

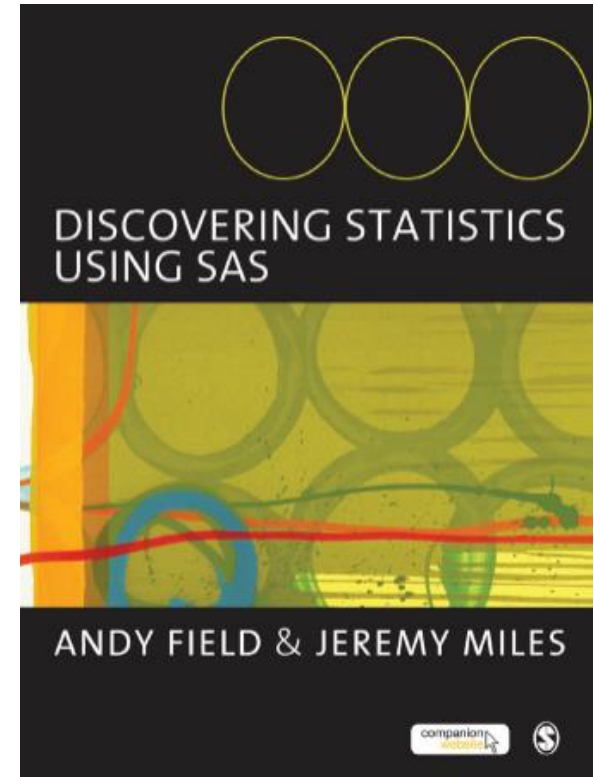
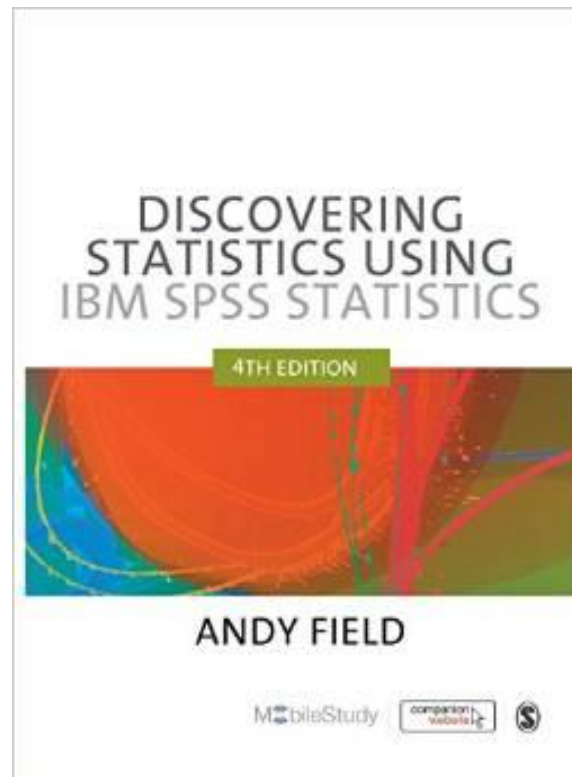
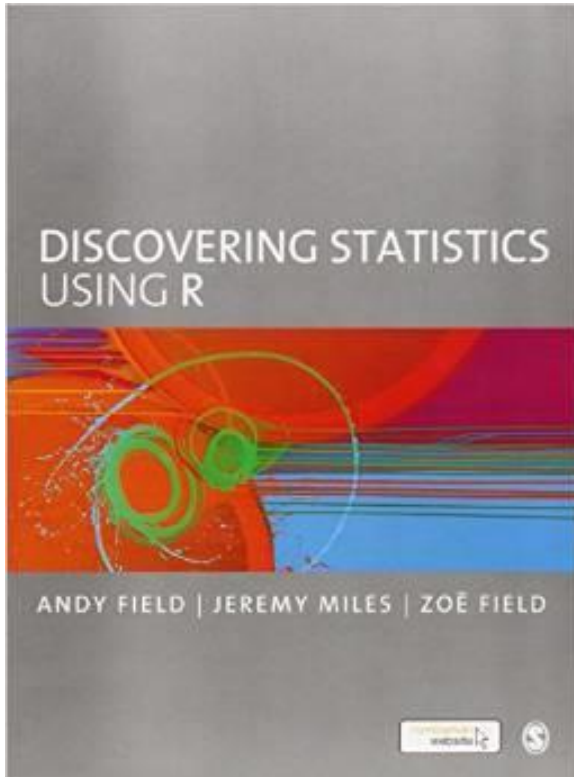
# **Kvantitativna analiza in SAS/STAT**

