. \* STATA Model 1a: Empty Means, Random Intercept

. xtmixed nm3rt , || id: , ///

> variance reml covariance(unstructured) residuals(independent,t(session)),

Note: single-variable random-effects specification; covariance structure set to identity

Note: t() not required for this residual structure; ignored

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -4268.4304

Iteration 1: log restricted-likelihood = -4268.4304

Computing standard errors:

Mixed-effects REML regression Number of obs = 606

Group variable: id Number of groups = 101

Obs per group: min = 6

avg = 6.0

max = 6

Wald chi2(0) = .

Log restricted-likelihood = -4268.4304 Prob > chi2 = .

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

\_cons | 1770.701 45.42063 38.98 0.000 1681.679 1859.724

------------------------------------------------------------------------------

------------------------------------------------------------------------------

Random-effects Parameters | Estimate Std. Err. [95% Conf. Interval]

-----------------------------+------------------------------------------------

id: Identity |

var(\_cons) | 200883 29471.23 150683.2 267806.8

-----------------------------+------------------------------------------------

var(Residual) | 44899.96 2825.63 39689.76 50794.13

------------------------------------------------------------------------------

LR test vs. linear regression: chibar2(01) = 691.74 Prob >= chibar2 = 0.0000

. estat ic, n(101)

-----------------------------------------------------------------------------

Model | Obs ll(null) ll(model) df AIC BIC

-------------+---------------------------------------------------------------

. | 101 . -4268.43 3 8542.861 8550.706

-----------------------------------------------------------------------------

Note: N=101 used in calculating BIC

. estat recovariance, level(id)

Random-effects covariance matrix for level id

| \_cons

-------------+-----------

\_cons | 200883

.

. \* STATA Model 1b: Saturated Means, Unstructured Variance

. xtmixed nm3rt ib(last).session, || id: , noconstant ///

> variance reml residuals(unstructured, t(session)),

Obtaining starting values by EM:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -4577.7163 (not concave)

Iteration 1: log restricted-likelihood = -4203.6656 (not concave)

Iteration 2: log restricted-likelihood = -4167.7878

Iteration 3: log restricted-likelihood = -4130.8331

Iteration 4: log restricted-likelihood = -4115.2859

Iteration 5: log restricted-likelihood = -4114.896

Iteration 6: log restricted-likelihood = -4114.8942

Iteration 7: log restricted-likelihood = -4114.8942

Computing standard errors:

Mixed-effects REML regression Number of obs = 606

Group variable: id Number of groups = 101

Obs per group: min = 6

avg = 6.0

max = 6

Wald chi2(5) = 83.60

Log restricted-likelihood = -4114.8942 Prob > chi2 = 0.0000

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

session |

1 | 289.7574 32.69997 8.86 0.000 225.6666 353.8481

2 | 143.0364 26.20308 5.46 0.000 91.67927 194.3935

3 | 77.89864 22.8842 3.40 0.001 33.04642 122.7509

4 | 45.66045 20.78533 2.20 0.028 4.921952 86.39894

5 | 35.03972 18.11681 1.93 0.053 -.468579 70.54802

|

\_cons | 1672.136 44.13439 37.89 0.000 1585.634 1758.638

------------------------------------------------------------------------------

------------------------------------------------------------------------------

Random-effects Parameters | Estimate Std. Err. [95% Conf. Interval]

