

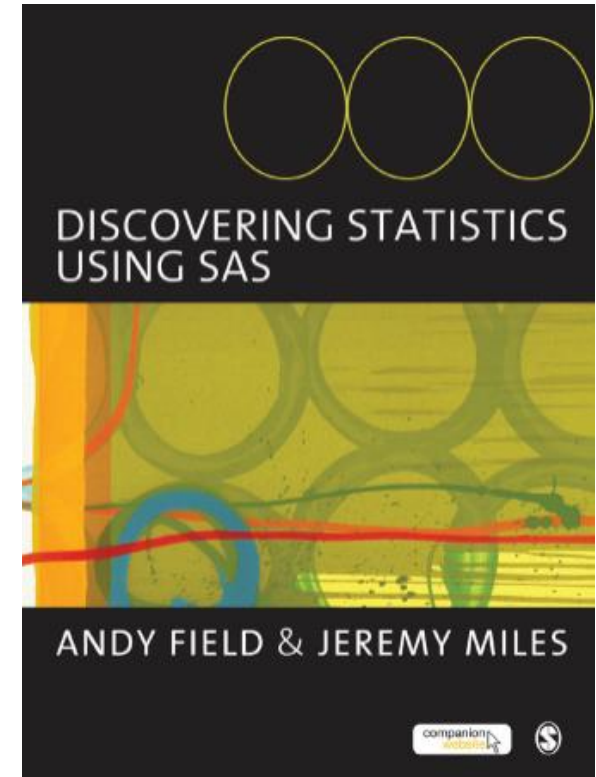
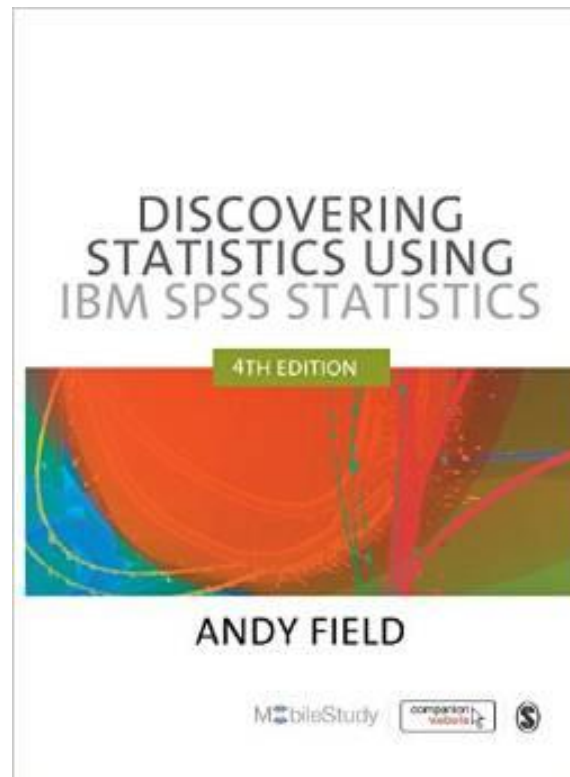
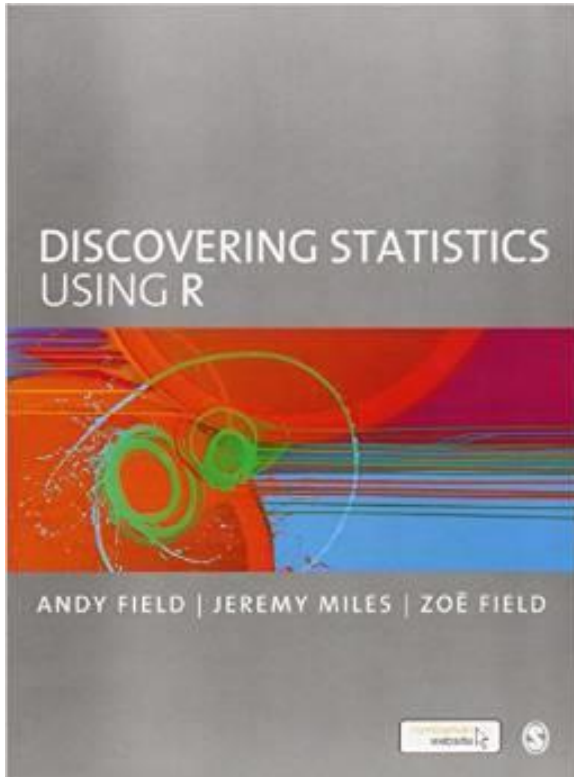
Kvantitativna analiza in SPSS

doc. dr. Franc Brcar

Pregled poglavij

Prirejeno po: Field, A. (2009). *Discovering Statistics Using SPSS*. London: SAGE.