## **doc. dr. Franc Brkar**

### **Pregled poglavij**

Prerejeno po: Field, A., & Miles, J. (2010). *Discovering Statistics Using SAS*. London: SAGE.

# Discovering Statistics Using R & SPSS & SAS



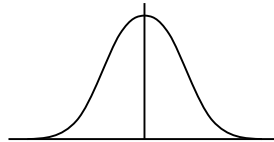
# Pregled poglavij

1. Uvod
2. Osnove statistike
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4. Preučevanje podatkov z grafi
5. Statistične omejitve in predpostavke
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# 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

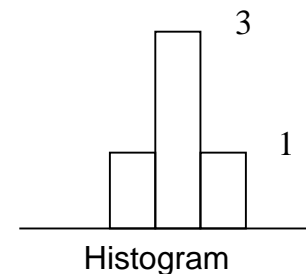
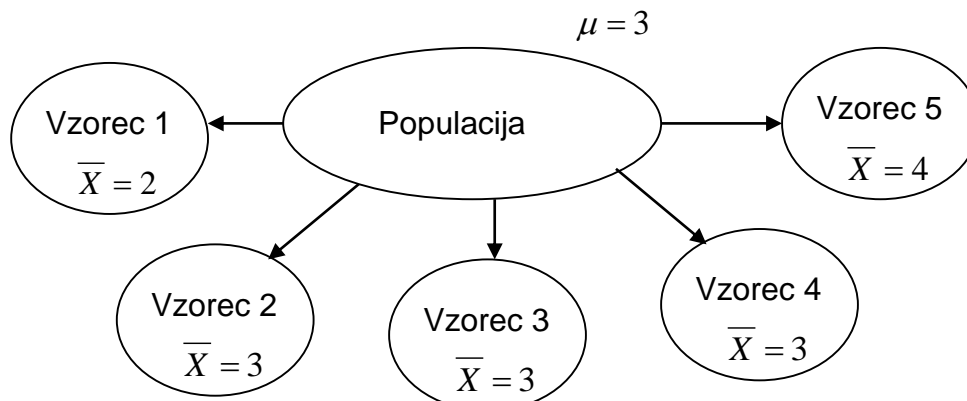
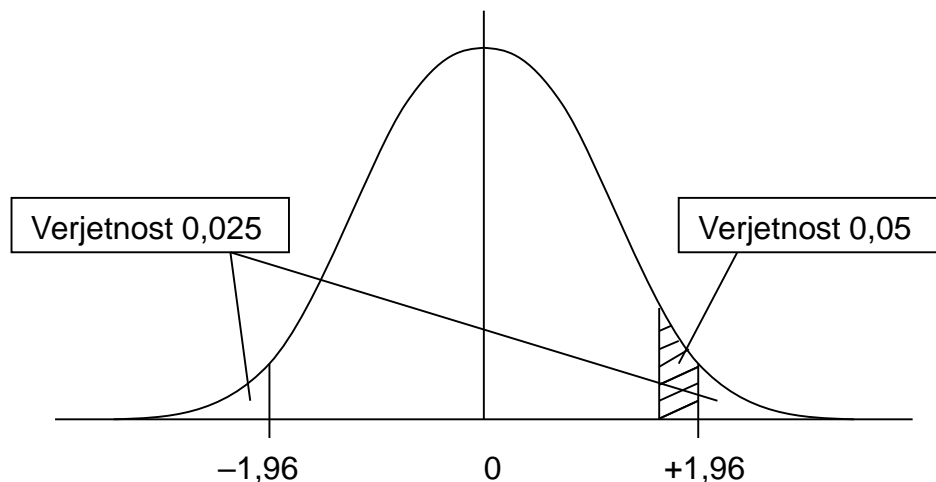
### Vse kar ste želeli vedeti o statistiki