-----------------------------+------------------------------------------------

id: (empty) |

-----------------------------+------------------------------------------------

Residual: Unstructured |

var(e1) | 301983.1 42696.65 228893.4 398411.6

var(e2) | 259148.8 36635.7 196433.4 341887.4

var(e3) | 233366.9 32990.48 176891.6 307872.9

var(e4) | 217542.8 30753.82 164896.4 286997.6

var(e5) | 212096.8 29984.63 160767.3 279814.7

var(e6) | 196732.3 27812.21 149121.6 259543.9

cov(e1,e2) | 235657.1 36563.79 163993.4 307320.8

cov(e1,e3) | 217992.5 34336.3 150694.6 285290.4

cov(e1,e4) | 202605.4 32657.69 138597.5 266613.2

cov(e1,e5) | 192152.4 31762.13 129899.7 254405

cov(e1,e6) | 195358.7 31224.07 134160.6 256556.7

cov(e2,e3) | 230215.6 33672.52 164218.7 296212.5

cov(e2,e4) | 213230.6 31899.27 150709.2 275752

cov(e2,e5) | 202091 30938.65 141452.3 262729.6

cov(e2,e6) | 193267.2 29707.66 135041.2 251493.1

cov(e3,e4) | 205208 30462.92 145501.8 264914.2

cov(e3,e5) | 196917.7 29697.89 138710.9 255124.5

cov(e3,e6) | 188603.5 28532.39 132681 244525.9

\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ (R)

/\_\_ / \_\_\_\_/ / \_\_\_\_/

\_\_\_/ / /\_\_\_/ / /\_\_\_/ 12.1 Copyright 1985-2011 StataCorp LP

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University of Nebraska Lincoln

Notes:

. doedit "F:\11\_ICPSR\Data Examples\CHAP\CHAP Example 3.do"

. use "F:\12\_ICPSR\ICPSR\_2012\_Download\STATA\Example35.dta", clear

. do "C:\DOCUME~1\lesa\LOCALS~1\Temp\STD00000000.tmp"

. \* STATA code to center time for polynomial models (and make quadratic versions)

. gen c1sess = Session - 1

Session not found

r(111);

end of do-file

r(111);

. do "C:\DOCUME~1\lesa\LOCALS~1\Temp\STD00000000.tmp"

. \* STATA code to center time for polynomial models (and make quadratic versions)

. gen c1sess = session - 1

. gen c6sess = session - 6

.

. \* calculate quadratic session variables

. gen c1sess2 = c1sess \* c1sess

. gen c6sess2 = c6sess \* c6sess

.

end of do-file

. do "C:\DOCUME~1\lesa\LOCALS~1\Temp\STD00000000.tmp"

. \* STATA Model 1a: Empty Means, Random Intercept Model

. xtmixed nm3rt , || id: , ///

> variance reml covariance(unstructured) residuals(independent,t(session)),

Note: single-variable random-effects specification; covariance structure set to identity

Note: t() not required for this residual structure; ignored

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -4268.4304

Iteration 1: log restricted-likelihood = -4268.4304

Computing standard errors:

Mixed-effects REML regression Number of obs = 606

Group variable: id Number of groups = 101

Obs per group: min = 6

avg = 6.0

max = 6

Wald chi2(0) = .

Log restricted-likelihood = -4268.4304 Prob > chi2 = .

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

\_cons | 1770.701 45.42063 38.98 0.000 1681.679 1859.724

------------------------------------------------------------------------------

------------------------------------------------------------------------------

Random-effects Parameters | Estimate Std. Err. [95% Conf. Interval]

-----------------------------+------------------------------------------------

id: Identity |

var(\_cons) | 200883 29471.23 150683.2 267806.8

-----------------------------+------------------------------------------------

var(Residual) | 44899.96 2825.63 39689.76 50794.13

------------------------------------------------------------------------------

LR test vs. linear regression: chibar2(01) = 691.74 Prob >= chibar2 = 0.0000

. estat ic, n(101)

-----------------------------------------------------------------------------

Model | Obs ll(null) ll(model) df AIC BIC

-------------+---------------------------------------------------------------

. | 101 . -4268.43 3 8542.861 8550.706

-----------------------------------------------------------------------------

Note: N=101 used in calculating BIC

. estat recovariance, level(id)

Random-effects covariance matrix for level id

| \_cons

-------------+-----------

\_cons | 200883

.

end of do-file

. do "C:\DOCUME~1\lesa\LOCALS~1\Temp\STD00000000.tmp"

