**Lab session II Tuesday - Chp. 6 – Hypothesis testing**

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 name: <unnamed>

 log: J:\Multilevel TA\Chp6\_Hypothesis\_testing.log

 log type: text

 opened on: 16 Apr 2012, 22:53:06

. \*\*chap6.do\*\*

. \*\*Example 6.1\*\*

. \*\*Hypothesis testing\*\*

.

.

. clear all

. set more off

. cd "J:\Multilevel TA"

J:\Multilevel TA

.

. \*Read in the data

.

. \*infile schoolnr pupilNR\_new langpost ses IQ\_verb sex Minority denomina sch\_ses sch\_iqv sch\_min usi

> ng "/Users/Jon/Documents/Snijders/SecondEditionExamples/DataSnijdersSecondEdition/mlbook2\_r.txt" in

> 2/3759, clear

. infile schoolnr pupilNR\_new langpost ses IQ\_verb sex Minority denomina sch\_ses sch\_iqv sch\_min usin

> g mlbook2\_r.txt

'schoolnr' cannot be read as a number for schoolnr[1]

'pupilNR\_new' cannot be read as a number for pupilNR\_new[1]

'langPOST' cannot be read as a number for langpost[1]

'ses' cannot be read as a number for ses[1]

'IQ\_verb' cannot be read as a number for IQ\_verb[1]

'sex' cannot be read as a number for sex[1]

'Minority' cannot be read as a number for Minority[1]

'denomina' cannot be read as a number for denomina[1]

'sch\_ses' cannot be read as a number for sch\_ses[1]

'sch\_iqv' cannot be read as a number for sch\_iqv[1]

'sch\_min' cannot be read as a number for sch\_min[1]

(3759 observations read)

.

. \*Example 6.1

.

. egen gmeanIQverb = mean(IQ\_verb), by(schoolnr)

(1 missing value generated)

. egen gmeanSES = mean(ses), by(schoolnr)

(1 missing value generated)

.

.

. \*Model 1

.

. xtmixed langpost IQ\_verb ses gmeanIQverb || schoolnr : IQ\_verb , mle covariance(un) var

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log likelihood = -12331.42

Iteration 1: log likelihood = -12330.99

Iteration 2: log likelihood = -12330.989

Iteration 3: log likelihood = -12330.989

Computing standard errors:

Mixed-effects ML regression Number of obs = 3758

Group variable: schoolnr Number of groups = 211

 Obs per group: min = 4

 avg = 17.8

 max = 34

 Wald chi2(3) = 1884.00

Log likelihood = -12330.989 Prob > chi2 = 0.0000

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

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

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

 IQ\_verb | 2.265913 .0648193 34.96 0.000 2.138869 2.392956

 ses | .1615671 .0111578 14.48 0.000 .1396981 .183436

 gmeanIQverb | .6060822 .2644147 2.29 0.022 .0878389 1.124326

 \_cons | 41.13673 .2348167 175.19 0.000 40.67649 41.59696

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

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

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

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

schoolnr: Unstructured |

 var(IQ\_verb) | .1973364 .0742749 .0943682 .4126563

 var(\_cons) | 9.116406 1.135057 7.142381 11.63602

 cov(IQ\_verb,\_cons) | -.8245968 .2327884 -1.280854 -.36834

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

 var(Residual) | 37.42575 .9095101 35.68493 39.25149

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

LR test vs. linear regression: chi2(3) = 460.49 Prob > chi2 = 0.0000

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

. est store mod1

. estat ic

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

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

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

 mod1 | 3758 . -12330.99 8 24677.98 24727.83

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

 Note: N=Obs used in calculating BIC; see [R] BIC note

.

. \*Model 2

.

. gen IQverb\_tilde = IQ\_verb- gmeanIQverb

(1 missing value generated)

.

. xtmixed langpost ses IQverb\_tilde gmeanIQverb || schoolnr : IQ\_verb , mle covariance(un) var

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log likelihood = -12331.42

Iteration 1: log likelihood = -12330.99

Iteration 2: log likelihood = -12330.989

Iteration 3: log likelihood = -12330.989

Computing standard errors:

Mixed-effects ML regression Number of obs = 3758

Group variable: schoolnr Number of groups = 211

 Obs per group: min = 4

 avg = 17.8

 max = 34

 Wald chi2(3) = 1884.00

Log likelihood = -12330.989 Prob > chi2 = 0.0000

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

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

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

 ses | .1615671 .0111578 14.48 0.000 .1396981 .183436

IQverb\_tilde | 2.265913 .0648193 34.96 0.000 2.138869 2.392956

 gmeanIQverb | 2.871995 .2624168 10.94 0.000 2.357667 3.386322

 \_cons | 41.13673 .2348167 175.19 0.000 40.67649 41.59696

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

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

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

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

schoolnr: Unstructured |

 var(IQ\_verb) | .1973364 .0742749 .0943682 .4126563

 var(\_cons) | 9.116406 1.135057 7.142381 11.63602

 cov(IQ\_verb,\_cons) | -.8245968 .2327884 -1.280854 -.36834

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

 var(Residual) | 37.42575 .9095101 35.68493 39.25149

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

LR test vs. linear regression: chi2(3) = 460.49 Prob > chi2 = 0.0000

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

. est store mod2

. estat ic

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

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

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

 mod2 | 3758 . -12330.99 8 24677.98 24727.83

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

 Note: N=Obs used in calculating BIC; see [R] BIC note

.

. esttab mod1 mod2, se wide nostar ///

> transform(ln\*: exp(2\*@) exp(2\*@) at\*: tanh(@) (1-tanh(@)^2)) ///

> eqlabels("" "var(u1)" "var(u0)" "corr(u1,\_cons)" "var(Residual)", none) ///

> varlabels(,elist(weight:\_cons "{break}{hline @width}")) ///

> varwidth(16)

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

 (1) (2)

 langpost langpost

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

IQ\_verb 2.266 (0.0648)

ses 0.162 (0.0112) 0.162 (0.0112)

gmeanIQverb 0.606 (0.264) 2.872 (0.262)

IQverb\_tilde 2.266 (0.0648)

\_cons 41.14 (0.235) 41.14 (0.235)

var(u1) 0.197 (0.0371) 0.197 (0.0371)

var(u0) 9.116 (0.568) 9.116 (0.568)

corr(u1,\_cons) -0.615 (0.148) -0.615 (0.148)

var(Residual) 37.43 (0.455) 37.43 (0.455)

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

N 3758 3758

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

Standard errors in parentheses

.

. /\*Note: esttab is an ado that creates regression tables. If you want to know more, look up

> estout and esttab. There is also a possibility to export these tables to LateX.

> Check out this web page: http://repec.org/bocode/e/estout/advanced.html\*/

.

.

. \*Test for random intercepts

.

. regr langpost IQ\_verb

 Source | SS df MS Number of obs = 3758

-------------+------------------------------ F( 1, 3756) = 2207.37

 Model | 109982.854 1 109982.854 Prob > F = 0.0000

 Residual | 187144.192 3756 49.8253973 R-squared = 0.3702

-------------+------------------------------ Adj R-squared = 0.3700

 Total | 297127.046 3757 79.0862513 Root MSE = 7.0587

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

 langpost | Coef. Std. Err. t P>|t| [95% Conf. Interval]

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

 IQ\_verb | 2.651263 .0564307 46.98 0.000 2.540625 2.761901

 \_cons | 41.29584 .1151725 358.56 0.000 41.07004 41.52165

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

. estat ic

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

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

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

 . | 3758 -13544.11 -12675.49 2 25354.98 25367.44

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

 Note: N=Obs used in calculating BIC; see [R] BIC note

.

. dis -2\*-12675.49

25350.98

. \*25350.98

.

. xtmixed langpost IQ\_verb || schoolnr:, var mle

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log likelihood = -12456.084

Iteration 1: log likelihood = -12456.084

Computing standard errors:

Mixed-effects ML regression Number of obs = 3758

Group variable: schoolnr Number of groups = 211

 Obs per group: min = 4

 avg = 17.8

 max = 34

 Wald chi2(1) = 2126.00

Log likelihood = -12456.084 Prob > chi2 = 0.0000

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

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

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

 IQ\_verb | 2.507445 .0543813 46.11 0.000 2.400859 2.61403

 \_cons | 41.05488 .2433866 168.68 0.000 40.57785 41.53191

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

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

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

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

schoolnr: Identity |

 var(\_cons) | 9.845065 1.23781 7.694809 12.59619

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

 var(Residual) | 40.4689 .9618532 38.62694 42.3987

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

LR test vs. linear regression: chibar2(01) = 438.81 Prob >= chibar2 = 0.0000

. estat ic

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

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

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

 . | 3758 . -12456.08 4 24920.17 24945.09

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

 Note: N=Obs used in calculating BIC; see [R] BIC note

.

. dis -2\*-12456.08

24912.16

. \*24912.16

.

. /\*Difference in deviance is 438.81. Note the bottom of the output! Compare page 99!\*/

.