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

Tabela 1: Napake tipa I ( $\alpha$ ) in II ( $\beta$ )

|                  | H0 je pravilna           | H0 je napačna            |
|------------------|--------------------------|--------------------------|
| <b>Zavrnamo</b>  | $\alpha$ = napaka tipa I | Pravilna odločitev       |
| <b>Sprejmemo</b> | Pravilna odločitev       | $\beta$ = napaka tipa II |

Opomba. H0: Izdelek je dober

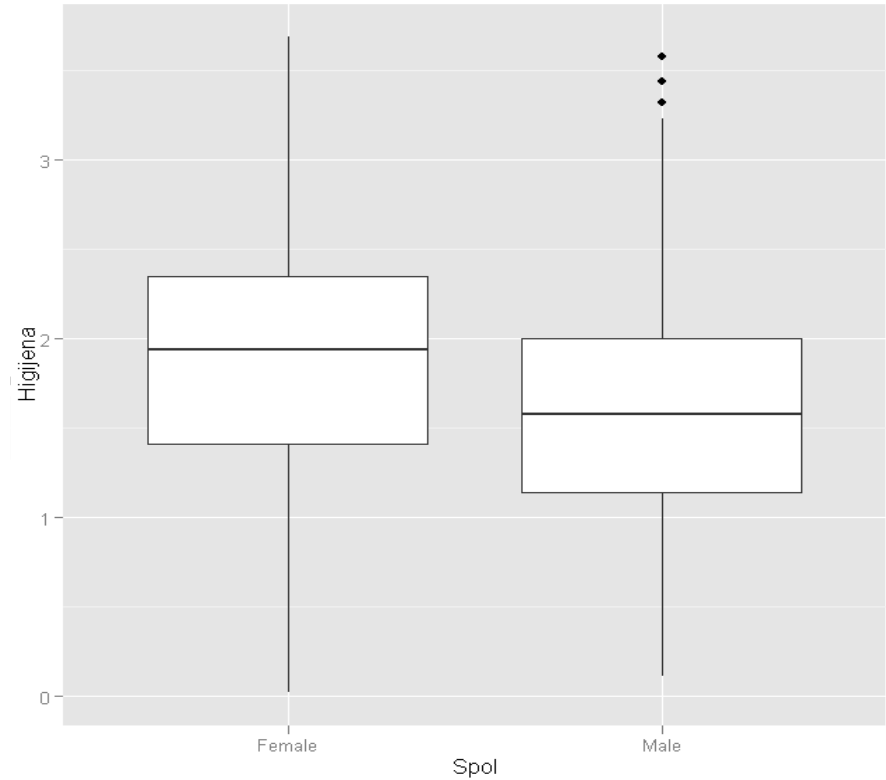


# 3. poglavje SAS/STAT okolje

The screenshot displays the SAS Studio web interface. The top navigation bar includes the SAS logo, the user name 'SAS Programmer', and a 'Sign Out' button. The left sidebar contains a 'Libraries' section with a tree view showing 'My Libraries' (APFMTLIB, SASHELP, SASUSER, WEBWORK, WORK) and 'IMPORT' selected under 'WORK'. The main workspace shows a data table with the following columns: exam, computer, lectures, and n. The table contains 10 rows of data. The 'View' dropdown is set to 'Column names'. The status bar at the bottom right indicates 'Messages: 1' and 'User: sasdemo'.

