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name: <unnamed>
log: F:\workshop\HLM and SEM approaches to Growth Curve Modeling\groth curve in stata.log
log type: text
opened on: 12 Feb 2018, 15:21:03
```

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.
.
. *****
. * Read in the data
. *****
.
. use http://www.stata-press.com/data/r14/childweight.dta, clear
(Weight data on Asian children)
```

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.
. *****
. * Describe the data
. *****
.
. des
```

```
Contains data from http://www.stata-press.com/data/r14/childweight.dta
obs:      198      Weight data on Asian children
vars:      5      23 May 2014 15:12
size:     3,168      (_dta has notes)
```

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variable name	storage type	display format	value label	variable label
id	int	%8.0g		child identifier
age	float	%8.0g		age in years
weight	float	%8.0g		weight in Kg
brthwt	int	%8.0g		Birth weight in g
girl	float	%9.0g	bg	gender

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Sorted by: id age

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. list in 1/16, sepby(id)
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	id	age	weight	brthwt	girl
1.	45	.136893	5.171	4140	boy
2.	45	.657084	10.86	4140	boy
3.	45	1.21834	13.15	4140	boy
4.	45	1.42916	13.2	4140	boy
5.	45	2.27242	15.88	4140	boy
6.	258	.19165	5.3	3155	girl
7.	258	.687201	9.74	3155	girl
8.	258	1.12799	9.98	3155	girl
9.	258	2.30527	11.34	3155	girl
10.	287	.134155	4.82	3850	boy
11.	287	.70089	9.09	3850	boy
12.	287	1.16906	11.1	3850	boy
13.	287	2.2423	16.8	3850	boy
14.	483	.747433	5.76	2875	girl
15.	483	1.01848	6.92	2875	girl
16.	483	2.24504	9.53	2875	girl

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.
. *****
. * A Linear relation between age and weight, assuming no gender differences
. *****
. graph twoway (scatter weight age) (lfit weight age), xtitle(Age in years) ytitle(Weight in kg)
.
. graph save regress1, replace
(file regress1.gph saved)
```

```
.
. *****
. * Respective linear relations between weight and age for boys and girls
. *****
. graph twoway (scatter weight age) (lfit weight age), by(girl) xtitle(Age in years) ytitle(Weight in kg)
.
. graph save regress1_gender, replace
```

(file regress1_gender.gph saved)

```
. graph twoway (line weight age, connect(ascending)), by(girl) xtitle(Age in years) ytitle(Weight in kg)
. graph save regress1_trajectory, replace
(file regress1_trajectory.gph saved)
```

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. *****
. * Respective Linear growth curve for boys and girls
. *****
. reg weight age if girl ==0
```

Source	SS	df	MS	Number of obs	=	
Model	745.956373	1	745.956373	F(1, 98)	=	300.64
Residual	243.160036	98	2.48122486	Prob > F	=	0.0000
				R-squared	=	0.7542
				Adj R-squared	=	0.7517
Total	989.11641	99	9.99107485	Root MSE	=	1.5752

weight	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
age	3.481124	.2007686	17.34	0.000	3.082705	3.879543
_cons	5.438747	.2673444	20.34	0.000	4.90821	5.969283

```
. reg weight age if girl ==1
```

Source	SS	df	MS	Number of obs	=	
Model	638.928216	1	638.928216	F(1, 96)	=	401.03
Residual	152.949509	96	1.59322406	Prob > F	=	0.0000
				R-squared	=	0.8069
				Adj R-squared	=	0.8048
Total	791.877725	97	8.16368789	Root MSE	=	1.2622

weight	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
age	3.250378	.1623103	20.03	0.000	2.928194	3.572561
_cons	4.955374	.2174555	22.79	0.000	4.523728	5.38702

```
. *****
. * Respective curvilinear growth curves for girls and boys, respectively
. *****
. reg weight c.age#c.age if girl ==0
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Source	SS	df	MS	Number of obs	=	
Model	832.82225	2	416.411125	F(2, 97)	=	258.43
Residual	156.29416	97	1.61128	Prob > F	=	0.0000
				R-squared	=	0.8420
				Adj R-squared	=	0.8387
Total	989.11641	99	9.99107485	Root MSE	=	1.2694

weight	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
age	7.985022	.6343855	12.59	0.000	6.725942	9.244101
c.age#c.age	-1.74346	.2374504	-7.34	0.000	-2.214733	-1.272187
_cons	3.684363	.3217223	11.45	0.000	3.045833	4.322893

```
. reg weight c.age#c.age if girl ==1
```