. \* STATA Model 1b: Saturated Means, Unstructured Variance Model

. xtmixed nm3rt ib(last).session, || id: , noconstant ///

> variance reml residuals(unstructured, t(session)),

Obtaining starting values by EM:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -4577.7163 (not concave)

Iteration 1: log restricted-likelihood = -4203.6656 (not concave)

Iteration 2: log restricted-likelihood = -4167.7878

Iteration 3: log restricted-likelihood = -4130.8331

Iteration 4: log restricted-likelihood = -4115.2859

Iteration 5: log restricted-likelihood = -4114.896

Iteration 6: log restricted-likelihood = -4114.8942

Iteration 7: log restricted-likelihood = -4114.8942

Computing standard errors:

Mixed-effects REML regression Number of obs = 606

Group variable: id Number of groups = 101

Obs per group: min = 6

avg = 6.0

max = 6

Wald chi2(5) = 83.60

Log restricted-likelihood = -4114.8942 Prob > chi2 = 0.0000

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

session |

1 | 289.7574 32.69997 8.86 0.000 225.6666 353.8481

2 | 143.0364 26.20308 5.46 0.000 91.67927 194.3935

3 | 77.89864 22.8842 3.40 0.001 33.04642 122.7509

4 | 45.66045 20.78533 2.20 0.028 4.921952 86.39894

5 | 35.03972 18.11681 1.93 0.053 -.468579 70.54802

|

\_cons | 1672.136 44.13439 37.89 0.000 1585.634 1758.638

------------------------------------------------------------------------------

------------------------------------------------------------------------------

Random-effects Parameters | Estimate Std. Err. [95% Conf. Interval]

-----------------------------+------------------------------------------------

id: (empty) |

-----------------------------+------------------------------------------------

Residual: Unstructured |

var(e1) | 301983.1 42696.65 228893.4 398411.6

var(e2) | 259148.8 36635.7 196433.4 341887.4

var(e3) | 233366.9 32990.48 176891.6 307872.9

var(e4) | 217542.8 30753.82 164896.4 286997.6

var(e5) | 212096.8 29984.63 160767.3 279814.7

var(e6) | 196732.3 27812.21 149121.6 259543.9

cov(e1,e2) | 235657.1 36563.79 163993.4 307320.8

cov(e1,e3) | 217992.5 34336.3 150694.6 285290.4

cov(e1,e4) | 202605.4 32657.69 138597.5 266613.2

cov(e1,e5) | 192152.4 31762.13 129899.7 254405

cov(e1,e6) | 195358.7 31224.07 134160.6 256556.7

cov(e2,e3) | 230215.6 33672.52 164218.7 296212.5

cov(e2,e4) | 213230.6 31899.27 150709.2 275752

cov(e2,e5) | 202091 30938.65 141452.3 262729.6

cov(e2,e6) | 193267.2 29707.66 135041.2 251493.1

cov(e3,e4) | 205208 30462.92 145501.8 264914.2

cov(e3,e5) | 196917.7 29697.89 138710.9 255124.5

cov(e3,e6) | 188603.5 28532.39 132681 244525.9

cov(e4,e5) | 193674.7 28910.48 137011.2 250338.2

cov(e4,e6) | 185320 27762.64 130906.2 239733.8

cov(e5,e6) | 187839.5 27739.82 133470.5 242208.6

------------------------------------------------------------------------------

LR test vs. linear regression: chi2(20) = 925.64 Prob > chi2 = 0.0000

Note: The reported degrees of freedom assumes the null hypothesis is not on the boundary of the parameter space. If this is not true, then

the reported test is conservative.