|   | exam | computer | lectures | n |
|---|------|----------|----------|---|
| 1 | 18   | 54       | 75.0     |   |
| 2 | 30   | 47       | 8.5      |   |
| 3 | 40   | 58       | 69.5     |   |
| 4 | 30   | 37       | 67.0     |   |
| 5 | 40   | 53       | 44.5     |   |
| 6 | 15   | 48       | 76.5     |   |
| 7 | 36   | 49       | 70.0     |   |
| 8 | 40   | 49       | 18.5     |   |
| 9 | 40   | 45       | 42.5     |   |

## 4. poglavje Grafii

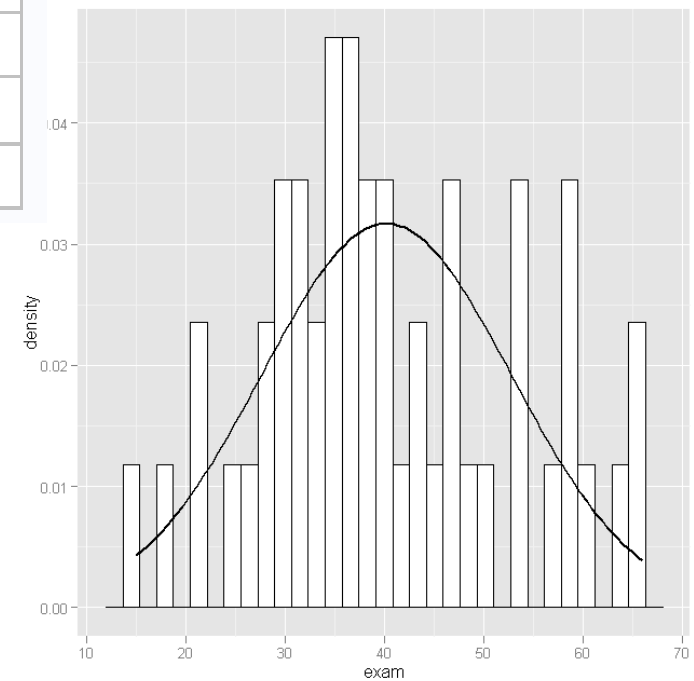


# 5. poglavje

## Raziskovanje predpostavk

- Kolmogorov-Smirnov in Shapiro-Wilk test normalnosti.

| Tests for Normality |           |          |           |         |
|---------------------|-----------|----------|-----------|---------|
| Test                | Statistic |          | p Value   |         |
| Shapiro-Wilk        | W         | 0.961309 | Pr < W    | 0.0050  |
| Kolmogorov-Smirnov  | D         | 0.1021   | Pr > D    | 0.0112  |
| Cramer-von Mises    | W-Sq      | 0.24529  | Pr > W-Sq | <0.0050 |
| Anderson-Darling    | A-Sq      | 1.403126 | Pr > A-Sq | <0.0050 |





## 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)

| Pearson Correlation Coefficients, N = 103<br>Prob >  r  under H0: Rho=0 |                    |                    |                    |
|-------------------------------------------------------------------------|--------------------|--------------------|--------------------|
|                                                                         | Revise             | Exam               | Anxiety            |
| Revise<br>Time Spent Revising                                           | 1.00000            | 0.39872<br><.0001  | -0.70925<br><.0001 |
| Exam<br>Exam Performance (%)                                            | 0.39872<br><.0001  | 1.00000            | -0.44099<br><.0001 |
| Anxiety<br>Exam Anxiety                                                 | -0.70925<br><.0001 | -0.44099<br><.0001 | 1.00000            |

|   | var1 | var2 |
|---|------|------|
| 1 | 1    | 4    |
| 2 | 2    | 5    |
| 3 | 3    | 4    |
| 4 | 1    | 4    |
| 5 | 2    | 3    |