Discovering Statistics Using R & SPSS & SAS



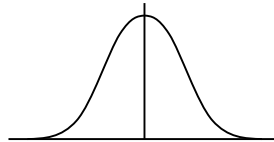
Pregled poglavij

1. Uvod
2. Osnove statistike
3. SPSS-okolje
4. Preučevanje podatkov z grafi
5. Statistične omejitve in predpostavke
6. Korelacija
7. Linearna regresija
8. Logistična regresija
9. Primerjava dveh povprečij s t-testom
10. Primerjava več povprečij (ANOVA – GLM 1)
11. Analiza kovarianc (ANCOVA – GLM 2)
12. Faktorska ANOVA (GLM 3)
13. Ponavljajoče merjenje (GLM 4)
14. Mešane analize (GLM 5)
15. Ne-parametrični testi
16. Multivariatna analiza variance (MANOVA)
17. Faktorska analiza
18. Kategorne spremenljivke in HI-kvadrat test
19. Več-nivojski modeli

1. poglavje

Zakaj statistika

- Spremenljivke:
 - *Nominal* – imenska: (DA/Ne).
 - *Ordinal* – urejenostna: (prvi/drugi/tretji, 1/2/3/4/5).
 - *Interval* – intervalna: (165 cm, 93 Kg, -3/-2/-1/0/1/2/3).
 - *Rational* – razmernostna: (0,85 s).



Normalna
porazdelitev

2. poglavje

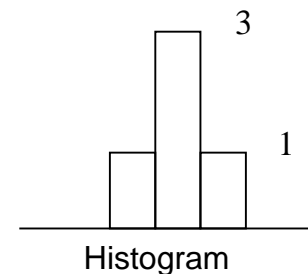
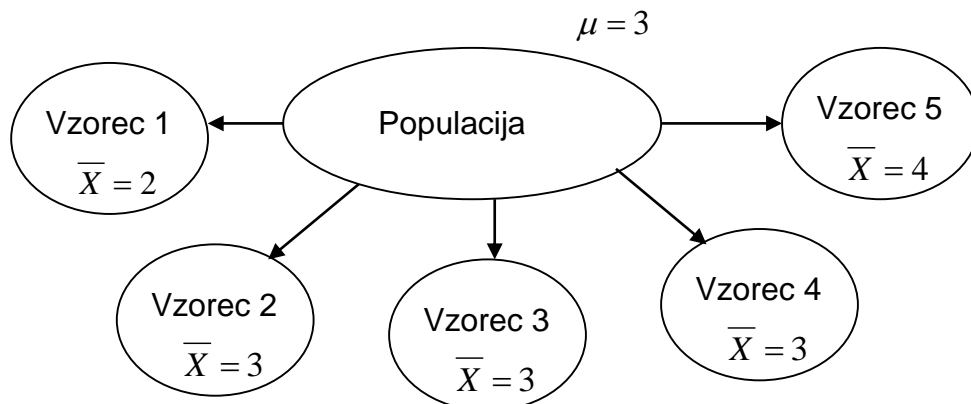
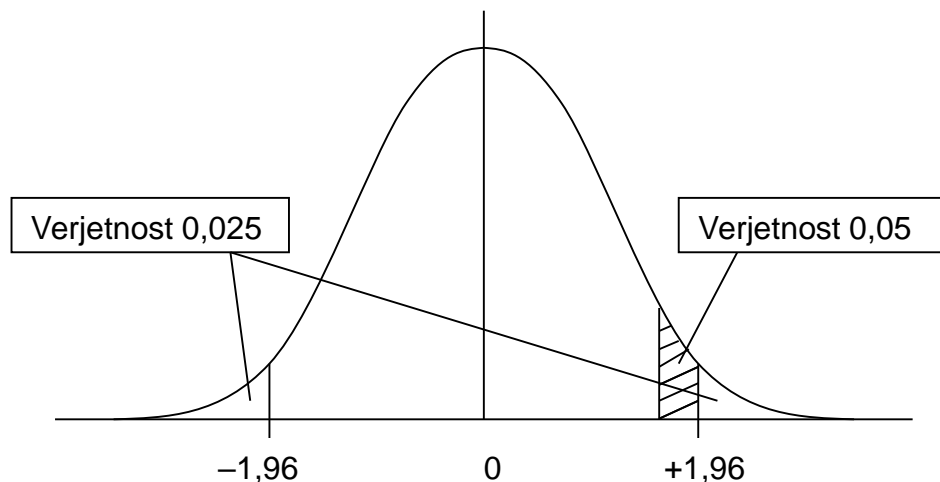
Vse kar ste želeli vedeti o statistiki

- Moč učinka:
- $r = 0,1$... majhen efekt.
- $r = 0,3$... srednji efekt.
- $r = 0,5$... velik efekt (močan).

Tabela 1: Napake tipa I (α) in II (β)

	H0 je pravilna	H0 je napačna
Zavrnamo	α = napaka tipa I	Pravilna odločitev
Sprejmemo	Pravilna odločitev	β = napaka tipa II

