

## Repeated Measures Part 4: Blood Flow data

```
/* bloodflow.sas */
options linesize=79 pagesize=100 noovp formdlm='_';
title 'Two within-subjects factors: Blood flow data (NWK p. 1181)';
proc format;
  value ynfmt 0 = 'No' 1 = 'Yes';

data blood;
  infile 'bloodflow.dat' firstobs=2; /* Skip the first line */
  input row1 iflow1 patient1 DrugA1 DrugB1
        row2 iflow2 patient2 DrugA2 DrugB2
        row3 iflow3 patient3 DrugA3 DrugB3
        row4 iflow4 patient4 DrugA4 DrugB4 ;
  format drug1-druga4 drugb1-drugb4 ynfmt.;

proc means n mean stddev;
  var iflow1-iflow4;

proc glm;
  title2 'Proc glm (Multivariate, univariate approaches)';
  model iflow1-iflow4 = ; /* No IV (just intercepts) */
  repeated Drug_A 2, Drug_B 2 / short summary;
  /* Variable on the right changes fastest */

data uvblood;
  infile 'bloodflow.dat' firstobs=2; /* Skip the first line */
  input row iflow patient DrugA DrugB;
  label iflow = 'Increase in Blood Flow';
  format DrugA DrugB ynfmt.;

proc mixed;
  title2 'Covariance Structure Approach with proc mixed';
  class DrugA DrugB;
  model iflow = DrugA|DrugB;
  repeated / type=un subject=patient r;
```

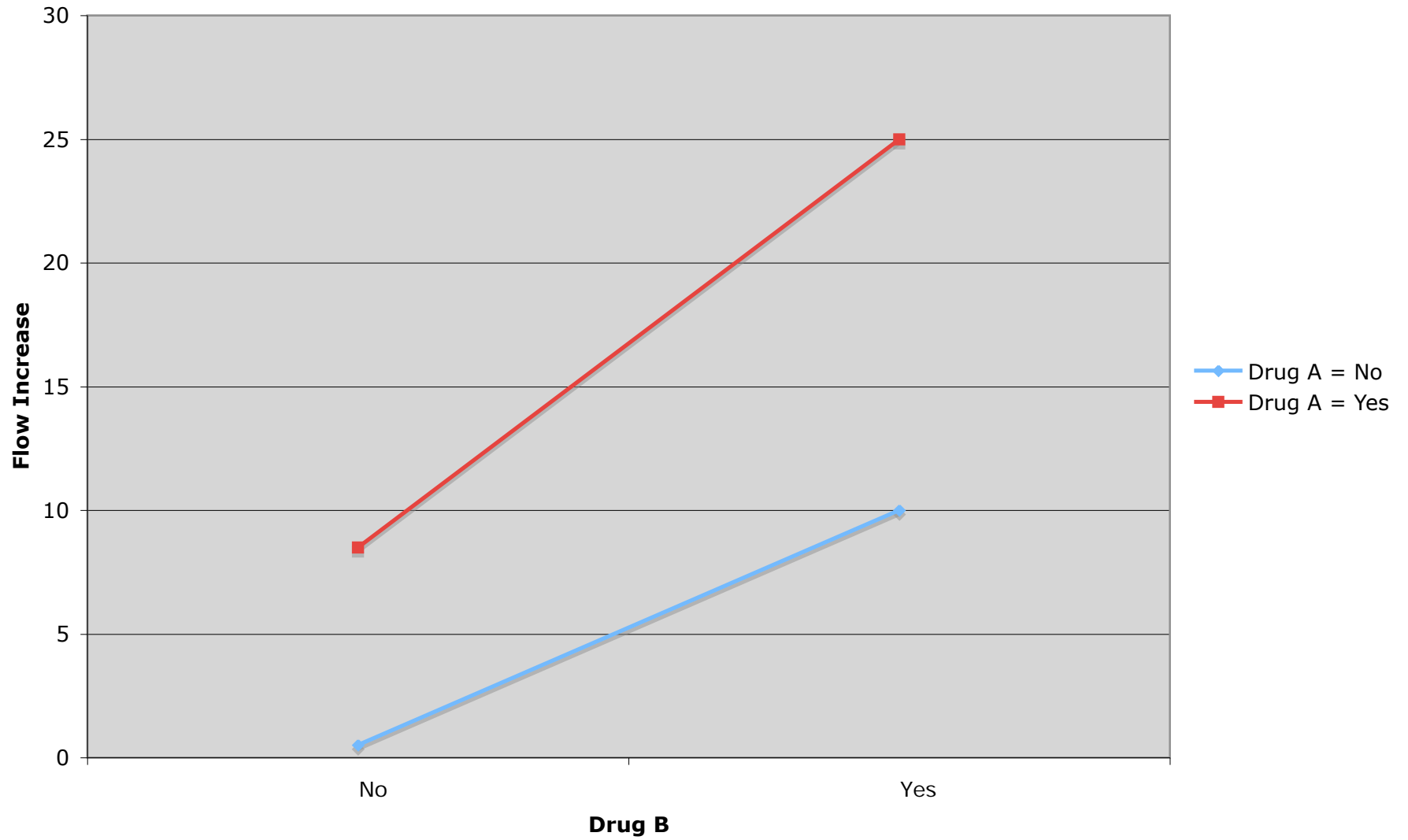
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Two within-subjects factors: Blood flow data (NWK p. 1181) 1  
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### The MEANS Procedure

