

Covariance Structure Approach to Repeated Measures on the Monkey Data

```
% head monkey.data
MONKEY    TREATMENT    WEEK2    WEEK4    WEEK8    WEEK12    WEEK16
Spank     CONTROL      95    75    80    65    70
Chim      CONTROL      85    75    55    75    85
Chak      CONTROL      75    95    60    40    45
Alf       CONTROL      85    80    70    45    80
Poet      CONTROL      65    80    75    65    65
Jessie    CONTROL      70    90    85    75    75
Phil      CONTROL      75    80    70    70    70
Irv       TREATED      75    50    70    75    75
Edy       TREATED      85    85    60    70    70
```

```
/* monkey2.sas */
options linesize=79 pagesize=100 noovp formdlim='_' nodate;
title 'Primate hippocampal function: Zola-Morgan and Squire, 1990';
title2 'Covariance Structure approach to repeated measures (within-cases)';

data memory2;
  infile 'monkey.data' firstobs=2;
  input monkey $ treatmnt $ week2 week4 week8 week12 week16;
  /* Make 5 "cases" in the data set for each line in the raw data file.
     The output command generates a case. */
  id = _n_;
  time = 2;  score = week2;  output;
  time = 4;  score = week4;  output;
  time = 8;  score = week8;  output;
  time = 12; score = week12; output;
  time = 16; score = week16; output;
  keep monkey treatmnt id time score;

proc print;

proc mixed;
  class treatmnt time;
  model score = treatmnt|time;
  repeated / type=un subject=id r;
  /* Could have used sunject=monkey, but then monkey must be declared in
     class because it's character-valued. */
```

MONKEY	TREATMENT	WEEK2	WEEK4	WEEK8	WEEK12	WEEK16
Spank	CONTROL	95	75	80	65	70
Chim	CONTROL	85	75	55	75	85
Chak	CONTROL	75	95	60	40	45
Alf	CONTROL	85	80	70	45	80
Poet	CONTROL	65	80	75	65	65
Jessie	CONTROL	70	90	85	75	75
Phil	CONTROL	75	80	70	70	70
Irv	TREATED	75	50	70	75	75
Edy	TREATED	85	85	60	70	70

Primate hippocampal function: Zola-Morgan and Squire, 1990
Covariance Structure approach to repeated measures (within-cases)

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Obs	monkey	treatmnt	id	time	score
1	Spank	CONTROL	1	2	95
2	Spank	CONTROL	1	4	75
3	Spank	CONTROL	1	8	80
4	Spank	CONTROL	1	12	65
5	Spank	CONTROL	1	16	70
6	Chim	CONTROL	2	2	85
7	Chim	CONTROL	2	4	75
8	Chim	CONTROL	2	8	55
9	Chim	CONTROL	2	12	75
10	Chim	CONTROL	2	16	85

Skipping ...

81	Corneliu	TREATED	17	2	45
82	Corneliu	TREATED	17	4	60
83	Corneliu	TREATED	17	8	65
84	Corneliu	TREATED	17	12	65
85	Corneliu	TREATED	17	16	70
86	Duncan	TREATED	18	2	65
87	Duncan	TREATED	18	4	55
88	Duncan	TREATED	18	8	55
89	Duncan	TREATED	18	12	80
90	Duncan	TREATED	18	16	75

The Mixed Procedure

Model Information

Data Set	WORK.MEMORY2
Dependent Variable	score
Covariance Structure	Unstructured
Subject Effect	id
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Between-Within

Class Level Information

Class	Levels	Values
treatmnt	2	CONTROL TREATED
time	5	2 4 8 12 16

Number of Observations

Number of Observations Read	90
Number of Observations Used	90
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	615.76098645	
1	1	606.99648116	0.00000000

Convergence criteria met.

Estimated R Matrix for Subject 1

Row	Col1	Col2	Col3	Col4	Col5
1	109.62	1.1972	-0.2638	5.6006	24.5739
2	1.1972	80.2354	-12.8856	-20.9010	-17.3295
3	-0.2638	-12.8856	102.76	18.9326	-16.3352
4	5.6006	-20.9010	18.9326	97.5649	46.4489
5	24.5739	-17.3295	-16.3352	46.4489	101.14

Covariance Parameter Estimates

Cov Parm	Subject	Estimate
UN(1,1)	id	109.62
UN(2,1)	id	1.1972
UN(2,2)	id	80.2354
UN(3,1)	id	-0.2638
UN(3,2)	id	-12.8856
UN(3,3)	id	102.76
UN(4,1)	id	5.6006
UN(4,2)	id	-20.9010
UN(4,3)	id	18.9326
UN(4,4)	id	97.5649
UN(5,1)	id	24.5739
UN(5,2)	id	-17.3295
UN(5,3)	id	-16.3352
UN(5,4)	id	46.4489
UN(5,5)	id	101.14

Fit Statistics

-2 Res Log Likelihood	607.0
AIC (smaller is better)	637.0
AICC (smaller is better)	644.5
BIC (smaller is better)	650.4

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
14	8.76	0.8458

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The Mixed Procedure

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
treatmnt	1	16	8.08	0.0118
time	4	16	0.76	0.5655
treatmnt*time	4	16	5.07	0.0078

For comparison, the multivariate approach gave us:

Effect	Num DF	Den DF	F Value	Pr > F
treatmnt	1	16	8.08	0.0118
time	4	13	0.62	0.6571
treatmnt*time	4	13	4.12	0.0227