Opomba. H0: Izdelek je dober



3. poglavje SPSS okolje

Album Sales.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

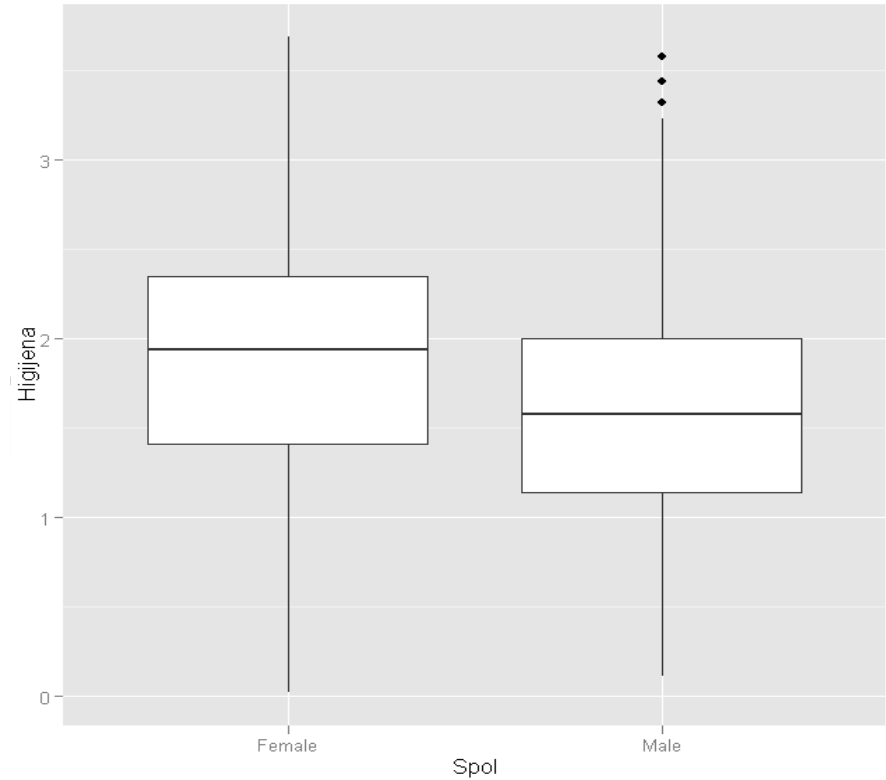
Visible: 4 of 4 Variables

	Adverts	Sales	Airplay	Attract	var	var	var	var	var	var	var
1	10,26	330	43	10							
2	985,69	120	28	7							
3	1445,56	360	35	7							
4	1188,19	270	33	7							
5	574,51	220	44	5							
6	568,95	170	19	5							
7	471,81	70	20	1							
8	537,35	210	22	9							
9	514,07	200	21	7							
10	174,09	300	40	7							
11	1720,81	290	32	7							
12	611,48	70	20	2							
13	251,19	150	24	8							
14	97,97	190	38	6							

Data View Variable View

IBM SPSS Statistics Processor is ready Unicode:ON

4. poglavje Grafii



5. poglavje

Raziskovanje predpostavk

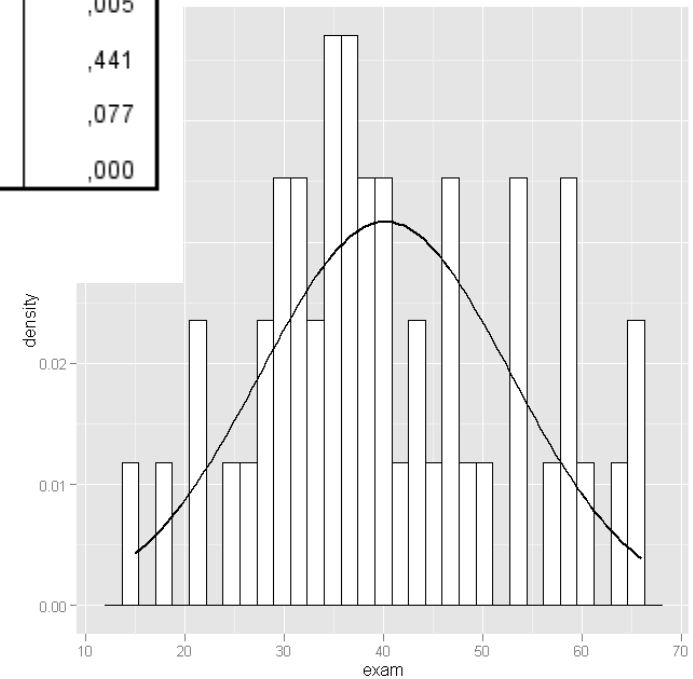
- Kolmogorov-Smirnov in Shapiro-Wilk test normalnosti.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Percentage on SPSS exam	,102	100	,012	,961	100	,005
Computer literacy	,095	100	,027	,987	100	,441
Percentage of lectures attended	,064	100	,200*	,977	100	,077
Numeracy	,153	100	,000	,924	100	,000

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction



6. poglavje Korelacija

- Korelacije:
 - Pearson
 - Spearman (NP), Kendall (NP), bootstrapping (NP)
 - Bi-serial (ena spremenljivka je kontinuirana dihotomna)
 - Point-bi-serial (ena spremenljivka je diskretna dihotomna)
 - Partial (imamo še kontrolno spremenljivko, ki vpliva na obe spremenljivki)
 - Semi-partial (imamo še kontrolno spremenljivko, ki vpliva na eno spremenljivko)

Correlations

		Time Spent Revising	Exam Performance (%)	Exam Anxiety
Time Spent Revising	Pearson Correlation	1	,397**	-,709**
	Sig. (2-tailed)		,000	,000
	N	103	103	103
Exam Performance (%)	Pearson Correlation	,397**	1	-,441**
	Sig. (2-tailed)	,000		,000
	N	103	103	103
Exam Anxiety	Pearson Correlation	-,709**	-,441**	1
	Sig. (2-tailed)	,000	,000	
	N	103	103	103

** . Correlation is significant at the 0.01 level (2-tailed).

	var1	var2
1	1	4
2	2	5
3	3	4
4	1	4
5	2	3

7. poglavje Regresija

- Regresija
 - Enostavna regresija
 - Multipla regresija
 - Robustna regresija: bootstrapping (NP)
 - Multipla regresija s kategorno napovedno spremenljivko
- Odvisna spremenljivka (rezultat).
- Neodvisna spremenljivka (napovedna spremenljivka).