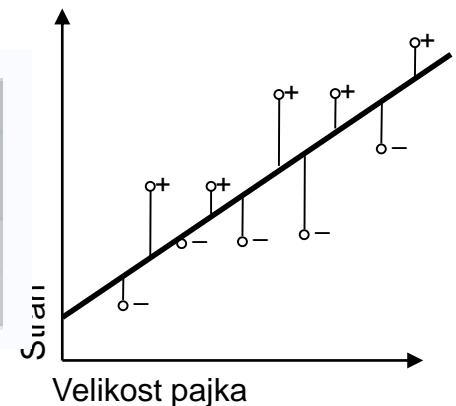
# 7. poglavje Regresija

- 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         |

| Parameter Estimates |                                          |    |                    |                |         |         |
|---------------------|------------------------------------------|----|--------------------|----------------|---------|---------|
| Variable            | Label                                    | DF | Parameter Estimate | Standard Error | t Value | Pr >  t |
| Intercept           | Intercept                                | 1  | 134.13994          | 7.53857        | 17.80   | <.0001  |
| Adverts             | Advertising Budget (Thousands of Pounds) | 1  | 0.00612            | 0.00063        | 9.98    | <.0001  |

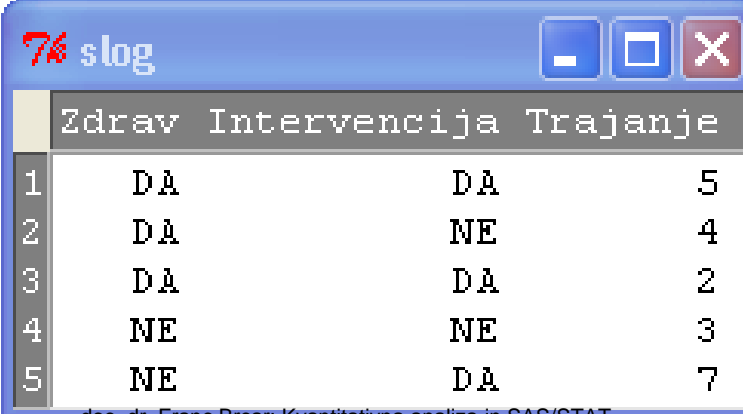


## 8. poglavje

### Logistična regresija

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

| Analysis of Maximum Likelihood Estimates |    |          |                |                 |            |          |
|------------------------------------------|----|----------|----------------|-----------------|------------|----------|
| Parameter                                | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq | Exp(Est) |
| Intercept                                | 1  | -0.2877  | 0.2700         | 1.1350          | 0.2867     | 0.750    |
| Intervention                             | 1  | 1.2287   | 0.3898         | 9.4485          | 0.0021     | 3.417    |



|   | 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 SAS/STAT.

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## 9. poglavje

### Primerjava dveh povprečij (*t*-test)

- Odvisni *t*-test
- Wilcoxon signed-rank.

The TTEST Procedure

Difference: picture - real

| N  | Mean    | Std Dev | Std Err | Minimum  | Maximum |
|----|---------|---------|---------|----------|---------|
| 12 | -7.0000 | 9.8072  | 2.8311  | -20.0000 | 11.0000 |

| Mean    | 95% CL Mean | Std Dev | 95% CL Std Dev |
|---------|-------------|---------|----------------|
| -7.0000 | -13.2312    | -0.7888 | 9.8072         |

| DF | t Value | Pr >  t |
|----|---------|---------|
| 11 | -2.47   | 0.0310  |

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

| Method        | Variances | DF     | t Value | Pr >  t |
|---------------|-----------|--------|---------|---------|
| Pooled        | Equal     | 22     | -1.68   | 0.1068  |
| Satterthwaite | Unequal   | 21.385 | -1.68   | 0.1072  |

| Equality of Variances |        |        |         |        |
|-----------------------|--------|--------|---------|--------|
| Method                | Num DF | Den DF | F Value | Pr > F |
| Folded F              | 11     | 11     | 1.41    | 0.5797 |