. \*Test for random slopes

. xtmixed langpost IQ\_verb || schoolnr:, var mle

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log likelihood = -12456.084

Iteration 1: log likelihood = -12456.084

Computing standard errors:

Mixed-effects ML regression Number of obs = 3758

Group variable: schoolnr Number of groups = 211

 Obs per group: min = 4

 avg = 17.8

 max = 34

 Wald chi2(1) = 2126.00

Log likelihood = -12456.084 Prob > chi2 = 0.0000

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

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

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

 IQ\_verb | 2.507445 .0543813 46.11 0.000 2.400859 2.61403

 \_cons | 41.05488 .2433866 168.68 0.000 40.57785 41.53191

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

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

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

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

schoolnr: Identity |

 var(\_cons) | 9.845065 1.23781 7.694809 12.59619

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

 var(Residual) | 40.4689 .9618532 38.62694 42.3987

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

LR test vs. linear regression: chibar2(01) = 438.81 Prob >= chibar2 = 0.0000

. est store XT1

.

. xtmixed langpost IQ\_verb || schoolnr: IQ\_verb, var mle cov(unstr)

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log likelihood = -12440.185

Iteration 1: log likelihood = -12439.393

Iteration 2: log likelihood = -12439.393

Computing standard errors:

Mixed-effects ML regression Number of obs = 3758

Group variable: schoolnr Number of groups = 211

 Obs per group: min = 4

 avg = 17.8

 max = 34

 Wald chi2(1) = 1584.27

Log likelihood = -12439.393 Prob > chi2 = 0.0000

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

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

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

 IQ\_verb | 2.519393 .0632968 39.80 0.000 2.395334 2.643452

 \_cons | 41.12806 .242474 169.62 0.000 40.65282 41.60331

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

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

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

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

schoolnr: Unstructured |

 var(IQ\_verb) | .2024366 .0772565 .095817 .4276963

 var(\_cons) | 9.77522 1.215771 7.660555 12.47363

 cov(IQ\_verb,\_cons) | -1.080031 .2394357 -1.549317 -.6107461

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

 var(Residual) | 39.74999 .9657733 37.90148 41.68867

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

LR test vs. linear regression: chi2(3) = 472.19 Prob > chi2 = 0.0000

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

. est store XT2

.

. lrtest XT2 XT1

Likelihood-ratio test LR chi2(2) = 33.38

(Assumption: XT1 nested in XT2) 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.

.

. \*Wald test for categorical variables

. \*Assume you are including a set of dummy variables. This test will check, whether all of them are j

> ointly 0.

.

. xtmixed langpost i.denomina || schoolnr:, var mle

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log likelihood = -13287.029

Iteration 1: log likelihood = -13287.029

Computing standard errors:

Mixed-effects ML regression Number of obs = 3758

Group variable: schoolnr Number of groups = 211

 Obs per group: min = 4

 avg = 17.8

 max = 34

 Wald chi2(4) = 22.43

Log likelihood = -13287.029 Prob > chi2 = 0.0002

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

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

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

 denomina |

 2 | 3.183912 .7766762 4.10 0.000 1.661654 4.706169

 3 | .9819202 .8350884 1.18 0.240 -.654823 2.618663

 4 | 4.412437 1.527009 2.89 0.004 1.419554 7.40532

 5 | 2.604167 1.36301 1.91 0.056 -.0672841 5.275617

 |

 \_cons | 39.29395 .5747184 68.37 0.000 38.16752 40.42038

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

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

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

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

schoolnr: Identity |

 var(\_cons) | 15.83271 2.025939 12.32073 20.34578

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

 var(Residual) | 62.88037 1.496778 60.01412 65.88351

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

LR test vs. linear regression: chibar2(01) = 411.45 Prob >= chibar2 = 0.0000

.

. testparm i.denomina

 ( 1) [langpost]2.denomina = 0

 ( 2) [langpost]3.denomina = 0

 ( 3) [langpost]4.denomina = 0

 ( 4) [langpost]5.denomina = 0

 chi2( 4) = 22.43

 Prob > chi2 = 0.0002

.

. \*Test whether the effects of different categories of the set of dummies are different from each oth

> er.

. \*In the denomination example: category 2 is Catholic schools, category 3 is Protestant schools.

. \*Do those two schooltypes differ in their language scores?

.

. . lincom \_b[2.denomina]-\_b[3.denomina]

 ( 1) [langpost]2.denomina - [langpost]3.denomina = 0

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

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

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

 (1) | 2.201992 .7999975 2.75 0.006 .6340252 3.769958

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

.

. capture log close