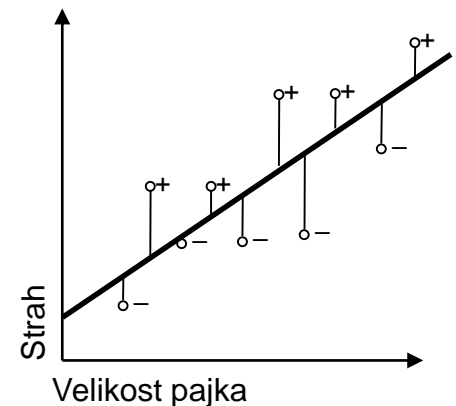
$$Y_i = (b_0 + b_1 X_i) + \varepsilon_i$$

	Odvisna	Neodvisna
1	1	4
2	2	5
3	3	4
4	1	4
5	2	3

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	134,140	7,537		17,799	,000
	Advertising Budget (Thousands of Pounds)	,096	,010	,578	9,979	,000

a. Dependent Variable: Album Sales (Thousands)



8. poglavje

Logistična regresija

- Logistična regresija
 - Logistična regresija (odvisna spremenljivka je kategorna)
 - Multinomialna logistična regresija (odvisna spremenljivka ima več kategorij)

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1 ^a	Intervention(1)	1,229	,400	9,447	1	,002	3,417	1,561	7,480
	Constant	-,288	,270	1,135	1	,287	,750		

a. Variable(s) entered on step 1: Intervention.

	Zdrav	Intervencija	Trajanje
1	DA	DA	5
2	DA	NE	4
3	DA	DA	2
4	NE	NE	3
5	NE	DA	7

doc. dr. Franc Bracar: Kvantitativna analiza in SPSS.

Prirejeno po: Field, A. (2009). Discovering Statistics Using SPSS. London: SAGE.

9. poglavje

Primerjava dveh povprečij (*t*-test)

- Odvisni *t*-test
- Wilcoxon signed-rank, WRS (Bootstrap).

Paired Samples Test

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Par 1	Picture of Spider - Real Spider	-7,000	9,807	2,831	-13,231	-7,769	-2,473	11	,031

- Neodvisni *t*-test.
- Wilcoxon rank-sum & Mann-Whitney, WRS.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Anxiety	Equal variances assumed	7,82	,386	-1,681	22	,107	-7,000	4,163	-15,634	1,634
	Equal variances not assumed			-1,681	21,385	,107	-7,000	4,163	-15,649	1,649

	picture	real
1	30	40
2	35	35
3	45	50
4	40	55
5	50	65
6	35	55
7	55	50
8	25	35
9	30	30
10	45	50
11	40	60
12	50	39

	Group	Anxiety
1	Picture	30
2	Picture	35
3	Picture	45
4	Picture	40
5	Picture	50
6	Picture	35
7	Picture	55
8	Picture	25
9	Picture	30
10	Picture	45
11	Picture	40
12	Picture	50
13	Real Spider	40
14	Real Spider	35
15	Real Spider	50
16	Real Spider	55
17	Real Spider	65
18	Real Spider	55
19	Real Spider	50
20	Real Spider	35
21	Real Spider	30
22	Real Spider	50
23	Real Spider	60
24	Real Spider	39

10. poglavje

Primerjava več povprečij – neodvisna ANOVA (GLM1)

- Neodvisna ANOVA
- Kruskal-Wallis (NP), WRS (Bootstrap)

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2,200	,627		3,508	,004
	Dummy Variable 1	2,800	,887	,773	3,157	,008
	Dummy Variable 2	1,000	,887	,276	1,127	,282

