SAS Output

• Test of the parallelism hypothesis:

M Matrix Describing Transformed Variables

	D8	D10	D12	D14
MVAR1	1	-1	0	0
MVAR2	0	1	-1	0
MVAR3	0	0	1	-1

Manova Test Criteria and Exact F Statistics for
the Hypothesis of no Overall Parallelism Effect
on the variables defined by the M Matrix Transformation
H = Contrast SS&CP Matrix for Parallelism E = Error SS&CP Matrix

	S=1	M=0.5	N=10.5			
Statistic	Valu	.e	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.73988	739	2.6953	3	23	0.0696
Pillai's Trace	0.26011	261	2.6953	3	23	0.0696
Hotelling-Lawley Trace	0.35155	702	2.6953	3	23	0.0696
Roy's Greatest Root	0.35155	702	2.6953	3	23	0.0696

- Since there are only two groups, all statistics are equivalent to Hotelling's two-sample T^2
- Test for differences between boys and girls (assuming parallelism):

M Matrix Describing Transformed Variables

	D8	D10	D12	D14
MVAR1	1	1	1	1

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall Sex (if Parallel) Effect on the variables defined by the M Matrix Transformation H = Contrast SS&CP Matrix for Sex (if Parallel) E = Error SS&CP Matrix

	S=1 M=-0.5	N=11.5			
Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda Pillai's Trace Hotelling-Lawley Trace Roy's Greatest Root	0.72903091 0.27096909 0.37168395 0.37168395	9.2921 9.2921 9.2921 9.2921	1 1 1	25 25 25 25	0.0054 0.0054 0.0054 0.0054

• This result is equivalent to a two-sample t test on the totals (or means) from each subject

SAS Output (Continued)

• Test for differences between boys and girls (without assuming parallelism):

M Matrix Describing Transformed Variables

	D8	D10	D12	D14
MVAR1	1	0	0	0
MVAR2	0	1	0	0
MVAR3	0	0	1	0
MVAR4	0	0	0	1

Manova Test Criteria and Exact F Statistics for
the Hypothesis of no Overall Sex (Not Parallel) Effect
on the variables defined by the M Matrix Transformation
H = Contrast SS&CP Matrix for Sex (Not Parallel) E = Error SS&CP Matrix

	S=1 M=1	N=10			
Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda Pillai's Trace Hotelling-Lawley Trace Roy's Greatest Root	0.60230061 0.39769939 0.66030051 0.66030051	3.6317 3.6317 3.6317 3.6317	4 4 4	22 22 22 22	0.0203 0.0203 0.0203 0.0203

• Test for differences among time points (assuming parallelism and using equal weights):

M Matrix Describing Transformed Variables

	D8	D10	D12	D14
MVAR1	1	0	0	-1
MVAR2	0	1	0	-1
MVAR3	0	0	1	-1

Manova Test Criteria and Exact F Statistics for
the Hypothesis of no Overall Time (Parallel) Effect
on the variables defined by the M Matrix Transformation
H = Contrast SS&CP Matrix for Time (Parallel) E = Error SS&CP Matrix

	S=1 $M=0.$	N=10.5			
Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.19479424	31.6911	3	23	0.0001
Pillai's Trace	0.80520576	31.6911	3	23	0.0001
Hotelling-Lawley Trace	4.13362211	31.6911	3	23	0.0001
Roy's Greatest Root	4.13362211	31.6911	3	23	0.0001

SAS Output (Continued)

• Test for differences among time points (assuming parallelism and using weights proportional to sample size):

M Matrix Describing Transformed Variables

	D8	D10	D12	D14
MVAR1	1	0	0	-1
MVAR2	0	1	0	-1
MVAR3	0	0	1	-1

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall Time (Par., Weights) Effect on the variables defined by the M Matrix Transformation H = Contrast SS&CP Matrix for Time (Par., Weights) E = Error SS&CP Matrix

S=1 M=0.5N=10.5F Statistic Num DF Den DF Pr > F Value Wilks' Lambda 36.2852 3 23 0.0001 0.17443309 Pillai's Trace 0.82556691 36.2852 3 23 0.0001 Hotelling-Lawley Trace 36.2852 3 23 0.0001 4.73285734 Roy's Greatest Root 4.73285734 36.2852 3 23 0.0001

• Test for differences among time points (without assuming parallelism):

M Matrix Describing Transformed Variables

	D8	D10	D12	D14
MVAR1	4	0	0	1
MVAR2	1	1	0	-1 -1
MVAR3	0	0	1	-1 -1
IIVAICO	V	V	-	

Manova Test Criteria and F Approximations for the Hypothesis of no Overall Time (Not Parallel) Effect on the variables defined by the M Matrix Transformation H = Contrast SS&CP Matrix for Time (Not Parallel) E = Error SS&CP Matrix

	S=2 M=0	N=10.5			
Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.16060498	11.4639	6	46	0.0001
Pillai's Trace	0.86220572	6.0623	6	48	0.0001
Hotelling-Lawley Trace	5.08442737	18.6429	6	44	0.0001
Roy's Greatest Root	5.05633791	40.4507	3	24	0.0001

NOTE: F Statistic for Roy's Greatest Root is an upper bound.

