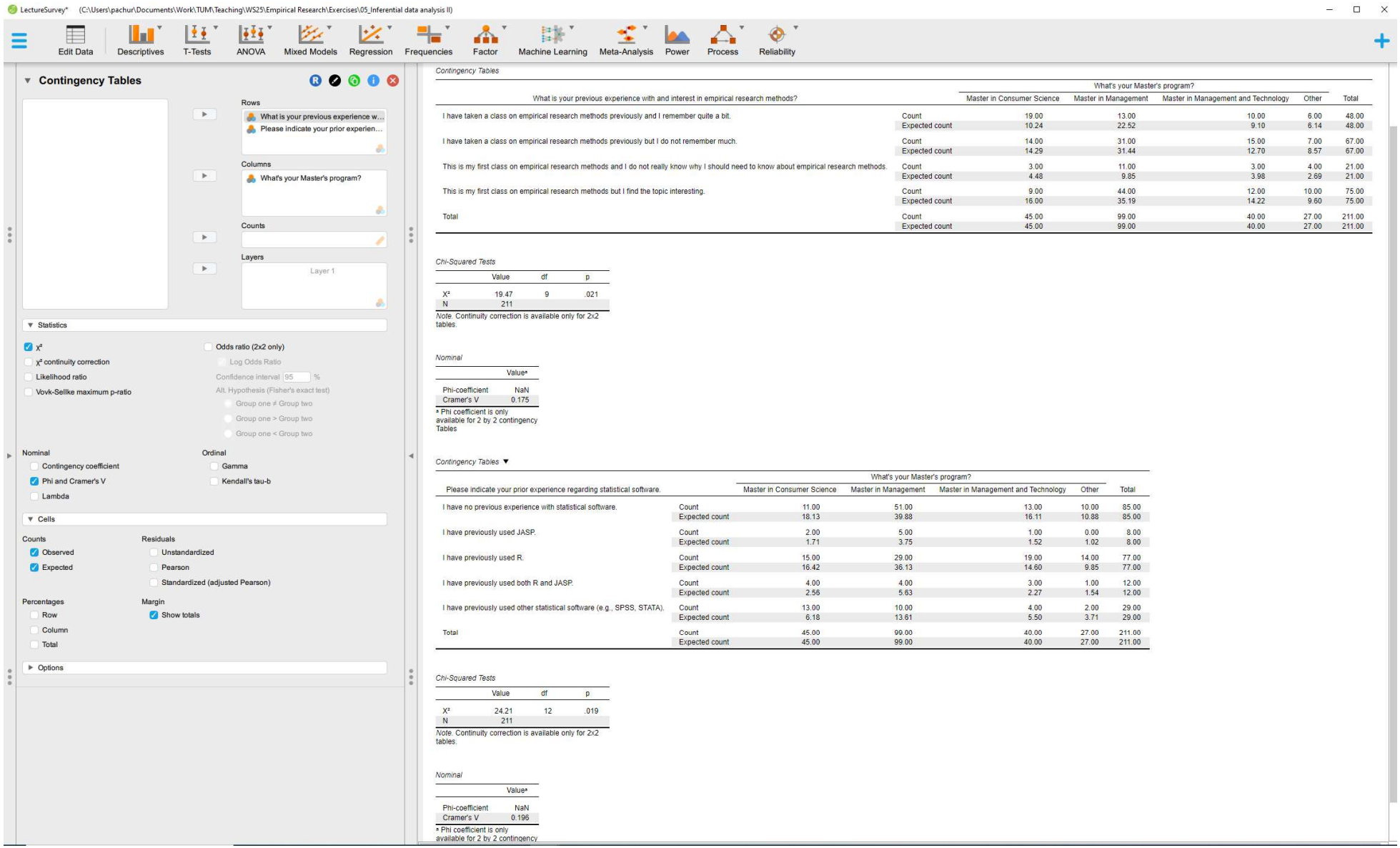
Chi-square test

- Does experience with statistical software differ across the different Master‘s programs? Also compute the effect size.
- Does experience with and interest in empirical research methods differ across the different Master‘s programs? Also compute the effect size.