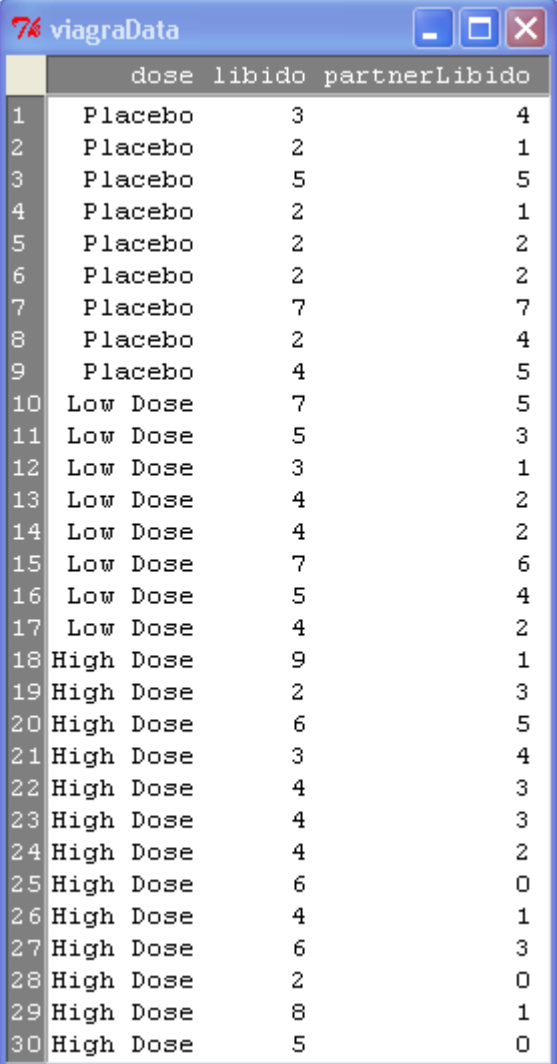
a. Dependent Variable: Libido

	skupina	rezultat
1	Placebo	3
2	Placebo	2
3	Placebo	1
4	Placebo	1
5	Placebo	4
6	Low Dose	5
7	Low Dose	2
8	Low Dose	4
9	Low Dose	2
10	Low Dose	3
11	High Dose	7
12	High Dose	4
13	High Dose	5
14	High Dose	3
15	High Dose	6

11. poglavje

Analiza kovarianc, ANCOVA (GLM2)

- Neodvisni ANOVA dodamo kovariat

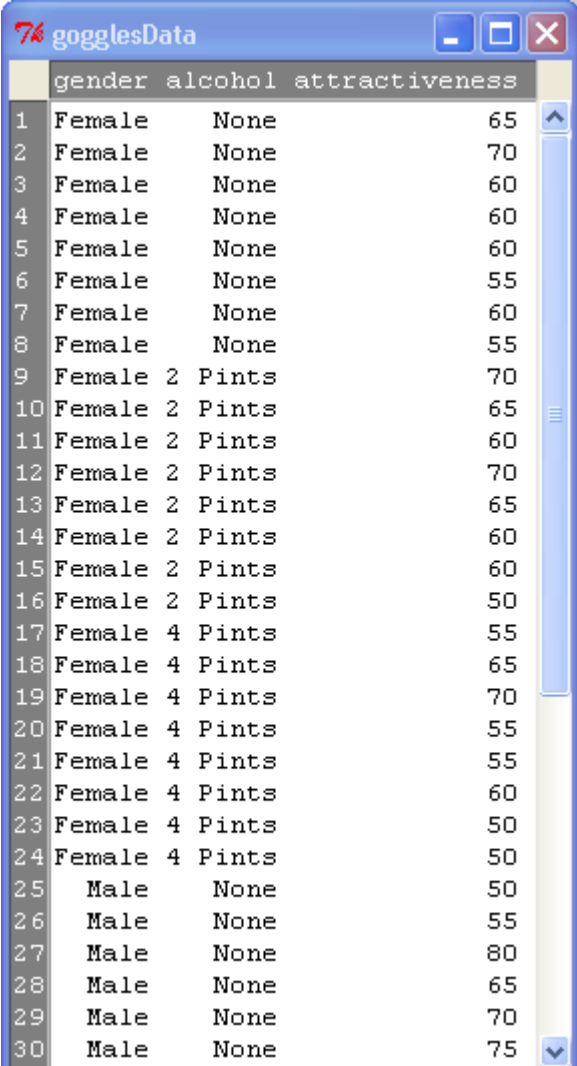


	dose	libido	partnerLibido
1	Placebo	3	4
2	Placebo	2	1
3	Placebo	5	5
4	Placebo	2	1
5	Placebo	2	2
6	Placebo	2	2
7	Placebo	7	7
8	Placebo	2	4
9	Placebo	4	5
10	Low Dose	7	5
11	Low Dose	5	3
12	Low Dose	3	1
13	Low Dose	4	2
14	Low Dose	4	2
15	Low Dose	7	6
16	Low Dose	5	4
17	Low Dose	4	2
18	High Dose	9	1
19	High Dose	2	3
20	High Dose	6	5
21	High Dose	3	4
22	High Dose	4	3
23	High Dose	4	3
24	High Dose	4	2
25	High Dose	6	0
26	High Dose	4	1
27	High Dose	6	3
28	High Dose	2	0
29	High Dose	8	1
30	High Dose	5	0

12. poglavje

Faktorska (neodvisna) ANOVA (GLM3)

- Faktorska neodvisna ANOVA
- Neodvisni ANOVA dodamo grupe (faktorje)



The screenshot shows a data viewer window titled 'gogglesData' with three columns: 'gender', 'alcohol', and 'attractiveness'. The data is organized into 30 rows, with the first 8 rows representing 'None' alcohol consumption, rows 9-16 representing '2 Pints', rows 17-24 representing '4 Pints', and the final 6 rows representing 'None' alcohol consumption for males.

	gender	alcohol	attractiveness
1	Female	None	65
2	Female	None	70
3	Female	None	60
4	Female	None	60
5	Female	None	60
6	Female	None	55
7	Female	None	60
8	Female	None	55
9	Female	2 Pints	70
10	Female	2 Pints	65
11	Female	2 Pints	60
12	Female	2 Pints	70
13	Female	2 Pints	65
14	Female	2 Pints	60
15	Female	2 Pints	60
16	Female	2 Pints	50
17	Female	4 Pints	55
18	Female	4 Pints	65
19	Female	4 Pints	70
20	Female	4 Pints	55
21	Female	4 Pints	55
22	Female	4 Pints	60
23	Female	4 Pints	50
24	Female	4 Pints	50
25	Male	None	50
26	Male	None	55
27	Male	None	80
28	Male	None	65
29	Male	None	70
30	Male	None	75