Variable	N	Mean	Std Dev
iflow1	12	0.5000000	2.1105794
iflow2	12	10.0000000	3.1908961
iflow3	12	8.5000000	2.0225996
iflow4	12	25.0000000	3.4377583

### Joint Effects of Drug A and Drug B on Increase in Blood Flow



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Two within-subjects factors: Blood flow data (NWK p. 1181) 2  
 Proc glm (Multivariate, univariate approaches)  
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The GLM Procedure

Number of observations 12

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Two within-subjects factors: Blood flow data (NWK p. 1181) 3  
 Proc glm (Multivariate, univariate approaches)  
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The GLM Procedure

Dependent Variable: iflow1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	3.00000000	3.00000000	0.67	0.4293
Error	11	49.00000000	4.45454545		
Uncorrected Total	12	52.00000000			

R-Square	Coeff Var	Root MSE	iflow1 Mean
0.000000	422.1159	2.110579	0.500000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	3.00000000	3.00000000	0.67	0.4293

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	3.00000000	3.00000000	0.67	0.4293

Parameter	Estimate	Standard Error	t Value	Pr >  t
Intercept	0.5000000000	0.60927180	0.82	0.4293

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Two within-subjects factors: Blood flow data (NWK p. 1181) 4  
 Proc glm (Multivariate, univariate approaches)  
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The GLM Procedure

Dependent Variable: iflow2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1200.000000	1200.000000	117.86	<.0001
Error	11	112.000000	10.181818		
Uncorrected Total	12	1312.000000			

R-Square	Coeff Var	Root MSE	iflow2 Mean
0.000000	31.90896	3.190896	10.00000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	1200.000000	1200.000000	117.86	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	1200.000000	1200.000000	117.86	<.0001

Parameter	Estimate	Standard Error	t Value	Pr >  t
Intercept	10.00000000	0.92113237	10.86	<.0001

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Two within-subjects factors: Blood flow data (NWK p. 1181) 5  
 Proc glm (Multivariate, univariate approaches)  
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The GLM Procedure

Dependent Variable: iflow3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	867.0000000	867.0000000	211.93	<.0001
Error	11	45.0000000	4.0909091		

Uncorrected Total 12 912.0000000

R-Square	Coeff Var	Root MSE	iflow3 Mean
0.000000	23.79529	2.022600	8.500000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	867.0000000	867.0000000	211.93	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	867.0000000	867.0000000	211.93	<.0001

Parameter	Estimate	Standard Error	t Value	Pr >  t
Intercept	8.500000000	0.58387421	14.56	<.0001

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Two within-subjects factors: Blood flow data (NWK p. 1181) 6  
 Proc glm (Multivariate, univariate approaches)  
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The GLM Procedure

Dependent Variable: iflow4

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	7500.000000	7500.000000	634.62	<.0001
Error	11	130.000000	11.818182		
Uncorrected Total	12	7630.000000			

R-Square	Coeff Var	Root MSE	iflow4 Mean
0.000000	13.75103	3.437758	25.00000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	7500.000000	7500.000000	634.62	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	7500.000000	7500.000000	634.62	<.0001

Parameter	Estimate	Standard Error	t Value	Pr >  t
Intercept	25.00000000	0.99239533	25.19	<.0001

Two within-subjects factors: Blood flow data (NWK p. 1181) 7  
 Proc glm (Multivariate, univariate approaches)  
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The GLM Procedure  
 Repeated Measures Analysis of Variance