. estat ic, n(101),

-----------------------------------------------------------------------------

Model | Obs ll(null) ll(model) df AIC BIC

-------------+---------------------------------------------------------------

. | 101 . -4114.894 27 8283.788 8354.397

-----------------------------------------------------------------------------

Note: N=101 used in calculating BIC

. margins i.session

Adjusted predictions Number of obs = 606

Expression : Linear prediction, fixed portion, predict()

------------------------------------------------------------------------------

| Delta-method

| Margin Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

session |

1 | 1961.893 54.68027 35.88 0.000 1854.722 2069.065

2 | 1815.172 50.65402 35.83 0.000 1715.892 1914.452

3 | 1750.035 48.06832 36.41 0.000 1655.822 1844.247

4 | 1717.796 46.41001 37.01 0.000 1626.835 1808.758

5 | 1707.176 45.82541 37.25 0.000 1617.36 1796.992

6 | 1672.136 44.13439 37.89 0.000 1585.634 1758.638

------------------------------------------------------------------------------

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end of do-file

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. do "C:\DOCUME~1\lesa\LOCALS~1\Temp\STD00000000.tmp"

. \* STATA Model 1a: Empty Means, Random Intercept

. xtmixed nm3rt , || id: , ///

> variance reml covariance(unstructured) residuals(independent,t(session)),

Note: single-variable random-effects specification; covariance structure set to identity

Note: t() not required for this residual structure; ignored

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -4268.4304

Iteration 1: log restricted-likelihood = -4268.4304

Computing standard errors:

Mixed-effects REML regression Number of obs = 606

Group variable: id Number of groups = 101

Obs per group: min = 6

avg = 6.0

max = 6

Wald chi2(0) = .

Log restricted-likelihood = -4268.4304 Prob > chi2 = .

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

\_cons | 1770.701 45.42063 38.98 0.000 1681.679 1859.724

------------------------------------------------------------------------------

------------------------------------------------------------------------------

Random-effects Parameters | Estimate Std. Err. [95% Conf. Interval]

-----------------------------+------------------------------------------------

id: Identity |

var(\_cons) | 200883 29471.23 150683.2 267806.8

-----------------------------+------------------------------------------------

var(Residual) | 44899.96 2825.63 39689.76 50794.13

------------------------------------------------------------------------------

LR test vs. linear regression: chibar2(01) = 691.74 Prob >= chibar2 = 0.0000

. estat ic, n(101)

-----------------------------------------------------------------------------

Model | Obs ll(null) ll(model) df AIC BIC

-------------+---------------------------------------------------------------

. | 101 . -4268.43 3 8542.861 8550.706

-----------------------------------------------------------------------------

Note: N=101 used in calculating BIC

. estat recovariance, level(id)

Random-effects covariance matrix for level id

| \_cons

-------------+-----------

\_cons | 200883

.

. \* STATA Model 1b: Saturated Means, Unstructured Variance

. xtmixed nm3rt ib(last).session, || id: , noconstant ///

> variance reml residuals(unstructured, t(session)),

Obtaining starting values by EM:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -4577.7163 (not concave)

Iteration 1: log restricted-likelihood = -4203.6656 (not concave)

Iteration 2: log restricted-likelihood = -4167.7878

Iteration 3: log restricted-likelihood = -4130.8331

Iteration 4: log restricted-likelihood = -4115.2859

Iteration 5: log restricted-likelihood = -4114.896

Iteration 6: log restricted-likelihood = -4114.8942

Iteration 7: log restricted-likelihood = -4114.8942

Computing standard errors:

Mixed-effects REML regression Number of obs = 606

Group variable: id Number of groups = 101

Obs per group: min = 6

avg = 6.0

max = 6

Wald chi2(5) = 83.60

Log restricted-likelihood = -4114.8942 Prob > chi2 = 0.0000

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

session |

1 | 289.7574 32.69997 8.86 0.000 225.6666 353.8481

2 | 143.0364 26.20308 5.46 0.000 91.67927 194.3935

3 | 77.89864 22.8842 3.40 0.001 33.04642 122.7509

4 | 45.66045 20.78533 2.20 0.028 4.921952 86.39894

5 | 35.03972 18.11681 1.93 0.053 -.468579 70.54802

|

\_cons | 1672.136 44.13439 37.89 0.000 1585.634 1758.638

------------------------------------------------------------------------------

------------------------------------------------------------------------------

Random-effects Parameters | Estimate Std. Err. [95% Conf. Interval]