|    | 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   |

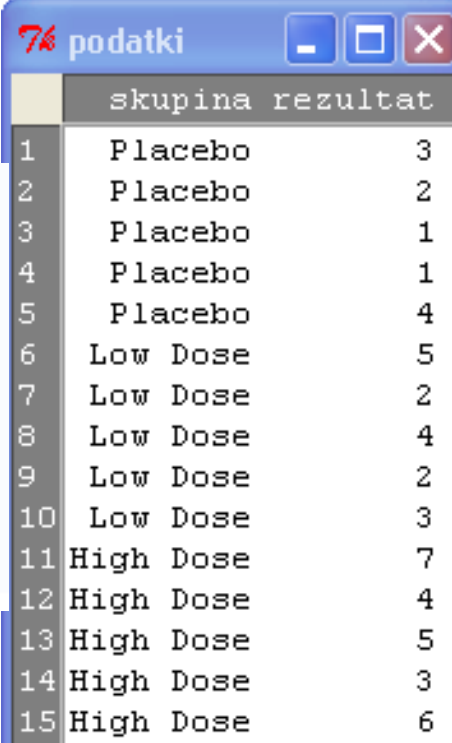
|    | Group       | Anxiety |
|----|-------------|---------|
| 1  | Picture     | 30      |
| 2  | Picture     | 35      |
| 3  | Picture     | 45      |
| 4  | Picture     | 40      |
| 5  | Picture     | 50      |
| 6  | Picture     | 35      |
| 7  | Picture     | 55      |
| 8  | Picture     | 25      |
| 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)

| Parameter      | Estimate    |   | Standard Error | t Value | Pr >  t |
|----------------|-------------|---|----------------|---------|---------|
| Intercept      | 2.200000000 | B | 0.62716292     | 3.51    | 0.0043  |
| dose High Dose | 2.800000000 | B | 0.88894231     | 3.16    | 0.0083  |
| dose Low Dose  | 1.000000000 | B | 0.88894231     | 1.13    | 0.2816  |
| dose Placebo   | 0.000000000 | B | .              | .       | .       |

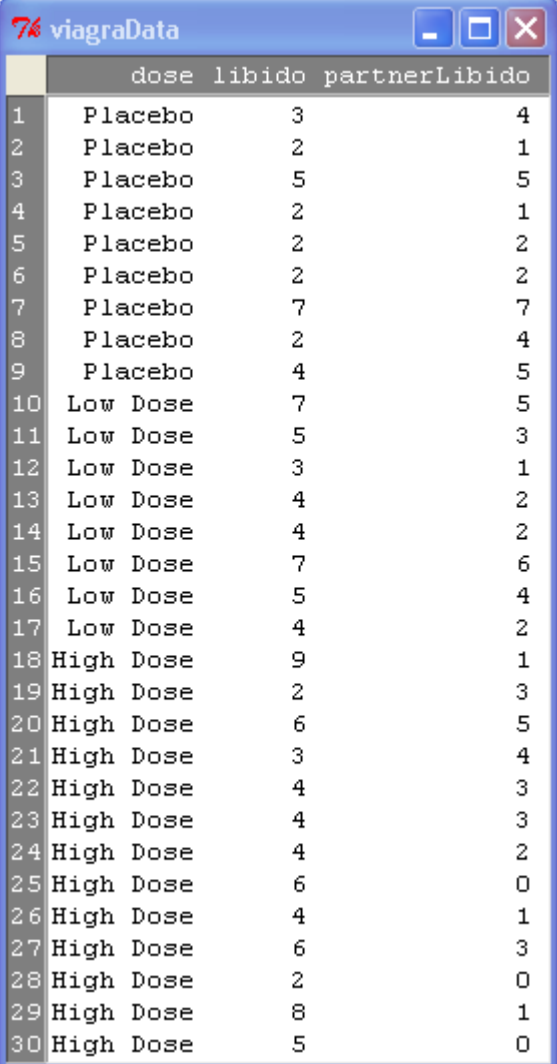


|    | skupina   | rezultat |
|----|-----------|----------|
| 1  | Placebo   | 3        |
| 2  | Placebo   | 2        |
| 3  | Placebo   | 1        |
| 4  | Placebo   | 1        |
| 5  | Placebo   | 4        |
| 6  | Low Dose  | 5        |
| 7  | Low Dose  | 2        |
| 8  | Low Dose  | 4        |
| 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