13. poglavje

Odvisna ANOVA – ponovljeno mejenje (GLM4)

- Odvisna ANOVA
 - Friedman-ova ANOVA (NP)
 - NP je WRS (Bootstrap)
 - Faktorska odvisna ANOVA

	participant	stick_insect	kangaroo_testicle	fish_eye	witchetty_grub
1	P1	8	7	1	6
2	P2	9	5	2	5
3	P3	6	2	3	8
4	P4	5	3	1	9
5	P5	8	4	5	8
6	P6	7	5	6	7
7	P7	10	2	7	2
8	P8	12	6	8	1

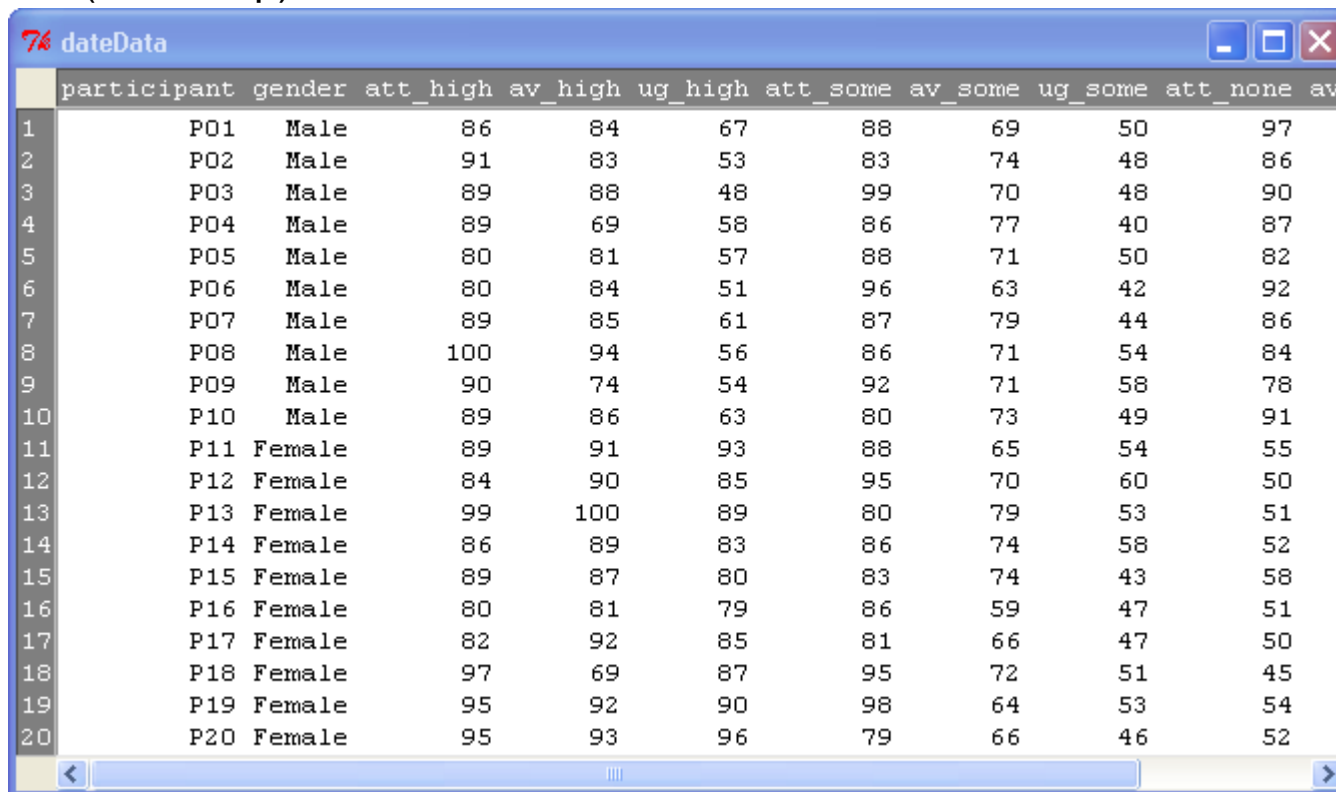
- Faktorska odvisna ANOVA

	beerpos	beerneq	beerneut	winepos	wineq	wineut	waterpos	waterneq	waterneu	par
1	1	6	5	38	-5	4	10	-14	-2	
2	43	30	8	20	-12	4	9	-10	-13	
3	15	15	12	20	-15	6	6	-16	1	
4	40	30	19	28	-4	0	20	-10	2	
5	8	12	8	11	-2	6	27	5	-5	
6	17	17	15	17	-6	6	9	-6	-13	
7	30	21	21	15	-2	16	19	-20	3	
	-	-	-	

14. poglavje

Mešana ANOVA (GLM4)

- Kombinacija odvisnega in neodvisnega dizajna
- Odvisni ANOVA dodamo grupe
- Mixed ANOVA
 - WRS (Bootstrap)



