

Stata output for Hierarchical Linear Models

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. *****
. * Unconditional Random Intercept Model
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$$\text{MATHACH}_{ij} = \gamma_{00} + u_{0j} + r_{ij}$$

```
. mixed mathach || school: , variance
```

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Performing EM optimization:
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Performing gradient-based optimization:
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```
Iteration 0: log likelihood = -23557.905
Iteration 1: log likelihood = -23557.905
```

```
Computing standard errors:
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Mixed-effects ML regression          Number of obs   =       7185
Group variable: school                Number of groups =        160

Obs per group: min =          14
                  avg =         44.9
                  max =          67
```

```
Log likelihood = -23557.905          Wald chi2(0)    =          .
                                      Prob > chi2      =          .
```

mathach	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
_cons	12.63707	.2436178	51.87	0.000	12.15959 13.11455

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]
school: Identity			
var(_cons)	8.55352	1.068642	6.69575 10.92674
var(Residual)	39.14839	.6606469	37.87473 40.46489

```
LR test vs. linear regression: chibar2(01) = 983.92 Prob >= chibar2 = 0.0000
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. *****
. * Random Intercept Model with a level 2 predictor
. *****

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$$\text{MATHACH}_{ij} = \gamma_{00} + \gamma_{01}(\text{MEANSES}) + u_{0j} + r_{ij}$$

```

. mixed mathach meanses || school: , variance

```

Performing EM optimization:

Performing gradient-based optimization:

```

Iteration 0:  log likelihood = -23479.554
Iteration 1:  log likelihood = -23479.554

```

Computing standard errors:

```

Mixed-effects ML regression              Number of obs      =      7185
Group variable: school                   Number of groups   =       160

                                         Obs per group: min =       14
                                         avg =              44.9
                                         max =              67

                                         Wald chi2(1)      =      266.52
Log likelihood = -23479.554              Prob > chi2       =      0.0000

```

mathach	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
meanses	5.862921	.3591249	16.33	0.000	5.15905	6.566793
_cons	12.64974	.1483176	85.29	0.000	12.35904	12.94044

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]	
school: Identity				
var(_cons)	2.593175	.3965849	1.921561	3.499529
var(Residual)	39.15732	.6608059	37.88335	40.47414

LR test vs. linear regression: chibar2(01) = 237.27 Prob >= chibar2 = 0.0000

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. *****
. * Random-coefficient Model with a Level 1 predictor
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$$\text{MATHACH}_{ij} = \gamma_{00} + \gamma_{10}(\text{SES} - \text{MEANSES}) + u_{0j} + u_{1j}(\text{SES} - \text{MEANSES}) + r_{ij}$$

```

. mixed mathach cses || school: cses, variance cov(un)

```

Performing EM optimization:

Performing gradient-based optimization:

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Iteration 0:  log likelihood = -23355.556
Iteration 1:  log likelihood = -23355.49
Iteration 2:  log likelihood = -23355.49

```

Computing standard errors:

```

Mixed-effects ML regression              Number of obs      =       7185
Group variable: school                   Number of groups   =        160

                                         Obs per group: min =         14
                                         avg =                 44.9
                                         max =                 67

                                         Wald chi2(1)       =       294.28
Log likelihood = -23355.49               Prob > chi2        =       0.0000

```

mathach	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
cses	2.193147	.1278471	17.15	0.000	1.942572 2.443723
_cons	12.64943	.2437377	51.90	0.000	12.17171 13.12715

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]
school: Unstructured			
var(cses)	.6782353	.2779737	.3037503 1.514412
var(_cons)	8.621115	1.06946	6.760375 10.99401
cov(cses,_cons)	.0504007	.4025587	-.7385998 .8394011
var(Residual)	36.70004	.6257354	35.49389 37.94718

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LR test vs. linear regression:          chi2(3) = 1063.33  Prob > chi2 = 0.0000

```

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

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. *****
. * Random-coefficient Model with predictors from two different levels
. *****
MATHACHij =  $\gamma_{00} + \gamma_{01}(\text{MEANSES}) + \gamma_{02}(\text{SECTOR}) + \gamma_{10}(\text{SES} - \text{MEANSES}) + \gamma_{11}(\text{MEANSES}) * (\text{SES} - \text{MEANSES}) + \gamma_{12}(\text{SECTOR}) * (\text{SES} - \text{MEANSES}) + u_{0j} + u_{1j}(\text{SES} - \text{MEANSES}) + r_{ij}$ 