Inferential data analysis



	What's your Master's program?	What is your previous experience with and interest in empirica	ase indicate your prior experience regarding statistical software.
1	Master in Management	This is my first class on empirical research methods but I find ...	no previous experience with statistical software.
2	Master in Consumer Science	I have taken a class on empirical research methods previously bu	previously used R.
3	Master in Management	This is my first class on empirical research methods and I do no...	no previous experience with statistical software.
4	Master in Management	This is my first class on empirical research methods but I find ...	no previous experience with statistical software.
5	Master in Management	This is my first class on empirical research methods but I find ...	no previous experience with statistical software.
6	Master in Management	I have taken a class on empirical research methods previously bu	no previous experience with statistical software.
7	Master in Management	This is my first class on empirical research methods and I do no...	previously used R.
8	Master in Management	This is my first class on empirical research methods but I find ...	no previous experience with statistical software.
9	Master in Management	This is my first class on empirical research methods but I find ...	no previous experience with statistical software.
10	Master in Management	This is my first class on empirical research methods but I find ...	previously used other statistical software (e.g., SPSS, S...
11	Master in Management and Technology	This is my first class on empirical research methods but I find ...	I have previously used R.
12	Master in Management	This is my first class on empirical research methods but I find ...	I have previously used R.
13	Master in Management	This is my first class on empirical research methods and I do no...	I have no previous experience with statistical software.
14	Other	This is my first class on empirical research methods but I find ...	I have previously used R.
15	Master in Management	This is my first class on empirical research methods but I find ...	I have no previous experience with statistical software.
16	Master in Management	I have taken a class on empirical research methods previously bu...	I have no previous experience with statistical software.
17	Master in Management and Technology	I have taken a class on empirical research methods previously bu...	I have previously used other statistical software (e.g., SPSS, S...
18	Master in Management	I have taken a class on empirical research methods previously bu...	I have previously used R.
19	Master in Management and Technology	This is my first class on empirical research methods but I find ...	I have no previous experience with statistical software.
20	Master in Management	This is my first class on empirical research methods but I find ...	I have previously used other statistical software (e.g., SPSS, S...
21	Other	This is my first class on empirical research methods but I find ...	I have previously used other statistical software (e.g., SPSS, S...
22	Master in Management	I have taken a class on empirical research methods previously bu...	I have no previous experience with statistical software.
23	Master in Management	This is my first class on empirical research methods but I find ...	I have no previous experience with statistical software.



Contingency Tables

What is your previous experience with and interest in empirical research methods?		What's your Master's program?				
		Master in Consumer Science	Master in Management	Master in Management and Technology	Other	Total
I have taken a class on empirical research methods previously and I remember quite a bit.	Count	19.00	13.00	10.00	6.00	48.00
	Expected count	10.24	22.52	9.10	6.14	48.00
I have taken a class on empirical research methods previously but I do not remember much.	Count	14.00	31.00	15.00	7.00	67.00
	Expected count	14.29	31.44	12.70	8.57	67.00
This is my first class on empirical research methods and I do not really know why I should need to know about empirical research methods.	Count	3.00	11.00	3.00	4.00	21.00
	Expected count	4.48	9.85	3.98	2.69	21.00
This is my first class on empirical research methods but I find the topic interesting.	Count	9.00	44.00	12.00	10.00	75.00
	Expected count	16.00	35.19	14.22	9.60	75.00
Total	Count	45.00	99.00	40.00	27.00	211.00
	Expected count	45.00	99.00	40.00	27.00	211.00

Chi-Squared Tests

	Value	df	p
X^2	19.47	9	.021
N	211		

Note. Continuity correction is available only for 2x2 tables.

Nominal

	Value[a]
Phi-coefficient	NaN
Cramer's V	0.175

[a] Phi coefficient is only available for 2 by 2 contingency Tables

Contingency Tables ▼

Please indicate your prior experience regarding statistical software.		What's your Master's program?				
		Master in Consumer Science	Master in Management	Master in Management and Technology	Other	Total
I have no previous experience with statistical software.	Count	11.00	51.00	13.00	10.00	85.00
	Expected count	18.13	39.88	16.11	10.88	85.00
I have previously used JASP.	Count	2.00	5.00	1.00	0.00	8.00
	Expected count	1.71	3.75	1.52	1.02	8.00
I have previously used R.	Count	15.00	29.00	19.00	14.00	77.00
	Expected count	16.42	36.13	14.60	9.85	77.00
I have previously used both R and JASP.	Count	4.00	4.00	3.00	1.00	12.00
	Expected count	2.56	5.63	2.27	1.54	12.00
I have previously used other statistical software (e.g., SPSS, STATA).	Count	13.00	10.00	4.00	2.00	29.00
	Expected count	6.18	13.61	5.50	3.71	29.00
Total	Count	45.00	99.00	40.00	27.00	211.00
	Expected count	45.00	99.00	40.00	27.00	211.00

Chi-Squared Tests

	Value	df	p
X^2	24.21	12	.019
N	211		

Note. Continuity correction is available only for 2x2 tables.

Nominal

	Value[a]
Phi-coefficient	NaN
Cramer's V	0.196

[a] Phi coefficient is only available for 2 by 2 contingency