Repeated Measures Level Information

Dependent Variable	iflow1	iflow2	iflow3	iflow4
Level of Drug_A	1	1	2	2
Level of Drug_B	1	2	1	2

Manova Test Criteria and Exact F Statistics  
 for the Hypothesis of no Drug\_A Effect  
 H = Type III SSCP Matrix for Drug\_A  
 E = Error SSCP Matrix

S=1 M=-0.5 N=4.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.01397950	775.87	1	11	<.0001
Pillai's Trace	0.98602050	775.87	1	11	<.0001
Hotelling-Lawley Trace	70.53333333	775.87	1	11	<.0001
Roy's Greatest Root	70.53333333	775.87	1	11	<.0001

Manova Test Criteria and Exact F Statistics  
 for the Hypothesis of no Drug\_B Effect  
 H = Type III SSCP Matrix for Drug\_B  
 E = Error SSCP Matrix

S=1 M=-0.5 N=4.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.02052644	524.89	1	11	<.0001
Pillai's Trace	0.97947356	524.89	1	11	<.0001
Hotelling-Lawley Trace	47.71764706	524.89	1	11	<.0001
Roy's Greatest Root	47.71764706	524.89	1	11	<.0001

Manova Test Criteria and Exact F Statistics for  
the Hypothesis of no Drug\_A\*Drug\_B Effect  
H = Type III SSCP Matrix for Drug\_A\*Drug\_B  
E = Error SSCP Matrix

S=1      M=-0.5      N=4.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.07836991	129.36	1	11	<.0001
Pillai's Trace	0.92163009	129.36	1	11	<.0001
Hotelling-Lawley Trace	11.76000000	129.36	1	11	<.0001
Roy's Greatest Root	11.76000000	129.36	1	11	<.0001

Two within-subjects factors: Blood flow data (NWK p. 1181)      8  
Proc glm (Multivariate, univariate approaches)  
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The GLM Procedure  
Repeated Measures Analysis of Variance  
Univariate Tests of Hypotheses for Within Subject Effects

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Drug_A	1	1587.000000	1587.000000	775.87	<.0001
Error(Drug_A)	11	22.500000	2.045455		

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Drug_B	1	2028.000000	2028.000000	524.89	<.0001
Error(Drug_B)	11	42.500000	3.863636		

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Drug_A*Drug_B	1	147.000000	147.000000	129.36	<.0001
Error(Drug_A*Drug_B)	11	12.500000	1.136363		

Skip the analysis of “contrast variables.”

Two within-subjects factors: Blood flow data (NWK p. 1181) 12  
 Covariance Structure Approach with proc mixed  
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The Mixed Procedure

Model Information

Data Set	WORK.UVBLOOD
Dependent Variable	iflow
Covariance Structure	Unstructured
Subject Effect	patient
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Between-Within

Class Level Information

Class	Levels	Values
DrugA	2	No Yes
DrugB	2	No Yes

Dimensions

Covariance Parameters	10
Columns in X	9
Columns in Z	0
Subjects	12
Max Obs Per Subject	4
Observations Used	48
Observations Not Used	0
Total Observations	48

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	224.25476467	
1	1	179.84564795	0.00000000

Convergence criteria met.

Estimated R Matrix for Subject 1

Row	Col1	Col2	Col3	Col4
1	4.4545	4.0000	2.7273	4.0909
2	4.0000	10.1818	5.2727	9.3636
3	2.7273	5.2727	4.0909	6.2727
4	4.0909	9.3636	6.2727	11.8182



Covariance Parameter Estimates

Cov Parm	Subject	Estimate
UN(1,1)	patient	4.4545
UN(2,1)	patient	4.0000
UN(2,2)	patient	10.1818
UN(3,1)	patient	2.7273
UN(3,2)	patient	5.2727
UN(3,3)	patient	4.0909
UN(4,1)	patient	4.0909
UN(4,2)	patient	9.3636
UN(4,3)	patient	6.2727
UN(4,4)	patient	11.8182

Fit Statistics

-2 Res Log Likelihood	179.8
AIC (smaller is better)	199.8
AICC (smaller is better)	206.5
BIC (smaller is better)	204.7

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
9	44.41	<.0001

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
DrugA	1	11	775.87	<.0001
DrugB	1	11	524.89	<.0001
DrugA*DrugB	1	11	129.36	<.0001