Source	SS	df	MS	Number of obs	=	
Model	695.950527	2	347.975263	F(2, 95)	=	344.61
Residual	95.9271985	95	1.00975998	Prob > F	=	0.0000
				R-squared	=	0.8789
				Adj R-squared	=	0.8763
Total	791.877725	97	8.16368789	Root MSE	=	1.0049

weight	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
age	7.008066	.5164687	13.57	0.000	5.982746	8.033386
c.age#c.age	-1.450582	.1930318	-7.51	0.000	-1.833798	-1.067365

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    _cons |      3.480933      .2616616      13.30      0.000      2.961469      4.000397
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. *****
. * Growth Curve Modeling
. *****
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. *****
. * Model_0 : Traditional regression
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. *****
. * Model_0: Regression commands
. *****

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. reg weight age

      Source |           SS          df           MS      Number of obs   =        198
-----+-----+-----+-----+-----+-----
      Model |    1381.02521            1    1381.02521      F(1, 196)       =       637.94
      Residual |    424.306142         196    2.16482725      Prob > F         =        0.0000
-----+-----+-----+-----+-----+-----
      Total |    1805.33136         197    9.16411856      R-squared        =       0.7650
                                           Adj R-squared    =       0.7638
                                           Root MSE        =       1.4713

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-----+-----
      weight |           Coef.      Std. Err.      t    P>|t|     [95% Conf. Interval]
-----+-----+-----+-----+-----+-----
           age |    3.363991      .1331882     25.26  0.000     3.101325     3.626657
           _cons |    5.202122      .1778919     29.24  0.000     4.851295     5.55295
-----+-----

```

```

. predict p_weight
(option xb assumed; fitted values)

. graph twoway (line p_weight age, connect(ascending))

. graph save model_0_0, replace
(file model_0_0.gph saved)

. graph twoway (line p_weight age if girl ==0, connect(ascending))

. graph save model_0_1, replace
(file model_0_1.gph saved)

.
.
. graph twoway (line p_weight age if girl ==0, connect(ascending))

. graph save model_0_2, replace
(file model_0_2.gph saved)

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. *****
. * HLM commands
. *****
. mixed weight c.age, nolog

```

```

Mixed-effects ML regression              Number of obs   =        198

                                           Wald chi2(1)    =       644.45
Log likelihood = -356.40646              Prob > chi2     =        0.0000

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-----+-----
      weight |           Coef.      Std. Err.      z    P>|z|     [95% Conf. Interval]
-----+-----+-----+-----+-----+-----
           age |    3.363991      .1325138     25.39  0.000     3.104269     3.623714
           _cons |    5.202122      .1769911     29.39  0.000     4.855226     5.549019
-----+-----

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-----+-----
      Random-effects Parameters |   Estimate    Std. Err.      [95% Conf. Interval]
-----+-----+-----+-----+-----
           var(Residual) |    2.14296     .2153756     1.759807     2.609535
-----+-----

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. est store model_0

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.
. *****
. * Model 1 : Linear Growth curve model with randownm intercept
. *****
.
. mixed weight age || id: , nolog

Mixed-effects ML regression      Number of obs   =      198
Group variable: id              Number of groups =       68

                                Obs per group:
                                min =          1
                                avg =          2.9
                                max =          5

                                Wald chi2(1)      =      866.65
                                Prob > chi2       =      0.0000

Log likelihood = -348.32402
    
```

weight	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
age	3.389281	.115129	29.44	0.000	3.163633	3.61493
_cons	5.156913	.180158	28.62	0.000	4.80381	5.510016

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]	
id: Identity				
var(_cons)	.6076662	.2040674	.3146395	1.173591
var(Residual)	1.524052	.1866496	1.198819	1.937518

LR test vs. linear model: chibar2(01) = 16.16 Prob >= chibar2 = 0.0000

```

. graph save model_1, replace
(file model_1.gph saved)
    