NOTE: F Statistic for Wilks' Lambda is exact.

SAS Output (Continued)

• Test for differences among time points in boys:

M Matrix Describing Transformed Variables

	D8	D10	D12	D14
MVAR1	1	0	0	-1
MVAR2	0	1	0	-1
MVAR3	0	0	1	-1

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall Time (M, Not Parall) Effect on the variables defined by the M Matrix Transformation H = Contrast SS&CP Matrix for Time (M, Not Parall) E = Error SS&CP Matrix

	S=1 $M=0.5$	5 N=10.5			
Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.19379154	31.8947	3	23	0.0001
Pillai's Trace	0.80620846	31.8947	3	23	0.0001
Hotelling-Lawley Trace	4.16018394	31.8947	3	23	0.0001
Roy's Greatest Root	4.16018394	31.8947	3	23	0.0001

• Test for differences among time points in girls:

M Matrix Describing Transformed Variables

	D8	D10	D12	D14
MVAR1	1	0	0	-1
MVAR2	0	1	0	-1
MVAR3	0	0	1	-1

Manova Test Criteria and Exact F Statistics for
the Hypothesis of no Overall Time (F, Not Parall) Effect
on the variables defined by the M Matrix Transformation
H = Contrast SS&CP Matrix for Time (F, Not Parall) E = Error SS&CP Matrix

S=1 M=0.5	N=10.5			
Value	F	Num DF	Den DF	Pr > F
0.51968477	7.0859	3	23	0.0015
0.48031523	7.0859	3	23	0.0015
0.92424343	7.0859	3	23	0.0015
0.92424343	7.0859	3	23	0.0015
	Value 0.51968477 0.48031523 0.92424343	Value F 0.51968477 7.0859 0.48031523 7.0859 0.92424343 7.0859	Value F Num DF 0.51968477 7.0859 3 0.48031523 7.0859 3 0.92424343 7.0859 3	Value F Num DF Den DF 0.51968477 7.0859 3 23 0.48031523 7.0859 3 23 0.92424343 7.0859 3 23

• Is the constant effect of age equal to zero?

Μ	Matrix	Describing	Transformed	Variables
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	SOP0	SOP1	SOP2	SOP3
MVAR1	1	0	0	0

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall INTERCEPT Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.00233639	8113.213	1	19	0.0001
Pillai's Trace	0.99766361	8113.213	1	19	0.0001
Hotelling-Lawley Trace	427.01122311	8113.213	1	19	0.0001
Roy's Greatest Root	427.01122311	8113.213	1	19	0.0001

• Is the linear effect of age equal to zero?

M Matrix Describing Transformed Variables

	SOP0	SOP1	SOP2	SOP3
MVAR1	0	1	0	0

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall INTERCEPT Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.26825765	51.8274	1	19	0.0001
Pillai's Trace	0.73174235	51.8274	1	19	0.0001
Hotelling-Lawley Trace	2.72775947	51.8274	1	19	0.0001
Roy's Greatest Root	2.72775947	51.8274	1	19	0.0001

• Is the quadratic effect of age equal to zero?

M Matrix Describing Transformed Variables

	SOP0	SOP1	SOP2	SOP3
MVAR1	0	0	1	0

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall INTERCEPT Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.99801735	0.0377	1	19	0.8480
Pillai's Trace	0.00198265	0.0377	1	19	0.8480
Hotelling-Lawley Trace	0.00198659	0.0377	1	19	0.8480
Roy's Greatest Root	0.00198659	0.0377	1	19	0.8480

• Is the cubic effect of age equal to zero?

M Matrix Describing Transformed Variables

	SOP0	SOP1	SOP2	SOP3
MVAR1	0	0	0	1

Manova Test Criteria and Exact F Statistics for
the Hypothesis of no Overall INTERCEPT Effect
on the variables defined by the M Matrix Transformation
H = Type III SS&CP Matrix for INTERCEPT E = Error SS&CP Matrix

	S=1 $M=-0$.	5 N=8.5			
Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.99997328	0.0005	1	19	0.9823
Pillai's Trace	0.00002672	0.0005	1	19	0.9823
Hotelling-Lawley Trace	0.00002672	0.0005	1	19	0.9823
Roy's Greatest Root	0.00002672	0.0005	1	19	0.9823

• Are the nonlinear effects of age simultaneously equal to zero?