-----------------------------+------------------------------------------------

id: (empty) |

-----------------------------+------------------------------------------------

Residual: Unstructured |

var(e1) | 301983.1 42696.65 228893.4 398411.6

var(e2) | 259148.8 36635.7 196433.4 341887.4

var(e3) | 233366.9 32990.48 176891.6 307872.9

var(e4) | 217542.8 30753.82 164896.4 286997.6

var(e5) | 212096.8 29984.63 160767.3 279814.7

var(e6) | 196732.3 27812.21 149121.6 259543.9

cov(e1,e2) | 235657.1 36563.79 163993.4 307320.8

cov(e1,e3) | 217992.5 34336.3 150694.6 285290.4

cov(e1,e4) | 202605.4 32657.69 138597.5 266613.2

cov(e1,e5) | 192152.4 31762.13 129899.7 254405

cov(e1,e6) | 195358.7 31224.07 134160.6 256556.7

cov(e2,e3) | 230215.6 33672.52 164218.7 296212.5

cov(e2,e4) | 213230.6 31899.27 150709.2 275752

cov(e2,e5) | 202091 30938.65 141452.3 262729.6

cov(e2,e6) | 193267.2 29707.66 135041.2 251493.1

cov(e3,e4) | 205208 30462.92 145501.8 264914.2

cov(e3,e5) | 196917.7 29697.89 138710.9 255124.5

cov(e3,e6) | 188603.5 28532.39 132681 244525.9

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. do "C:\DOCUME~1\lesa\LOCALS~1\Temp\STD00000000.tmp"

. \* STATA Model 2a: Fixed Linear Time, Random Intercept

. xtmixed nm3rt c.c1sess, || id: , ///

> variance reml covariance(un) residuals(independent,t(session)),

Note: single-variable random-effects specification; covariance structure set to identity

Note: t() not required for this residual structure; ignored

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -4207.344

Iteration 1: log restricted-likelihood = -4207.344

Computing standard errors:

Mixed-effects REML regression Number of obs = 606

Group variable: id Number of groups = 101

Obs per group: min = 6

avg = 6.0

max = 6

Wald chi2(1) = 131.82

Log restricted-likelihood = -4207.344 Prob > chi2 = 0.0000

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

c1sess | -51.57185 4.491815 -11.48 0.000 -60.37565 -42.76806

\_cons | 1899.631 46.7882 40.60 0.000 1807.928 1991.334

------------------------------------------------------------------------------

------------------------------------------------------------------------------

Random-effects Parameters | Estimate Std. Err. [95% Conf. Interval]

-----------------------------+------------------------------------------------

id: Identity |

var(\_cons) | 202422.7 29469.85 152172.6 269266.3

-----------------------------+------------------------------------------------

var(Residual) | 35661.79 2246.481 31519.73 40348.16

------------------------------------------------------------------------------

LR test vs. linear regression: chibar2(01) = 787.61 Prob >= chibar2 = 0.0000

. estat ic, n(101),

-----------------------------------------------------------------------------

Model | Obs ll(null) ll(model) df AIC BIC

-------------+---------------------------------------------------------------

. | 101 . -4207.344 4 8422.688 8433.149

-----------------------------------------------------------------------------

Note: N=101 used in calculating BIC

. estat recovariance, level(id),

Random-effects covariance matrix for level id

| \_cons

-------------+-----------

\_cons | 202422.7

. estimates store FixLin

.