```

```

. est store model_1
    
```

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. *****
. * Model 2: Linear Growth curve model with randownm slope
. *****
.
. mixed weight age || id: c.age, covariance(unstructured) nolog

Mixed-effects ML regression      Number of obs   =      198
Group variable: id              Number of groups =       68

                                Obs per group:
                                min =          1
                                avg =          2.9
                                max =          5

                                Wald chi2(1)      =      755.27
                                Prob > chi2       =      0.0000

Log likelihood = -342.71777
    
```

weight	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
age	3.459671	.1258877	27.48	0.000	3.212936	3.706406
_cons	5.110496	.1494781	34.19	0.000	4.817524	5.403468

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]	
id: Unstructured				
var(age)	.202392	.1242859	.0607411	.6743782
var(_cons)	.0970272	.1107995	.0103483	.9097395
cov(age,_cons)	.1401339	.0566908	.0290221	.2512458
var(Residual)	1.357922	.165053	1.070071	1.723205

LR test vs. linear model: chi2(3) = 27.38 Prob > chi2 = 0.0000

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

```

. graph save model_2, replace
(file model_2.gph saved)
    
```

```

. est store model_2
    
```

```

. *****
. * Model 3 : Curvilinear Growth model with random intercept
. *****
.
. mixed weight age c.age#c.age || id: c.age, covariance(unstructured) nolog

Mixed-effects ML regression          Number of obs   =       198
Group variable: id                   Number of groups =        68

                                   Obs per group:
                                   min =         1
                                   avg =        2.9
                                   max =         5

                                   Wald chi2(2)      =    1978.20
                                   Prob > chi2      =         0.0000

Log likelihood = -258.07784
    
```

weight	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
age	7.703998	.2394082	32.18	0.000	7.234767	8.173229
c.age#c.age	-1.660465	.0885229	-18.76	0.000	-1.833967	-1.486963
_cons	3.494512	.1372636	25.46	0.000	3.22548	3.763544

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]	
id: Unstructured				
var(age)	.254097	.0886513	.1282407	.5034696
var(_cons)	.40444	.1645248	.1822168	.8976766
cov(age,_cons)	.0880873	.0880255	-.0844394	.2606141
var(Residual)	.3315169	.0582667	.2349093	.4678548

LR test vs. linear model: chi2(3) = 115.58 Prob > chi2 = 0.0000

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

```

. graph save model_3, replace
(file model_3.gph saved)
    
```

```

. est store model_3
    
```

```

. *****
. * Compare Models 1 through 3
. *****
. lrtest model_0 model_1
    
```

```

Likelihood-ratio test          LR chi2(1) =    16.16
(Assumption: model_0 nested in model_1)  Prob > chi2 =    0.0001
    
```

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

```

. lrtest model_1 model_2
    
```

```

Likelihood-ratio test          LR chi2(2) =    11.21
(Assumption: model_1 nested in model_2)  Prob > chi2 =    0.0037
    
```

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

```

. lrtest model_2 model_3
    
```

```

Likelihood-ratio test          LR chi2(1) =   169.28
(Assumption: model_2 nested in model_3)  Prob > chi2 =    0.0000
    
```

```

. *****
. * Model 4: Same linear and curvilinear time effects for boys and girls
. *****
.
. mixed weight age c.age#c.age i.girl || id: c.age, covariance(unstructured) nolog
    
```

```

Mixed-effects ML regression          Number of obs   =       198
Group variable: id                   Number of groups =        68
    
```

```

                                Obs per group:
                                min =          1
                                avg =          2.9
                                max =          5

                                Wald chi2(3)    =    1975.44
                                Prob > chi2     =    0.0000

Log likelihood = -253.86692
    
```

weight	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
age	7.697967	.2382121	32.32	0.000	7.23108 8.164854
c.age#c.age	-1.657843	.0880529	-18.83	0.000	-1.830423 -1.485262
girl					
girl	-.5960093	.196369	-3.04	0.002	-.9808854 -.2111333
_cons	3.794769	.1655053	22.93	0.000	3.470385 4.119153

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]
id: Unstructured			
var(age)	.2598034	.0888719	.1328835 .5079471
var(_cons)	.3537053	.1534276	.151152 .827693
cov(age,_cons)	.0476256	.0875145	-.1238996 .2191508
var(Residual)	.3275616	.0568064	.2331717 .4601614