M Matrix Describing Transformed Variables

	SOP0	SOP1	SOP2	SOP3
MVAR1	0	0	1	0
MVAR2	0	0	0	1

Manova Test Criteria and Exact F Statistics for
the Hypothesis of no Overall INTERCEPT Effect
on the variables defined by the M Matrix Transformation
H = Type III SS&CP Matrix for INTERCEPT E = Error SS&CP Matrix

	S=1 M=0	N=8			
Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.99800451	0.0180	2	18	0.9822
Pillai's Trace	0.00199549	0.0180	2	18	0.9822
Hotelling-Lawley Trace	0.00199948	0.0180	2	18	0.9822
Roy's Greatest Root	0.00199948	0.0180	2	18	0.9822

SAS Output $(q=2, G=I_4)$

General Linear Models Procedure

Dependent Variabl	e: PIO				
-		Sum of	Mean		
Source	DF	Squares	Square	F Value	Pr > F
Model	1	22441.65012	22441.65012	208.41	0.0001
Error	19	2045.95238	107.68170		
Uncorrected Total		24487.60250			
	R-Square	C.V.	Root MSE		PIO Mean
	0.000000	30.97837	10.37698		33.49750
Source	DF	Type I SS	Mean Square	F Value	Pr > F
INTERCEPT	1	22441.65012	22441.65012	208.41	0.0001
Source	DF	Type III SS	Mean Square	F Value	Pr > F
INTERCEPT	1	22441.65012	22441.65012	208.41	0.0001
		T fo	or HO: Pr	> T Std	Error of
Parameter			meter=0		stimate
INTERCEPT	33	. 49750000	14.44 0.0	0001 2	.32036316
Dependent Variabl	e: PI1				
Dependent Variabl	e: PI1	Sum of	Mean		
Dependent Variabl	e: PI1 DF	Sum of Squares	Mean Square	F Value	Pr > F
-				F Value 51.83	Pr > F 0.0001
Source	DF	Squares	Square		
Source Model	DF 1 19	Squares 71.89632000	Square 71.89632000		
Source Model Error	DF 1 19	Squares 71.89632000 26.35728000	Square 71.89632000		
Source Model Error	DF 1 19 20	Squares 71.89632000 26.35728000	Square 71.89632000		
Source Model Error	DF 1 19	Squares 71.89632000 26.35728000 98.25360000	Square 71.89632000 1.38722526		0.0001
Source Model Error	DF 1 19 20 R-Square	Squares 71.89632000 26.35728000 98.25360000	Square 71.89632000 1.38722526 Root MSE		0.0001 PI1 Mean
Source Model Error	DF 1 19 20 R-Square	Squares 71.89632000 26.35728000 98.25360000 C.V. 62.12053	Square 71.89632000 1.38722526 Root MSE 1.177805		0.0001 PI1 Mean
Source Model Error Uncorrected Total	DF 1 19 20 R-Square 0.000000	Squares 71.89632000 26.35728000 98.25360000	Square 71.89632000 1.38722526 Root MSE	51.83	0.0001 PI1 Mean 1.896000
Source Model Error Uncorrected Total	DF 1 19 20 R-Square 0.000000	Squares 71.89632000 26.35728000 98.25360000 C.V. 62.12053 Type I SS	Square 71.89632000 1.38722526 Root MSE 1.177805 Mean Square	51.83	0.0001 PI1 Mean 1.896000 Pr > F
Source Model Error Uncorrected Total Source INTERCEPT	DF 1 19 20 R-Square 0.000000 DF 1	Squares 71.89632000 26.35728000 98.25360000 C.V. 62.12053 Type I SS 71.89632000	Square 71.89632000 1.38722526 Root MSE 1.177805 Mean Square 71.89632000	51.83 F Value 51.83	0.0001 PI1 Mean 1.896000 Pr > F 0.0001
Source Model Error Uncorrected Total Source INTERCEPT Source	DF 1 19 20 R-Square 0.000000	Squares 71.89632000 26.35728000 98.25360000 C.V. 62.12053 Type I SS 71.89632000 Type III SS	Square 71.89632000 1.38722526 Root MSE 1.177805 Mean Square	51.83	0.0001 PI1 Mean 1.896000 Pr > F 0.0001 Pr > F
Source Model Error Uncorrected Total Source INTERCEPT	DF 1 19 20 R-Square 0.000000 DF 1	Squares 71.89632000 26.35728000 98.25360000 C.V. 62.12053 Type I SS 71.89632000	Square 71.89632000 1.38722526 Root MSE 1.177805 Mean Square 71.89632000 Mean Square	F Value 51.83	0.0001 PI1 Mean 1.896000 Pr > F 0.0001
Source Model Error Uncorrected Total Source INTERCEPT Source	DF 1 19 20 R-Square 0.000000 DF 1	Squares 71.89632000 26.35728000 98.25360000 C.V. 62.12053 Type I SS 71.89632000 Type III SS 71.89632000	Square 71.89632000 1.38722526 Root MSE 1.177805 Mean Square 71.89632000 Mean Square 71.89632000	F Value 51.83 F Value 51.83	0.0001 PI1 Mean 1.896000 Pr > F 0.0001 Pr > F
Source Model Error Uncorrected Total Source INTERCEPT Source INTERCEPT	DF 1 19 20 R-Square 0.000000 DF 1	Squares 71.89632000 26.35728000 98.25360000 C.V. 62.12053 Type I SS 71.89632000 Type III SS 71.89632000 T fe	Square 71.89632000 1.38722526 Root MSE 1.177805 Mean Square 71.89632000 Mean Square 71.89632000	F Value 51.83 F Value 51.83 > T Std	0.0001 PI1 Mean 1.896000 Pr > F 0.0001 Pr > F 0.0001
Source Model Error Uncorrected Total Source INTERCEPT Source	DF 1 19 20 R-Square 0.000000 DF 1 DF	Squares 71.89632000 26.35728000 98.25360000 C.V. 62.12053 Type I SS 71.89632000 Type III SS 71.89632000 T fo	Square 71.89632000 1.38722526 Root MSE 1.177805 Mean Square 71.89632000 Mean Square 71.89632000 or H0: Pr meter=0	F Value 51.83 F Value 51.83 > T Std Es	0.0001 PI1 Mean 1.896000 Pr > F 0.0001 Pr > F 0.0001