. \* STATA Model 2b: Random Linear Time

. xtmixed nm3rt c.c1sess, || id: c1sess, ///

> variance reml covariance(un) residuals(independent,t(session)),

Note: t() not required for this residual structure; ignored

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -4186.0513

Iteration 1: log restricted-likelihood = -4186.0512

Computing standard errors:

Mixed-effects REML regression Number of obs = 606

Group variable: id Number of groups = 101

Obs per group: min = 6

avg = 6.0

max = 6

Wald chi2(1) = 70.17

Log restricted-likelihood = -4186.0512 Prob > chi2 = 0.0000

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

c1sess | -51.57185 6.156722 -8.38 0.000 -63.63881 -39.5049

\_cons | 1899.631 51.4998 36.89 0.000 1798.693 2000.569

------------------------------------------------------------------------------

------------------------------------------------------------------------------

Random-effects Parameters | Estimate Std. Err. [95% Conf. Interval]

-----------------------------+------------------------------------------------

id: Unstructured |

var(c1sess) | 2233.833 552.9239 1375.178 3628.626

var(\_cons) | 253258 37897.26 188881.9 339575.3

cov(c1sess,\_cons) | -12700.79 3621.977 -19799.74 -5601.848

-----------------------------+------------------------------------------------

var(Residual) | 27905.42 1963.419 24310.74 32031.62

------------------------------------------------------------------------------

LR test vs. linear regression: chi2(3) = 830.20 Prob > chi2 = 0.0000

Note: LR test is conservative and provided only for reference.

. estat ic, n(101),

-----------------------------------------------------------------------------

Model | Obs ll(null) ll(model) df AIC BIC

-------------+---------------------------------------------------------------

. | 101 . -4186.051 6 8384.102 8399.793

-----------------------------------------------------------------------------

Note: N=101 used in calculating BIC

. estat recovariance, level(id),

Random-effects covariance matrix for level id

| c1sess \_cons

-------------+----------------------

c1sess | 2233.833

\_cons | -12700.79 253258

. estimates store RandLin,

. lrtest RandLin FixLin

Likelihood-ratio test LR chi2(2) = 42.59

(Assumption: FixLin nested in RandLin) Prob > chi2 = 0.0000

Note: The reported degrees of freedom assumes the null hypothesis is not on the boundary of

the parameter space. If this is not true, then the reported test is conservative.

Note: LR tests based on REML are valid only when the fixed-effects specification is

identical for both models.

.

. \* STATA Model 3a: Fixed Quadratic, Random Linear Time

. xtmixed nm3rt c.c1sess c.c1sess2, || id: c1sess, ///

> variance reml covariance(un) residuals(independent,t(session)),

Note: t() not required for this residual structure; ignored

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -4170.7387

Iteration 1: log restricted-likelihood = -4170.7386

Computing standard errors:

Mixed-effects REML regression Number of obs = 606

Group variable: id Number of groups = 101

Obs per group: min = 6

avg = 6.0

max = 6

Wald chi2(2) = 97.86

Log restricted-likelihood = -4170.7386 Prob > chi2 = 0.0000

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

c1sess | -120.8999 14.54147 -8.31 0.000 -149.4007 -92.39917

c1sess2 | 13.86561 2.634761 5.26 0.000 8.701578 19.02965

\_cons | 1945.85 52.2433 37.25 0.000 1843.455 2048.245

------------------------------------------------------------------------------

------------------------------------------------------------------------------

Random-effects Parameters | Estimate Std. Err. [95% Conf. Interval]

-----------------------------+------------------------------------------------

id: Unstructured |

var(c1sess) | 2332.667 551.5799 1467.501 3707.891

var(\_cons) | 254164 37895.62 189758.3 340429.7

cov(c1sess,\_cons) | -12947.88 3620.697 -20044.31 -5851.442

-----------------------------+------------------------------------------------

var(Residual) | 26175.83 1844.008 22800.05 30051.42

------------------------------------------------------------------------------

LR test vs. linear regression: chi2(3) = 851.78 Prob > chi2 = 0.0000

Note: LR test is conservative and provided only for reference.