LR test vs. linear model: chi2(3) = 104.17 Prob > chi2 = 0.0000

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

```

.
.
.
.
. margins i.girl, at(age=(0(1)3)) vsquish
    
```

Adjusted predictions Number of obs = 198

```

Expression : Linear prediction, fixed portion, predict()
1._at      : age = 0
2._at      : age = 1
3._at      : age = 2
4._at      : age = 3
    
```

	Margin	Delta-method Std. Err.	z	P> z	[95% Conf. Interval]
_at#girl					
1#boy	3.794769	.1655053	22.93	0.000	3.470385 4.119153
1#girl	3.19876	.1668333	19.17	0.000	2.871772 3.525747
2#boy	9.834894	.1566511	62.78	0.000	9.527863 10.14192
2#girl	9.238884	.1563958	59.07	0.000	8.932354 9.545414
3#boy	12.55933	.1981441	63.38	0.000	12.17098 12.94769
3#girl	11.96332	.1978473	60.47	0.000	11.57555 12.3511
4#boy	11.96809	.3416399	35.03	0.000	11.29848 12.63769
4#girl	11.37208	.3421204	33.24	0.000	10.70153 12.04262

```

. marginsplot, name(model_4, replace) x(age)
    
```

Variables that uniquely identify margins: age girl

```

.
.
. *****
. * Model 5: Different linear and curvilinear time effects for boys and girls
. *****
.
. mixed weight i.girl#c.age#c.age || id: c.age, covariance(unstructured) nolog
    
```

Mixed-effects ML regression Number of obs = 198
 Group variable: id Number of groups = 68

```

Obs per group:
min = 1
avg = 2.9
max = 5
    
```

Wald chi2(5) = 2057.07

Log likelihood = -252.17245 Prob > chi2 = 0.0000

weight	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
girl						
girl	-.2880334	.2671076	-1.08	0.281	-.8115547	.2354878
age	8.088514	.3280961	24.65	0.000	7.445457	8.73157
girl#c.age						
girl	-.7976061	.4725759	-1.69	0.091	-1.723838	.1286257
c.age#c.age	-1.767464	.1212487	-14.58	0.000	-2.005107	-1.529821
girl#c.age#c.age						
girl	.2254455	.1748906	1.29	0.197	-.1173337	.5682248
_cons	3.644952	.1863481	19.56	0.000	3.279717	4.010188

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]	
id: Unstructured				
var(age)	.2420157	.0852982	.1212937	.4828906
var(_cons)	.355564	.1516959	.1540869	.8204834
cov(age, _cons)	.0539353	.0842912	-.1112724	.2191429
var(Residual)	.3236147	.0561127	.230375	.4545913

LR test vs. linear model: chi2(3) = 105.48 Prob > chi2 = 0.0000

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

. est store model_5

.
 . margins i.girl, at(age=(0(1)3)) vsquish

Adjusted predictions Number of obs = 198

Expression : Linear prediction, fixed portion, predict()
 1._at : age = 0
 2._at : age = 1
 3._at : age = 2
 4._at : age = 3

	Delta-method		z	P> z	[95% Conf. Interval]	
	Margin	Std. Err.				
_at#girl						
1#boy	3.644952	.1863481	19.56	0.000	3.279717	4.010188
1#girl	3.356919	.1913657	17.54	0.000	2.981849	3.731989
2#boy	9.966002	.1716366	58.06	0.000	9.6296	10.3024
2#girl	9.105808	.1719598	52.95	0.000	8.768773	9.442843
3#boy	12.75212	.24049	53.03	0.000	12.28077	13.22348
3#girl	11.77066	.2392029	49.21	0.000	11.30183	12.23949
4#boy	12.00332	.4535865	26.46	0.000	11.11431	12.89233
4#girl	11.35148	.4591025	24.73	0.000	10.45165	12.2513

. marginsplot, name(model_5, replace) x(age)

Variables that uniquely identify margins: age girl

.
 .
 . *****
 . * close the log file
 . *****
 . log close
 name: <unnamed>
 log: F:\workshop\HLM and SEM approaches to Growth Curve Modeling\groth curve in stata.log
 log type: text
 closed on: 12 Feb 2018, 15:21:13