

## Constraining fixed effects to be equal

A user may wish to constrain two or more fixed effects to be equal. For example, we may want to test that the coefficients associated with the level-2 predictor SECTOR are equal in the model

FileBasic SettingsOther SettingsRun AnalysisHelpOutcomeLEVEL 1 MODELLevel-1MATHACH $\beta_{0j} + \beta_{1j}(SES_{ij} - SES_{j}) + r_{ij}$ INTRCPT2LEVEL 2 MODELSIZESECTOR $\beta_{0j} = \gamma_{00} + \gamma_{01}(SECTOR_j) + \gamma_{02}(MEANSES_j - MEANSES_j) + u_{0j}$ PRACAD $\beta_{1j} = \gamma_{10} + \gamma_{11}(SECTOR_j) + \gamma_{12}(MEANSES_j - MEANSES_j) + u_{1j}$ DISCLIM $\beta_{1j} = \gamma_{10} + \gamma_{11}(SECTOR_j) + \gamma_{12}(MEANSES_j - MEANSES_j) + u_{1j}$	WHLM: hlm2 M	IDM File: HSB.MDM Command File: HSB1.MLM	
OutcomeLEVEL 1 MODELLevel-1MATHACH ij = $\beta_{0j} + \beta_{1j}(SES_{ij} - SES_{.j}) + r_{ij}$ INTRCPT2 SIZE SECTOR PRACAD DISCLIM HIMINTY MEANSESLEVEL 2 MODEL $\beta_{1j} = \gamma_{10} + \gamma_{01}(SECTOR_j) + \gamma_{02}(MEANSES_j - MEANSES_) + u_{0j}$ $\beta_{1j} = \gamma_{10} + \gamma_{11}(SECTOR_j) + \gamma_{12}(MEANSES_j - MEANSES_) + u_{1j}$	File Basic Setting	js Other Settings Run Analysis Help	
>> Level-2 <MATHACH_{ij} = $\beta_{0j} + \beta_{1j}(SES_{ij} - SES_{.j}) + r_{ij}$ INTRCPT2 SIZE SECTOR PRACAD DISCLIM HIMINTY MEANSESLEVEL 2 MODEL $\beta_{0j} = \gamma_{00} + \gamma_{01}(SECTOR_j) + \gamma_{02}(MEANSES_j - MEANSES_) + u_{0j}$	Outcome Level-1	LEVEL 1 MODEL	<b>^</b>
INTRCPT2 SIZE SECTOR PRACAD DISCLIM HIMINTY MEANSES LEVEL 2 MODEL $\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{SECTOR}_j) + \gamma_{02}(\text{MEANSES}_j - \overline{\text{MEANSES}}_) + u_{0j}$	>> Level-2 <<	$MATHACH_{ij} = \beta_{0j} + \beta_{1j} (SES_{ij} - SES_{.j}) + r_{ij}$	
	INTRCPT2 SIZE SECTOR PRACAD DISCLIM HIMINTY MEANSES	<b>LEVEL 2 MODEL</b> $\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{SECTOR}_j) + \gamma_{02}(\text{MEANSES}_j - \overline{\text{MEANSES}}_) + u_{0j}$ $\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{SECTOR}_j) + \gamma_{12}(\text{MEANSES}_j - \overline{\text{MEANSES}}_) + u_{1j}$	

In other words, we want to set  $H_0: \gamma_{01} = \gamma_{11}$  against the alternative  $H_0: \gamma_{01} \neq \gamma_{11}$ .

To do this, start by opening the **Other Settings** menu and selecting the **Estimation Settings** option to open the **Estimation Settings – HLM2** dialog box. Next, click on the Constrain fixed effects button to open the **Constrain Gammas** dialog box and set  $\gamma_{01}$  and  $\gamma_{11}$  equal to 1.

Constrain Gammas	
ОК	Cancel
INTRCPT1, $\beta_0$ INTRCPT2, $\gamma_{00}$ SECTOR, $\gamma_{01}$ MEANSES, $\gamma_{02}$ SES slope, $\beta_1$ INTRCPT2, $\gamma_{10}$ SECTOR, $\gamma_{11}$ MEANSES, $\gamma_{12}$	0 1 0 1 1 0

The output obtained for this model (see below) shows the result: a single common estimate is provided form the predictor SECTOR.