. estat ic, n(101),

-----------------------------------------------------------------------------

Model | Obs ll(null) ll(model) df AIC BIC

-------------+---------------------------------------------------------------

. | 101 . -4170.739 7 8355.477 8373.783

-----------------------------------------------------------------------------

Note: N=101 used in calculating BIC

. estat recovariance, level(id),

Random-effects covariance matrix for level id

| c1sess \_cons

-------------+----------------------

c1sess | 2332.667

\_cons | -12947.88 254164

. estimates store FixQuad

.

. \* STATA Model 3b: Random Quadratic Time

. xtmixed nm3rt c.c1sess c.c1sess2, || id: c1sess c1sess2, ///

> variance reml covariance(un) residuals(independent,t(session)),

Note: t() not required for this residual structure; ignored

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -4153.7932

Iteration 1: log restricted-likelihood = -4151.7999

Iteration 2: log restricted-likelihood = -4151.3732

Iteration 3: log restricted-likelihood = -4151.3728

Computing standard errors:

Mixed-effects REML regression Number of obs = 606

Group variable: id Number of groups = 101

Obs per group: min = 6

avg = 6.0

max = 6

Wald chi2(2) = 71.74

Log restricted-likelihood = -4151.3728 Prob > chi2 = 0.0000

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

c1sess | -120.8999 20.04752 -6.03 0.000 -160.1923 -81.6075

c1sess2 | 13.86561 3.41541 4.06 0.000 7.171534 20.55969

\_cons | 1945.85 53.84993 36.13 0.000 1840.306 2051.394

------------------------------------------------------------------------------

------------------------------------------------------------------------------

Random-effects Parameters | Estimate Std. Err. [95% Conf. Interval]

-----------------------------+------------------------------------------------

id: Unstructured |

var(c1sess) | 25839.79 5864.685 16561.42 40316.29

var(c1sess2) | 634.4659 172.375 372.5198 1080.605

var(\_cons) | 276207.8 41445.59 205831.2 370647.1

cov(c1sess,c1sess2) | -3903.291 982.6248 -5829.2 -1977.381

cov(c1sess,\_cons) | -35734.05 11947.96 -59151.62 -12316.48

cov(c1sess2,\_cons) | 3901.974 1950.304 79.44722 7724.5

-----------------------------+------------------------------------------------

var(Residual) | 20298.19 1649.117 17310.19 23801.96

------------------------------------------------------------------------------

LR test vs. linear regression: chi2(6) = 890.51 Prob > chi2 = 0.0000

Note: LR test is conservative and provided only for reference.

. estat ic, n(101),

-----------------------------------------------------------------------------

Model | Obs ll(null) ll(model) df AIC BIC

-------------+---------------------------------------------------------------

. | 101 . -4151.373 10 8322.746 8348.897

-----------------------------------------------------------------------------

Note: N=101 used in calculating BIC

. estat recovariance, level(id),

Random-effects covariance matrix for level id

| c1sess c1sess2 \_cons

-------------+---------------------------------

c1sess | 25839.79

c1sess2 | -3903.291 634.4659

\_cons | -35734.05 3901.974 276207.8

. estimates store RandQuad,

. lrtest RandQuad FixQuad,

Likelihood-ratio test LR chi2(3) = 38.73

(Assumption: FixQuad nested in RandQuad) Prob > chi2 = 0.0000

Note: The reported degrees of freedom assumes the null hypothesis is not on the boundary of

the parameter space. If this is not true, then the reported test is conservative.

Note: LR tests based on REML are valid only when the fixed-effects specification is

identical for both models.