SAS Output (q=2, G=S)

General Linear Models Procedure

Dependent Variabl	e: PSO				
•		Sum of	Mean		
Source	DF	Squares	Square	F Valu	e Pr > F
Model	1	_	22297.37042	284.3	3 0.0001
Error	19	1490.00413	78.42127		
Uncorrected Total	_ 20	23787.37455			
	R-Square	C.V.	Root MSE		PSO Mean
	0.000000		8.855578		33.38965
Source	DF	Type I SS	Mean Square	F Valu	e Pr > F
INTERCEPT	1	· -	22297.37042		
Source	DF	Type III SS	Mean Square	F Valu	e Pr > F
INTERCEPT	1		22297.37042		
		т -	for HO: Pr	> T St	d Error of
Parameter			ameter=0		Estimate
INTERCEPT	33	.38964691			1.98016754
					_,,,,,,,,,
Dependent Variabl	e: PS1				
•		Sum of	Mean		
Source	DF	Squares	Square	F Valu	e Pr > F
Model	1	72.69201271	72.69201271	73.1	2 0.0001
Error	19	18.88861654	0.99413771		
Uncorrected Total	. 20	91.58062925			
	R-Square	C.V.	Root MSE		PS1 Mean
	0.000000		0.997065		1.906463
Source	DF	Type I SS	Mean Square	F Valu	e Pr > F
INTERCEPT	1		72.69201271	73.1	
Source	DF	Type III SS	Mean Square	F Valu	e Pr > F
INTERCEPT	1		72.69201271		
	_	, _ , , , , , , , , , , , , , , , , , ,	,_,,,,		
					d Error of
Parameter			ameter=0		Estimate
INTERCEPT	1.	906462860	8.55 0.0	0001	0.22295041
	1	Т :	for HO: Pr	> T St	d Error of
INTERCEPT	1.	906462860	8.55 0.0	0001	0.22295041

 \bullet The model is: Ramus Height = $33.3896 + 1.906\,\mathrm{Age}$

• Are the joint constant effects of age in boys and girls equal to zero?

M Matrix Describing Transformed Variables

	SOP0	SOP1	SOP2	SOP3
MVAR1	1	0	0	0

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall Both Sexes Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.00601330	2066.224	2	25	0.0001
Pillai's Trace	0.99398670	2066.224	2	25	0.0001
Hotelling-Lawley Trace	165.29791169	2066.224	2	25	0.0001
Roy's Greatest Root	165.29791169	2066.224	2	25	0.0001

• Are the joint linear effects of age in boys and girls equal to zero?

M Matrix Describing Transformed Variables

	SOP0	SOP1	SOP2	SOP3
MVAR1	0	1	0	0

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall Both Sexes Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.19295530	52.2818	2	25	0.0001
Pillai's Trace	0.80704470	52.2818	2	25	0.0001
Hotelling-Lawley Trace	4.18254757	52.2818	2	25	0.0001
Roy's Greatest Root	4.18254757	52.2818	2	25	0.0001

• Are the joint quadratic effects of age in boys and girls equal to zero?

M Matrix Describing Transformed Variables

	SOP0	SOP1	SOP2	SOP3
MVAR1	0	0	1	0

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall Both Sexes Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.90775401	1.2703	2	25	0.2983
Pillai's Trace	0.09224599	1.2703	2	25	0.2983
Hotelling-Lawley Trace	0.10162003	1.2703	2	25	0.2983
Roy's Greatest Root	0.10162003	1.2703	2	25	0.2983

• Are the joint cubic effects of age in boys and girls equal to zero?

M Matrix Describing Transformed Variables

	SOP0	SOP1	SOP2	SOP3
MVAR1	0	0	0	1

Manova Test Criteria and Exact F Statistics for
the Hypothesis of no Overall Both Sexes Effect
on the variables defined by the M Matrix Transformation
H = Contrast SS&CP Matrix for Both Sexes E = Error SS&CP Matrix

F
2
2
2
2
)

• Are the nonlinear effects of age in boys and girls simultaneously equal to zero?