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```

. generate msesXcses = meanses*cses
. generate secXcses = sector*cses
. mixed mathach meanses sector cses msesXcses secXcses || school: cses, variance cov(un)

```

Performing EM optimization:

Performing gradient-based optimization:

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Iteration 0: log likelihood = -23249.409
Iteration 1: log likelihood = -23248.226
Iteration 2: log likelihood = -23248.218
Iteration 3: log likelihood = -23248.217
Computing standard errors:

```

```

Mixed-effects ML regression          Number of obs   =   7185
Group variable: school              Number of groups =    160

Obs per group: min =    14
                  avg =   44.9
                  max =    67

Wald chi2(5) =   761.60
Prob > chi2  =    0.0000

Log likelihood = -23248.217

```

mathach	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
meanses	5.337947	.3656956	14.60	0.000	4.621196	6.054697
sector	1.216947	.3033824	4.01	0.000	.6223288	1.811566
cses	2.939369	.1534874	19.15	0.000	2.638539	3.240199
msesXcses	1.042399	.2960229	3.52	0.000	.4622052	1.622594
secXcses	-1.643879	.2373474	-6.93	0.000	-2.109071	-1.178687
_cons	12.1136	.1969226	61.51	0.000	11.72764	12.49956

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]	
school: Unstructured				
var(cses)	.0650789	.2082457	.0001229	34.4505
var(_cons)	2.319207	.3610702	1.709301	3.146737
cov(cses,_cons)	.1885097	.1984887	-.200521	.5775404

var(Residual)	36.72116	.6261941	35.51413	37.96922

LR test vs. linear regression: chi2(3) = 216.69 Prob > chi2 = 0.0000

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

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. *****
. *Unconditional Growth Curve Model without predictors
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```

$$Y_{ij} = [b_{00} + b_{10} \text{TIME}_{ij}] + [u_{0j} + u_{1j} \text{TIME}_{ij} + r_{ij}]$$

```

. use F:\hlm\willett.dta, clear

. mixed y time || id: time, variance cov(un)

```

Performing EM optimization:

Performing gradient-based optimization:

```

Iteration 0:  log likelihood = -637.6823
Iteration 1:  log likelihood = -637.6823

```

Computing standard errors:

```

Mixed-effects ML regression          Number of obs   =       140
Group variable: id                  Number of groups =        35

                                     Obs per group: min =         4
                                     avg =         4.0
                                     max =         4

                                     Wald chi2(1)     =       159.39
Log likelihood = -637.6823           Prob > chi2     =        0.0000

```

y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
time	26.96	2.135429	12.63	0.000	22.77464	31.14536
_cons	164.3743	6.030806	27.26	0.000	152.5541	176.1944

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]	
id: Unstructured				
var(time)	127.7065	38.53122	70.69541	230.6933
var(_cons)	1161.338	304.8832	694.2161	1942.775
cov(time, _cons)	-172.7673	85.21018	-339.7762	-5.758386
var(Residual)	159.477	26.95652	114.5035	222.1147

```

LR test vs. linear regression:      chi2(3) = 120.21  Prob > chi2 = 0.0000

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

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. *****
. *Growth Curve Model with a level 1 predictor
. *****

$$Y_{ij} = b_{00} + b_{10}(TIME)_{ij} + b_{01}(COVAR)_{ij} + b_{11}(COVAR)(TIME)_{ij} + U_{0j} + U_{1j}(TIME)_{ij} + r_{ij}$$


```

```

. mixed y time ccovar timeBYccovar || id: time, variance cov(un)

```

Performing EM optimization:

Performing gradient-based optimization:

```

Iteration 0: log likelihood = -633.45046
Iteration 1: log likelihood = -633.45046

```

Computing standard errors:

```

Mixed-effects ML regression      Number of obs      =      140
Group variable: id              Number of groups    =       35

Obs per group: min =           4
                  avg =          4.0
                  max =           4

```

```

Log likelihood = -633.45046      Wald chi2(3)       =      203.48
                                Prob > chi2            =       0.0000

```

y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
time	26.96	1.936075	13.93	0.000	23.16536 30.75464
ccovar	-.1135527	.4894	-0.23	0.817	-1.072759 .8456536
timeBYccovar	.4328577	.1572333	2.75	0.006	.1246861 .7410294
_cons	164.3743	6.026173	27.28	0.000	152.5632 176.1854

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]
id: Unstructured			
var(time)	99.29816	31.82131	52.98627 186.0883
var(_cons)	1159.383	304.4167	692.9927 1939.658
cov(time,_cons)	-165.3148	78.28058	-318.7419 -11.88769
var(Residual)	159.477	26.95653	114.5035 222.1147

```

LR test vs. linear regression:    chi2(3) = 119.52    Prob > chi2 = 0.0000

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