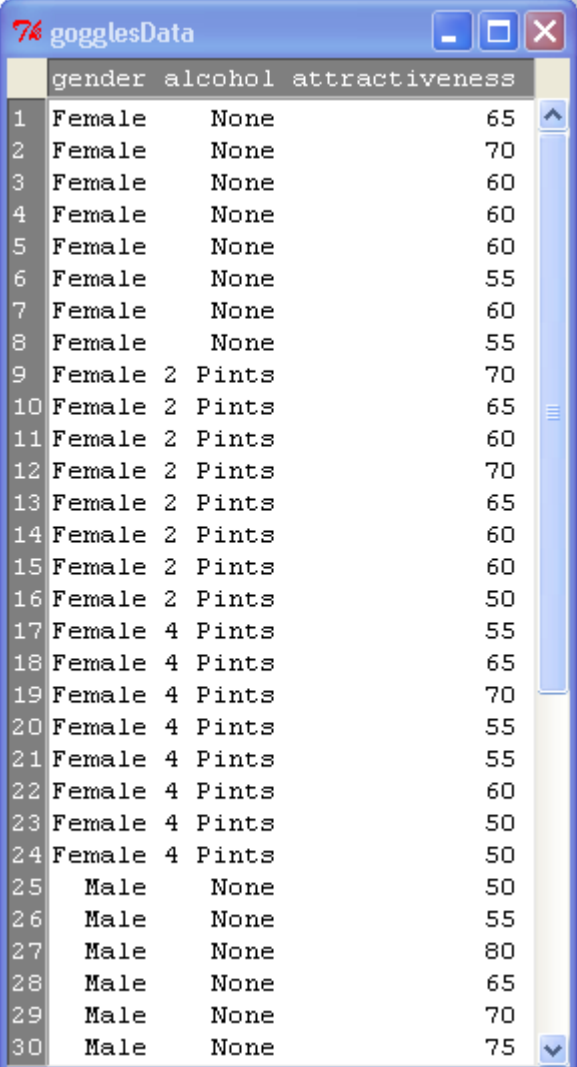


|    | dose      | libido | partnerLibido |
|----|-----------|--------|---------------|
| 1  | Placebo   | 3      | 4             |
| 2  | Placebo   | 2      | 1             |
| 3  | Placebo   | 5      | 5             |
| 4  | Placebo   | 2      | 1             |
| 5  | Placebo   | 2      | 2             |
| 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)



|    | 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)
  - 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 | beerneg | beerneut | winepos | wineneg | wineneut | waterpos | waterneg | 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