M Matrix Describing Transformed Variables

	SOP0	SOP1	SOP2	SOP3
MVAR1	0	0	1	0
MVAR2	0	0	0	1

Manova Test Criteria and F Approximations for
the Hypothesis of no Overall Both Sexes Effect
on the variables defined by the M Matrix Transformation
H = Contrast SS&CP Matrix for Both Sexes E = Error SS&CP Matrix

	S=2 M=-	0.5 N=11			
Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.89590891	0.6780	4	48	0.6106
Pillai's Trace	0.10414288	0.6866	4	50	0.6046
Hotelling-Lawley Trace	0.11612709	0.6677	4	46	0.6177
Roy's Greatest Root	0.11562716	1.4453	2	25	0.2547

NOTE: F Statistic for Roy's Greatest Root is an upper bound.

NOTE: F Statistic for Wilks' Lambda is exact.

SAS Output (Covariate-Adjusted Linear Model with Tests of Joint Effects)

General Linear Models Procedure

Dependent Variable: SOPO						
C	DE	Sum of	Mean	E Value	D > F	
Source	DF	Squares	Square	F Value	Pr > F	
Model	4	62488.67539	15622.16885	1004.33	0.0001	
_	20	055 50044	45 55405			
Error	23	357.76211	15.55487			
Uncorrected Total	L 27	62846.43750				
	R-Square	C.V.	Root MSE		SOPO Mean	
	0.994307	8.208680	3.943967		48.04630	
NOTE: No intercep						
			., .		5 . 5	
Source	DF	Type I SS	Mean Square	F Value	Pr > F	
MALE	1	39900.06250	39900.06250	2565.12	0.0001	
FEMALE	1	22568.46023	22568.46023	1450.89	0.0001	
SOP2	1	0.67977	0.67977	0.04	0.8363	
SOP3	1	19.47289	19.47289	1.25	0.2747	
Source	DF	Type III SS	Mean Square	F Value	Pr > F	
MALE	1	35692.59704	35692.59704	2294.62	0.0001	
FEMALE	1	22579.35173	22579.35173		0.0001	
SOP2	1	0.92895	0.92895		0.8091	
SOP3	1	19.47289	19.47289	1.25	0.2747	
Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F	
Both Sexes	2	58712.11974	29356.05987	1887.26	0.0001	
Doth Bexes	Z	50712.11974	29330.03901	1007.20	0.0001	
		T f	for HO: Pr >	\T\ Std	Error of	
Parameter		Estimate Para	meter=0	Es	stimate	
MALE	ΛQ	87425119	47.90 0.0	0001 1.	04116742	
FEMALE		33076043			18979058	
SOP2		18896614			77325140	
SOP3		55659727			49746113	
DUFO	-0.	00003121	-1.12 0.2	21 -1 1 0.	73140113	

[•] The contrast labelled "Both Sexes" tests the null hypothesis that the constant terms for boys and girls are jointly equal to zero

SAS Output (Covariate-Adjusted Linear Model with Tests of Joint Effects)

Source Model Error Uncorrected Total	DF 4 23 27	S 252.5 54.0 306.6	Sum of quares 593850 781150 375000	2.3	Mean Square 1398463 3512224	F	Value 26.85	Pr > F 0.0001
	R-Square		C.V.		oot MSE			SOP1 Mean
	0.823642		.93571		.533370			2.952438
NOTE: No intercept	t term is	used: R-s	quare is	not co	orrected	lfo	r the m	nean.
Source	DF	Тур	e I SS	Mean	Square	F	Value	Pr > F
MALE	1	196.8	781250	196.8	3781250		83.73	0.0001
FEMALE	1	50.5	920455	50.5	5920455		21.52	0.0001
SOP2	1	4.8	377981	4.8	3377981		2.06	0.1649
SOP3	1	0.2	514165	0.2	2514165		0.11	0.7466
Source MALE FEMALE	DF 1 1	196.1	III SS 822754 694528	196.1	Square 1822754 3694528	F	Value 83.44 21.21	Pr > F 0.0001 0.0001
SOP2	1		633791		7633791		2.03	
SOP3	1		514165		2514165		0.11	0.7466
						_		
Contrast	DF		ast SS		Square	F		Pr > F
Both Sexes	2	247.5	879145	123.7	7939573		52.65	0.0001
				r HO:	Pr >	\T\		Error of
Parameter	_	Estimate		eter=0				stimate
MALE		397576751		9.13		0001		40479409
FEMALE		130367713		4.61		0001		46257710
SOP2		127902706		-1.42		681		30063138
SOP3	0.0	063244497		0.33	0.7	'466	0.	19340725

M Matrix Describing Transformed Variables

	SOP0	SOP1
MVAR1	1	0
MVAR2	0	1

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall Both Sexes Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.00508090	143.3201	4	44	0.0001
Pillai's Trace	1.15284171	15.6496	4	46	0.0001
Hotelling-Lawley Trace	164.73390412	864.8530	4	42	0.0001
Roy's Greatest Root	164.54500978	1892.268	2	23	0.0001

SAS Output (Covariate-Adjusted Linear Model with Tests of Effect Equality)