. lincom 1\*\_cons + 0\*c1sess + 0\*c1sess2 // intercept at session 1

( 1) [nm3rt]\_cons = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | 1945.85 53.84993 36.13 0.000 1840.306 2051.394

------------------------------------------------------------------------------

. lincom 1\*\_cons + 1\*c1sess + 1\*c1sess2 // intercept at session 2

( 1) [nm3rt]c1sess + [nm3rt]c1sess2 + [nm3rt]\_cons = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | 1838.815 48.48658 37.92 0.000 1743.784 1933.847

------------------------------------------------------------------------------

. lincom 1\*\_cons + 2\*c1sess + 4\*c1sess2 // intercept at session 3

( 1) 2\*[nm3rt]c1sess + 4\*[nm3rt]c1sess2 + [nm3rt]\_cons = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | 1759.512 46.99744 37.44 0.000 1667.399 1851.626

------------------------------------------------------------------------------

. lincom 1\*\_cons + 2.5\*c1sess + 6.25\*c1sess2 // intercept at mean session

( 1) 2.5\*[nm3rt]c1sess + 6.25\*[nm3rt]c1sess2 + [nm3rt]\_cons = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | 1730.26 46.52532 37.19 0.000 1639.072 1821.448

------------------------------------------------------------------------------

. lincom 1\*\_cons + 3\*c1sess + 9\*c1sess2 // intercept at session 4

( 1) 3\*[nm3rt]c1sess + 9\*[nm3rt]c1sess2 + [nm3rt]\_cons = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | 1707.941 45.89598 37.21 0.000 1617.986 1797.895

------------------------------------------------------------------------------

. lincom 1\*\_cons + 4\*c1sess + 16\*c1sess2 // intercept at session 5

( 1) 4\*[nm3rt]c1sess + 16\*[nm3rt]c1sess2 + [nm3rt]\_cons = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | 1684.1 44.23964 38.07 0.000 1597.392 1770.808

------------------------------------------------------------------------------

. lincom 1\*\_cons + 5\*c1sess + 25\*c1sess2 // intercept at session 6

( 1) 5\*[nm3rt]c1sess + 25\*[nm3rt]c1sess2 + [nm3rt]\_cons = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | 1687.991 44.20394 38.19 0.000 1601.352 1774.629

------------------------------------------------------------------------------

. lincom 1\*c1sess + 0\*c1sess2 // linear slope at session 1

( 1) [nm3rt]c1sess = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | -120.8999 20.04752 -6.03 0.000 -160.1923 -81.6075

------------------------------------------------------------------------------

. lincom 1\*c1sess + 2\*c1sess2 // linear slope at session 2

( 1) [nm3rt]c1sess + 2\*[nm3rt]c1sess2 = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | -93.1687 13.64968 -6.83 0.000 -119.9216 -66.4158

------------------------------------------------------------------------------

. lincom 1\*c1sess + 4\*c1sess2 // linear slope at session 3

( 1) [nm3rt]c1sess + 4\*[nm3rt]c1sess2 = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | -65.43747 8.002796 -8.18 0.000 -81.12266 -49.75228

------------------------------------------------------------------------------

. lincom 1\*c1sess + 5\*c1sess2 // linear slope at mean session

( 1) [nm3rt]c1sess + 5\*[nm3rt]c1sess2 = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | -51.57185 6.156724 -8.38 0.000 -63.63881 -39.5049

------------------------------------------------------------------------------

. lincom 1\*c1sess + 6\*c1sess2 // linear slope at session 4

( 1) [nm3rt]c1sess + 6\*[nm3rt]c1sess2 = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | -37.70624 5.92417 -6.36 0.000 -49.3174 -26.09508

------------------------------------------------------------------------------

. lincom 1\*c1sess + 8\*c1sess2 // linear slope at session 5

( 1) [nm3rt]c1sess + 8\*[nm3rt]c1sess2 = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | -9.975015 9.973315 -1.00 0.317 -29.52235 9.572324

------------------------------------------------------------------------------

. lincom 1\*c1sess + 10\*c1sess2 // linear slope at session 6

( 1) [nm3rt]c1sess + 10\*[nm3rt]c1sess2 = 0

------------------------------------------------------------------------------

nm3rt | Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

(1) | 17.75621 16.03616 1.11 0.268 -13.67408 49.18651

------------------------------------------------------------------------------

.

end of do-file