The screenshot shows a data editor window titled 'dateData' with the following data:

	participant	gender	att_high	av_high	ug_high	att_some	av_some	ug_some	att_none	av
1	P01	Male	86	84	67	88	69	50	97	
2	P02	Male	91	83	53	83	74	48	86	
3	P03	Male	89	88	48	99	70	48	90	
4	P04	Male	89	69	58	86	77	40	87	
5	P05	Male	80	81	57	88	71	50	82	
6	P06	Male	80	84	51	96	63	42	92	
7	P07	Male	89	85	61	87	79	44	86	
8	P08	Male	100	94	56	86	71	54	84	
9	P09	Male	90	74	54	92	71	58	78	
10	P10	Male	89	86	63	80	73	49	91	
11	P11	Female	89	91	93	88	65	54	55	
12	P12	Female	84	90	85	95	70	60	50	
13	P13	Female	99	100	89	80	79	53	51	
14	P14	Female	86	89	83	86	74	58	52	
15	P15	Female	89	87	80	83	74	43	58	
16	P16	Female	80	81	79	86	59	47	51	
17	P17	Female	82	92	85	81	66	47	50	
18	P18	Female	97	69	87	95	72	51	45	
19	P19	Female	95	92	90	98	64	53	54	
20	P20	Female	95	93	96	79	66	46	52	

15. poglavje

Ne-parametrični testi

- Neparametrični testi
 - Wilcoxon rank-sum test & M-W test – neodvisen t -test
 - Wilcoxon signed-rank test – odvisen t -test
 - Kruskal-Wallis – neodvisna ANOVA
 - Friedman ANOVA – odvisna ANOVA

	drug	sundayBDI
1	Ecstasy	15
2	Ecstasy	35
3	Ecstasy	16
4	Ecstasy	18
5	Ecstasy	19
6	Ecstasy	17
7	Ecstasy	27
8	Ecstasy	16
9	Ecstasy	13
10	Ecstasy	20
11	Alcohol	16
12	Alcohol	15
13	Alcohol	20
14	Alcohol	15

	sundayBDI	wedsBDI
1	15	28
2	35	35
3	16	35
4	18	24
5	19	39
6	17	32
7	27	27
8	16	29
9	13	36
10	20	35
11	16	5
12	15	-
13	20	-
14	15	-

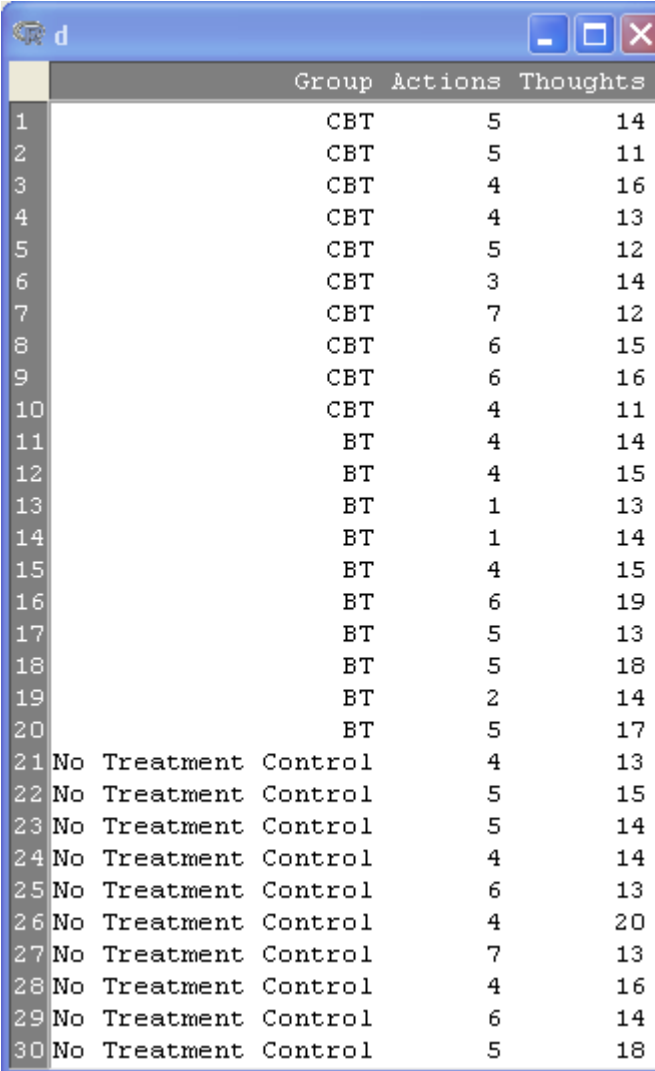
	Start	Month1	Month2
1	63.74562	65.38369	81.34006
2	62.98285	66.24456	69.31040
3	65.98489	67.69847	77.89319
4	107.26758	102.72155	91.32564
5	66.58389	69.44708	72.86975
6	120.46445	119.96376	114.25894
7	62.01109	66.09247	68.01017
8	71.87376	73.61720	55.43131
9	83.00535	75.81079	71.62893
10	76.62397	67.65546	68.60000