General Linear Models Procedure

Dependent Variable: SOPO						
C	DE	Sum o		Mean	D > E	
Source	DF	Square	s 5q	uare F Value	Pr > F	
Model	4	62488.6753	9 15622.1	6885 1004.33	0.0001	
P	00	257 7604	4 45 5	F 4 0 7		
Error	23	357.7621	1 15.5	5487		
Uncorrected Total	1 27	62846.4375	0			
	R-Square	C.V	. Root	MSE	SOPO Mean	
	0.994307	8.20868	0 3.94	3967	48.04630	
NOTE: No interce	pt term is					
C	DE	Т Т. С	C Mass C.	F V-1	D > E	
Source	DF	Type I S	S Mean Sq	uare F Value	Pr > F	
MALE	1	39900.0625	0 39900.0	6250 2565.12	0.0001	
FEMALE	1	22568.4602	3 22568.4	6023 1450.89	0.0001	
SOP2	1	0.6797	7 0.6	7977 0.04	0.8363	
SOP3	1	19.4728	9 19.4	7289 1.25	0.2747	
Source	DF	Type III S	S Mean Sq	uare F Value	Pr > F	
MALE	1	35692.5970	4 35692.5	9704 2294.62	0.0001	
FEMALE	1	22579.3517				
SOP2	1	0.9289		2895 0.06		
SOP3	1	19.4728				
2010	-	10.17.20		1120	0.2.1	
Contrast	DF	Contrast S	S Mean Sq	uare F Value	Pr > F	
Sex	1	127.488674	9 127.488	6749 8.20	0.0088	
		т	for HO:	Pr > \T\ Std	Error of	
Parameter			rameter=0		stimate	
MALE	49.	87425119	47.90	0.0001 1	.04116742	
FEMALE	45.	33076043	38.10	0.0001 1	.18979058	
SOP2		18896614	-0.24		.77325140	
SOP3		55659727	-1.12		.49746113	
·- e= =	٠.	 	= · 	, v	- · 	

ullet The contrast labelled Sex tests the null hypothesis that the constant terms for boys and girls are equal

SAS Output (Covariate-Adjusted Linear Model with Tests of Effect Equality)

Dependent Variable: SOP1						
-		Sum of	Mean			
Source	DF	Squares	Square	F Value	Pr > F	
Model	4	252.5593850	63.1398463	26.85	0.0001	
Error	23	54.0781150	2.3512224			
Uncorrected Total	27	306.6375000				
	R-Square	C.V.	Root MSE		SOP1 Mean	
	0.823642	51.93571	1.533370		2.952438	
NOTE: No intercept	t term is	used: R-square is	not corrected	for the m	ean.	
_						
Source	DF	Type I SS	-	F Value	Pr > F	
MALE	1	196.8781250	196.8781250	83.73	0.0001	
FEMALE	1	50.5920455	50.5920455	21.52		
SOP2	1	4.8377981	4.8377981	2.06	0.1649	
SOP3	1	0.2514165	0.2514165	0.11	0.7466	
Source	DF	Type III SS	Mean Square	F Value	Pr > F	
MALE	1	196.1822754	196.1822754	83.44	0.0001	
FEMALE	1	49.8694528	49.8694528	21.21	0.0001	
	1					
SOP2		4.7633791	4.7633791	2.03		
SOP3	1	0.2514165	0.2514165	0.11	0.7466	
Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F	
Sex	1	15.16862320	15.16862320	6.45	0.0183	

		T for HO:	$Pr > \T$	Std Error of
Parameter	Estimate	Parameter=0		Estimate
MALE	3.697576751	9.13	0.0001	0.40479409
FEMALE	2.130367713	4.61	0.0001	0.46257710
SOP2	-0.427902706	-1.42	0.1681	0.30063138
SOP3	0.063244497	0.33	0.7466	0.19340725

M Matrix Describing Transformed Variables

	SOP0	SOP1
MVAR1	1	0
MVAR2	0	1

Manova Test Criteria and Exact F Statistics for
the Hypothesis of no Overall Sex Effect
on the variables defined by the M Matrix Transformation
H = Contrast SS&CP Matrix for Sex E = Error SS&CP Matrix

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.63572589	6.3031	2	22	0.0069
Pillai's Trace	0.36427411	6.3031	2	22	0.0069
Hotelling-Lawley Trace	0.57300501	6.3031	2	22	0.0069
Roy's Greatest Root	0.57300501	6.3031	2	22	0.0069

SAS Output (Potthoff-Roy Linear Model with G=S)