(with robust standard	i errors)				
Fixed Effect	Coefficient	Standard error	t-ratio	Approx. d.f.	p-value
For INTRCPT1, β <sub>0</sub>					
INTRCPT2, you	12.893983	0.174318	73.968	157	<0.001
SECTOR, yo1*	-0.557407	0.184857	-3.015	157	0.003
MEANSES, Y02	6.111559	0.332276	18.393	157	<0.001
For SES slope, $\beta_1$					
INTRCPT2, γ10	2.447020	0.146255	16.731	158	<0.001
MEANSES, γ <sub>12</sub>	0.544891	0.345942	1.575	158	0.117

Final estimation of fixed effects (with robust standard errors)

The "\*" gammas have been constrained.

To test whether this is realistic, the **Hypothesis Testing** dialog box may be used instead. This dialog box is accessed via the **Other Settings**, **Hypothesis Testing** option.

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48
est	again	ist an	other	mod	el —			1			

A test is set up via the **Multivariate Hypothesis Tests** field as shown below. This corresponds to the hypothesis  $H_0: \gamma_{01} - \gamma_{11} = 0$ .

General Linear Hypothesis:	Hypothesis 1				
OK Cancel	• • 1	C 2	С 3	C 4	 ○ 5
	0.0000	0.0000			
SECTOR, 701	1.0000	0.0000			
MEANSES, 702	0.0000	0.0000			
SES slope, β <sub>1</sub> INTRCPT2, γ <sub>10</sub>	0.0000	0.0000			
SECTOR, Y11	-1	0.0000			
MEANSES, 712	0.0000	0.0000			
					J

After running the model, the following results are printed to the output file:

Results of General Linear Hypothesis Testing - Test							
	Coefficients	Contrast					
For INTRCPT1, $\beta_0$							
INTRCPT2, Yoo	12.083837	0.0000					
SECTOR, Y01	1.280341	1.0000					
MEANSES, $\gamma_{02}$	5.163791	0.0000					

For SES slope, $\beta_1$						
INTRCPT2, Y10	2.935664	0.0000				
SECTOR, Y11	-1.642102	-1.0000				
MEANSES, $\gamma_{12}$	1.044120	0.0000				
Estimate		2.9224				
Standard error of estin	0.3918					
$\chi^2$ statistic = 55.632927 Degrees of freedom = 1						

*p*-value = <0.001

The chi-square and associated p-value indicate that it is highly unlikely that observed estimates for  $\gamma_{01}$  and  $\gamma_{11}$  could have occurred under the specified null hypothesis.

Alternatively, it may be of interest to test whether  $\gamma_{01}$  and  $\gamma_{11}$  are significantly different from zero. The null hypothesis  $H_0$ :  $\gamma_{01} = \gamma_{11} = 0$  may be tested by setting up the **General Linear Hypothesis** dialog box as shown below:

General Linear Hypothesis:	Hypothesis 1			- Channell	
OK Cancel	<b>↓</b> ○ 1	€ 2	С 3	C 4	
INTRCPT1, B0					3
INTRCPT2, Y00	0.0000	0.0000			
SECTOR, Y <sub>01</sub>	1.0000	0.0000			
MEANSES, 702	0.0000	0.0000			
SES slope, β <sub>1</sub>					
INTRCPT2, Y <sub>10</sub>	0.0000	0.0000			
SECTOR, Y11	0.0000	1			
MEANSES, 712	0.0000	0.0000			
					-

For this case, the following output is obtained:

Results of General Linear Hypothesis Testing - Test 1						
Coefficients Contrast						
For INTRCPT1, $\beta_0$						
INTRCPT2, γοο	12.095005	0.0000	0.0000			
SECTOR, Y01	1.226775	1.0000	0.0000			
MEANSES, $\gamma_{02}$	5.331626	0.0000	0.0000			
For SES slope, $\beta_1$						
INTRCPT2, Y10	2.939314	0.0000	0.0000			
SECTOR, Y11	-1.644087	0.0000	1.0000			
MEANSES, Y12	1.042828	0.0000	0.0000			

Estimate	1.2268	-1.6441
Standard error of estimate	0.3033	0.2371
$\chi^2$ statistic = 69.255618 Degrees of freedom = 2 <i>p</i> -value = <0.001		

The chi-square and associated p-value indicate that it is highly unlikely that observed estimates for  $\gamma_{01}$  and  $\gamma_{11}$  could have occurred under the specified null hypothesis.