	Soya	Sperm
17	No Soya	9.6185687
18	No Soya	10.0481410
19	No Soya	10.3229182
20	No Soya	21.0800000
21	1 Soya Meal	0.3255391
22	1 Soya Meal	0.3641975
23	1 Soya Meal	0.6292157
24	1 Soya Meal	0.6359349
25	1 Soya Meal	0.7657087
26	1 Soya Meal	1.5325388
27	1 Soya Meal	1.6222084
28	1 Soya Meal	1.7059739
29	1 Soya Meal	1.9400000
30	1 Soya Meal	2.4796328
31	1 Soya Meal	2.7104913
32	1 Soya Meal	4.1161159
33	1 Soya Meal	5.6510126
34	1 Soya Meal	6.7596653
35	1 Soya Meal	7.0786499
36	1 Soya Meal	7.2635264
37	1 Soya Meal	7.9150662
38	1 Soya Meal	8.0444065
39	1 Soya Meal	12.0950189
40	1 Soya Meal	18.4700000
41	4 Soya Meal	0.4025473
42	4 Soya Meal	0.5981972
43	4 Soya Meal	0.9587061
44	4 Soya Meal	1.2032736
45	4 Soya Meal	1.3126042
46	4 Soya Meal	1.3542799
47	4 Soya Meal	1.6000000
48	4 Soya Meal	1.6000000
49	4 Soya Meal	1.6000000
50	4 Soya Meal	1.6000000

16. poglavje

Multivariatna analiza variance (MANOVA)

- MANOVA
 - Neodvisna ANOVA z dvema odvisnima spremenljivkama
 - Diskriminantna analiza
 - WRS (Bootstrap)



	Group	Actions	Thoughts	
1	CBT	5	14	
2	CBT	5	11	
3	CBT	4	16	
4	CBT	4	13	
5	CBT	5	12	
6	CBT	3	14	
7	CBT	7	12	
8	CBT	6	15	
9	CBT	6	16	
10	CBT	4	11	
11	BT	4	14	
12	BT	4	15	
13	BT	1	13	
14	BT	1	14	
15	BT	4	15	
16	BT	6	19	
17	BT	5	13	
18	BT	5	18	
19	BT	2	14	
20	BT	5	17	
21	No Treatment	Control	4	13
22	No Treatment	Control	5	15
23	No Treatment	Control	5	14
24	No Treatment	Control	4	14
25	No Treatment	Control	6	13
26	No Treatment	Control	4	20
27	No Treatment	Control	7	13
28	No Treatment	Control	4	16
29	No Treatment	Control	6	14
30	No Treatment	Control	5	18

17. poglavje

Raziskovalna faktorska analiza

item	F1	F2	F3	F4
Q06	6	0.80		
Q18	18	0.68	0.33	
Q13	13	0.65		
Q07	7	0.64	0.33	
Q14	14	0.58	0.36	
Q10	10	0.55		
Q15	15	0.46		
Q20	20		0.68	
Q21	21		0.66	
Q03	3		-0.57	0.37
Q12	12	0.47	0.52	
Q04	4	0.32	0.52	0.31
Q16	16	0.33	0.51	0.31
Q01	1		0.50	0.36
Q05	5	0.32	0.43	
Q08	8			0.83
Q17	17			0.75
Q11	11			0.75
Q09	9			0.65
Q22	22			0.65
Q23	23			0.59
Q02	2		-0.34	0.54
Q19	19		-0.37	0.43

SD = Strongly Disagree, D = Disagree, N = Neither, A = Agree, SA = Strongly Agree		SD	D	N	A	SA
1	Statistics make me cry	o	o	o	o	o
2	My friends will think I'm stupid for not being able to cope with R	o	o	o	o	o
3	Standard deviation excite me	o	o	o	o	o
4	I dream that Pearson is attacking me with correlation coefficient	o	o	o	o	o
5	Idon't understand statistics	o	o	o	o	o
6	I have little experience of computers	o	o	o	o	o
7	All computers hate me	o	o	o	o	o
8	I have never been good at mathematics	o	o	o	o	o
9	My friends are better at statistics than me	o	o	o	o	o
10	Computers are useful only for playing games	o	o	o	o	o

18. poglavje

χ^2 -test

- Kategorni podatki
 - HI-kvadrat
 - Loglinearna analiza (več kategornih spremenljivk)

Type of Training * Did they dance? Crosstabulation

			Did they dance?		Total
			Yes	No	
Type of Training	Food as Reward	Count	28	10	38
		Expected Count	14,4	23,6	38,0
		% within Type of Training	73,7%	26,3%	100,0%
		% within Did they dance?	36,8%	8,1%	19,0%
		% of Total	14,0%	5,0%	19,0%
		Std. Residual	3,6	-2,8	
	Affection as Reward	Count	48	114	162
		Expected Count	61,6	100,4	162,0
		% within Type of Training	29,8%	70,4%	100,0%
		% within Did they dance?	63,2%	91,9%	81,0%
		% of Total	24,0%	57,0%	81,0%
		Std. Residual	-1,7	1,4	
Total		Count	76	124	200
		Expected Count	76,0	124,0	200,0
		% within Type of Training	38,0%	62,0%	100,0%
		% within Did they dance?	100,0%	100,0%	100,0%
		% of Total	38,0%	62,0%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	25,356 ^a	1	,000		
Continuity Correction ^b	23,520	1	,000		
Likelihood Ratio	24,932	1	,000		
Fisher's Exact Test				,000	,000
Linear-by-Linear Association	25,229	1	,000		
N of Valid Cases	200				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 1.444.

19. poglavje

Več-nivojski linearni model

- Razredi so ugnezdjeni v različne šole in dobimo naslednji nivo.
 - Neodvisen dizajn.
 - Odvisen dizajn.