General Linear Models Procedure

Dependent Variable: SO	PS0	Sum of	Mean		
Source	DF	Squares	Square	F Value	Pr > F
Model	2	62402.71113	31201.35557		
Error	25	357.76211	14.31048	2100.31	0.0001
Uncorrected Total	27	62760.47325	14.31040		
oncorrected local	21	02700.47323			
R-Sq1		C.V.	Root MSE		SOPSO Mean
0.994	1300	7.877276	3.782920		48.02320
NOTE: No intercept term	n is	used: R-square is	s not corrected	d for the m	nean.
Source	DF	Type I SS	Mean Square	F Value	Pr > F
MALE	1	39799.05489	39799.05489	2781.11	0.0001
FEMALE	1	22603.65624	22603.65624	1579.52	0.0001
Source	DF	Type III SS	Mean Square	F Value	Pr > F
MALE	1	39799.05489	39799.05489	2781.11	0.0001
FEMALE	1	22603.65624	22603.65624	1579.52	0.0001
		T fo	or HO: Pr >	\T\ Std	Error of
Parameter		Estimate Param	meter=0	Es	stimate
MALE	49	.87425118	52.74 0.0	0001 0	.94573002
FEMALE	45	.33076042	39.74 0.0	0001 1	. 14059333
Dependent Variable: SO	PS1				
-		Sum of	Mean		
Source	DF	Squares	Square		Pr > F
Source Model	DF 2	Squares 268.6763145	Square 134.3381572	F Value 62.10	Pr > F 0.0001
Source Model Error	DF 2 25	Squares 268.6763145 54.0781151	Square		
Source Model	DF 2	Squares 268.6763145 54.0781151	Square 134.3381572		
Source Model Error Uncorrected Total	DF 2 25 27	Squares 268.6763145 54.0781151 322.7544296 C.V.	Square 134.3381572 2.1631246 Root MSE		0.0001 SOPS1 Mean
Source Model Error Uncorrected Total R-Squ 0.83	DF 2 25 27 1are	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833	Square 134.3381572 2.1631246 Root MSE 1.470756	62.10	0.0001 SOPS1 Mean 3.059084
Source Model Error Uncorrected Total	DF 2 25 27 1are	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833	Square 134.3381572 2.1631246 Root MSE 1.470756	62.10	0.0001 SOPS1 Mean 3.059084
Source Model Error Uncorrected Total R-Squ 0.83	DF 2 25 27 1are	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833	Square 134.3381572 2.1631246 Root MSE 1.470756	62.10	0.0001 SOPS1 Mean 3.059084 nean.
Source Model Error Uncorrected Total R-Squ 0.833	DF 2 25 27 1are 2448	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833 used: R-square is	Square 134.3381572 2.1631246 Root MSE 1.470756 s not corrected	62.10	0.0001 SOPS1 Mean 3.059084 nean. Pr > F
Source Model Error Uncorrected Total R-Squ 0.833 NOTE: No intercept term	DF 2 25 27 lare 2448 n is	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833 used: R-square is	Square 134.3381572 2.1631246 Root MSE 1.470756 s not corrected Mean Square	62.10 I for the r F Value	0.0001 SOPS1 Mean 3.059084 nean. Pr > F
Source Model Error Uncorrected Total R-Sqn 0.833 NOTE: No intercept term Source MALE	DF 2 25 27 1are 2448 1 is DF 1	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833 used: R-square is Type I SS 218.7531819	Square 134.3381572 2.1631246 Root MSE 1.470756 s not corrected Mean Square 218.7531819	62.10 If for the r F Value 101.13	0.0001 SOPS1 Mean 3.059084 nean. Pr > F 0.0001
Source Model Error Uncorrected Total R-Sqn 0.833 NOTE: No intercept term Source MALE FEMALE	DF 2 25 27 1are 2448 1 is DF 1	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833 used: R-square is Type I SS 218.7531819 49.9231326	Square 134.3381572 2.1631246 Root MSE 1.470756 s not corrected Mean Square 218.7531819 49.9231326	62.10 If for the r F Value 101.13 23.08	0.0001 SOPS1 Mean 3.059084 nean. Pr > F 0.0001 0.0001 Pr > F
Source Model Error Uncorrected Total R-Sqn 0.833 NOTE: No intercept term Source MALE FEMALE Source	DF 2 25 27 lare 2448 n is DF 1 1	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833 used: R-square is Type I SS 218.7531819 49.9231326 Type III SS	Square 134.3381572 2.1631246 Root MSE 1.470756 s not corrected Mean Square 218.7531819 49.9231326 Mean Square	62.10 If for the r F Value 101.13 23.08 F Value	0.0001 SOPS1 Mean 3.059084 nean. Pr > F 0.0001 Pr > F 0.0001
Source Model Error Uncorrected Total R-Sqn 0.833 NOTE: No intercept term Source MALE FEMALE Source MALE Source	DF 2 25 27 lare 2448 n is DF 1 1	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833 used: R-square is Type I SS 218.7531819 49.9231326 Type III SS 218.7531819 49.9231326	Square 134.3381572 2.1631246 Root MSE 1.470756 s not corrected Mean Square 218.7531819 49.9231326 Mean Square 218.7531819	62.10 If for the r F Value 101.13 23.08 F Value 101.13 23.08	0.0001 SOPS1 Mean 3.059084 nean. Pr > F 0.0001 0.0001 Pr > F 0.0001 0.0001
Source Model Error Uncorrected Total R-Sqn 0.833 NOTE: No intercept term Source MALE FEMALE Source MALE Source	DF 2 25 27 lare 2448 n is DF 1 1	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833 used: R-square is Type I SS 218.7531819 49.9231326 Type III SS 218.7531819 49.9231326 T fo	Square 134.3381572 2.1631246 Root MSE 1.470756 s not corrected Mean Square 218.7531819 49.9231326 Mean Square 218.7531819 49.9231326	62.10 If for the r F Value 101.13 23.08 F Value 101.13 23.08	0.0001 SOPS1 Mean 3.059084 nean. Pr > F 0.0001 0.0001 Pr > F 0.0001 0.0001
Source Model Error Uncorrected Total R-Sqn 0.833 NOTE: No intercept term Source MALE FEMALE Source MALE FEMALE FEMALE	DF 2 25 27 lare 2448 n is DF 1 1 DF 1	Squares 268.6763145 54.0781151 322.7544296 C.V. 48.07833 used: R-square is Type I SS 218.7531819 49.9231326 Type III SS 218.7531819 49.9231326 T fo	Square 134.3381572 2.1631246 Root MSE 1.470756 s not corrected Mean Square 218.7531819 49.9231326 Mean Square 218.7531819 49.9231326 or HO: Pr > meter=0 10.06 0.0	62.10 If for the r F Value 101.13 23.08 F Value 101.13 23.08	0.0001 SOPS1 Mean 3.059084 nean. Pr > F 0.0001 0.0001 Pr > F 0.0001 0.0001