|    | 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        | -       |

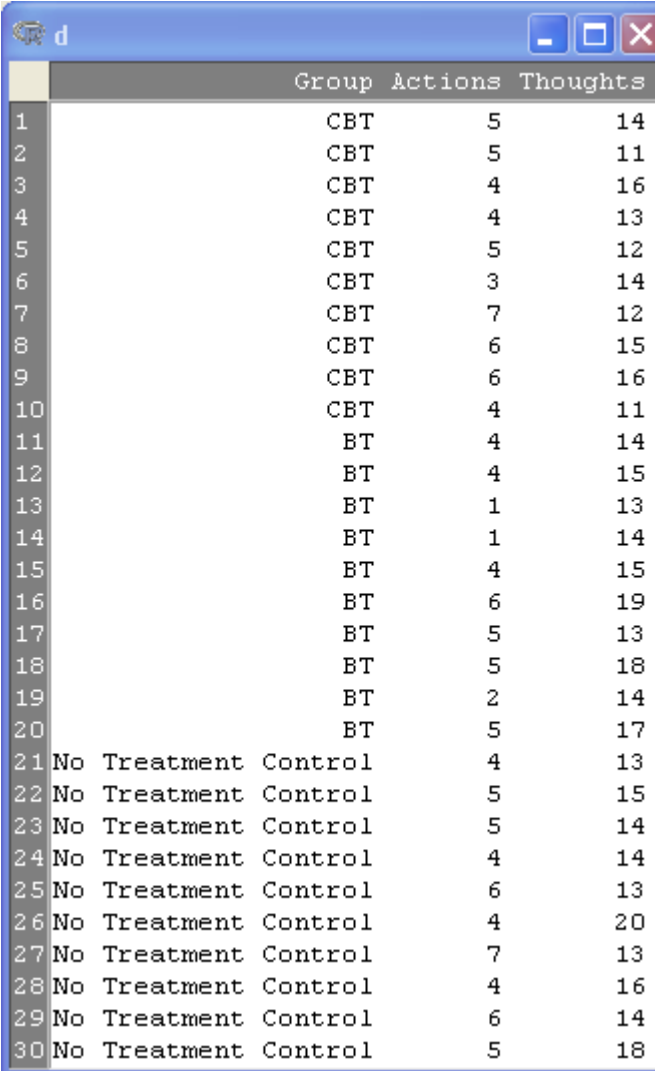
|    | Start     | Month1    | Month2    |
|----|-----------|-----------|-----------|
| 1  | 63.74562  | 65.38369  | 81.34006  |
| 2  | 62.98285  | 66.24456  | 69.31040  |
| 3  | 65.98489  | 67.69847  | 77.89319  |
| 4  | 107.26758 | 102.72155 | 91.32564  |
| 5  | 66.58389  | 69.44708  | 72.86975  |
| 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



|    | 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

## $\chi^2$ -test

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

The FREQ Procedure

| Frequency<br>Expected<br>Percent<br>Row Pct<br>Col Pct | Table of Training by Dance |                        |        |       |
|--------------------------------------------------------|----------------------------|------------------------|--------|-------|
|                                                        | Training(Type of Training) | Dance(Did they dance?) |        | Total |
|                                                        |                            | Yes                    | No     |       |
| Food as Reward                                         | 28                         | 10                     | 38     |       |
|                                                        | 14.44                      | 23.58                  |        |       |
|                                                        | 14.00                      | 5.00                   | 19.00  |       |
|                                                        | 73.68                      | 28.32                  |        |       |
|                                                        | 36.84                      | 8.00                   |        |       |
| Affection as Reward                                    | 48                         | 114                    | 162    |       |
|                                                        | 61.56                      | 100.44                 |        |       |
|                                                        | 24.00                      | 57.00                  | 81.00  |       |
|                                                        | 29.83                      | 70.37                  |        |       |
|                                                        | 83.16                      | 91.84                  |        |       |
| Total                                                  | 76                         | 124                    | 200    |       |
|                                                        | 38.00                      | 62.00                  | 100.00 |       |

Statistics for Table of Training by Dance

| Statistic                   | DF | Value   | Prob   |
|-----------------------------|----|---------|--------|
| Chi-Square                  | 1  | 25.3557 | <.0001 |
| Likelihood Ratio Chi-Square | 1  | 24.9316 | <.0001 |
| Continuity Adj. Chi-Square  | 1  | 23.5203 | <.0001 |
| Mantel-Haenszel Chi-Square  | 1  | 25.2289 | <.0001 |
| Phi Coefficient             |    | 0.3561  |        |
| Contingency Coefficient     |    | 0.3254  |        |
| Cramer's V                  |    | 0.3561  |        |

# 19. poglavje

## Več-nivojski linearni model

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