SAS Output (Potthoff-Roy Linear Model on Natural Time Scale, G = S)

Dependent Variable	e: PSO				
Source Model Error Uncorrected Total	DF 2 25 27	Sum of Squares 7355.728239 378.153108 7733.881347	Mean Square 3677.864119 15.126124	F Value 243.15	Pr > F 0.0001
Source MALE FEMALE	DF 1 1	Type III SS 4015.650102 3340.078137	Mean Square 4015.650102 3340.078137	265.48	Pr > F 0.0001 0.0001
Contrast Both Sexes	DF 2	Contrast SS 7355.728239	Mean Square 3677.864119	F Value 243.15	Pr > F 0.0001
Parameter MALE FEMALE	15.			Es 0001 0	Error of stimate .97230796 .17264752
Dependent Variable	e: PS1	g	.,		
Source Model Error Uncorrected Total	DF 2 25 27	Sum of Squares 13.43381565 2.70390575 16.13772140	Mean Square 6.71690783 0.10815623	F Value	Pr > F 0.0001
Source MALE FEMALE	DF 1 1	Type III SS 10.93765903 2.49615663	Mean Square 10.93765903 2.49615663	101.13	Pr > F 0.0001 0.0001
Contrast Both Sexes	DF 2	Contrast SS 13.43381565	Mean Square 6.71690783		Pr > F 0.0001
Parameter MALE FEMALE	0.82			Es 0001 0	Error of stimate .08221779 .09915838
	M Matrix MVAR1 MVAR2	Describing Trans PSO 1 0		es S1 0 1	

Manova Test Criteria and F Approximations for the Hypothesis of no Overall Both Sexes Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.00474354	162.2328	4	48	0.0001
Pillai's Trace	1.15982342	17.2556	4	50	0.0001
Hotelling-Lawley Trace	175.12004861	1006.940	4	46	0.0001
Roy's Greatest Root	174.92171510	2186.521	2	25	0.0001

SAS Output (Potthoff-Roy Linear Model on Natural Time Scale, G = S) Tests of Equality of Effects for Boys and Girls

General Linear Models Procedure Multivariate Analysis of Variance

M Matrix Describing Transformed Variables

	PS0	PS1
MVAR1	1	0

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall Sex Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.95858871	1.0800	1	25	0.3086
Pillai's Trace	0.04141129	1.0800	1	25	0.3086
Hotelling-Lawley Trace	0.04320027	1.0800	1	25	0.3086
Roy's Greatest Root	0.04320027	1.0800	1	25	0.3086

M Matrix Describing Transformed Variables

	PS0	PS1	
MVAR1	0	1	

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall Sex Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.77156862	7.4015	1	25	0.0117
Pillai's Trace	0.22843138	7.4015	1	25	0.0117
Hotelling-Lawley Trace	0.29606101	7.4015	1	25	0.0117
Roy's Greatest Root	0.29606101	7.4015	1	25	0.0117

M Matrix Describing Transformed Variables

	PS0	PS1
MVAR1	1	0
MVAR2	0	1

Manova Test Criteria and Exact F Statistics for the Hypothesis of no Overall Sex Effect on the variables defined by the M Matrix Transformation

Statistic	Value	F	Num DF	Den DF	Pr > F
Wilks' Lambda	0.62312886	7.2577	2	24	0.0034
Pillai's Trace	0.37687114	7.2577	2	24	0.0034
Hotelling-Lawley Trace	0.60480449	7.2577	2	24	0.0034
Roy's Greatest Root	0.60480449	7.2577	2	24	0.0034