

```
*****
*****      Example Three (Unbalanced data)      *****
*****;
```

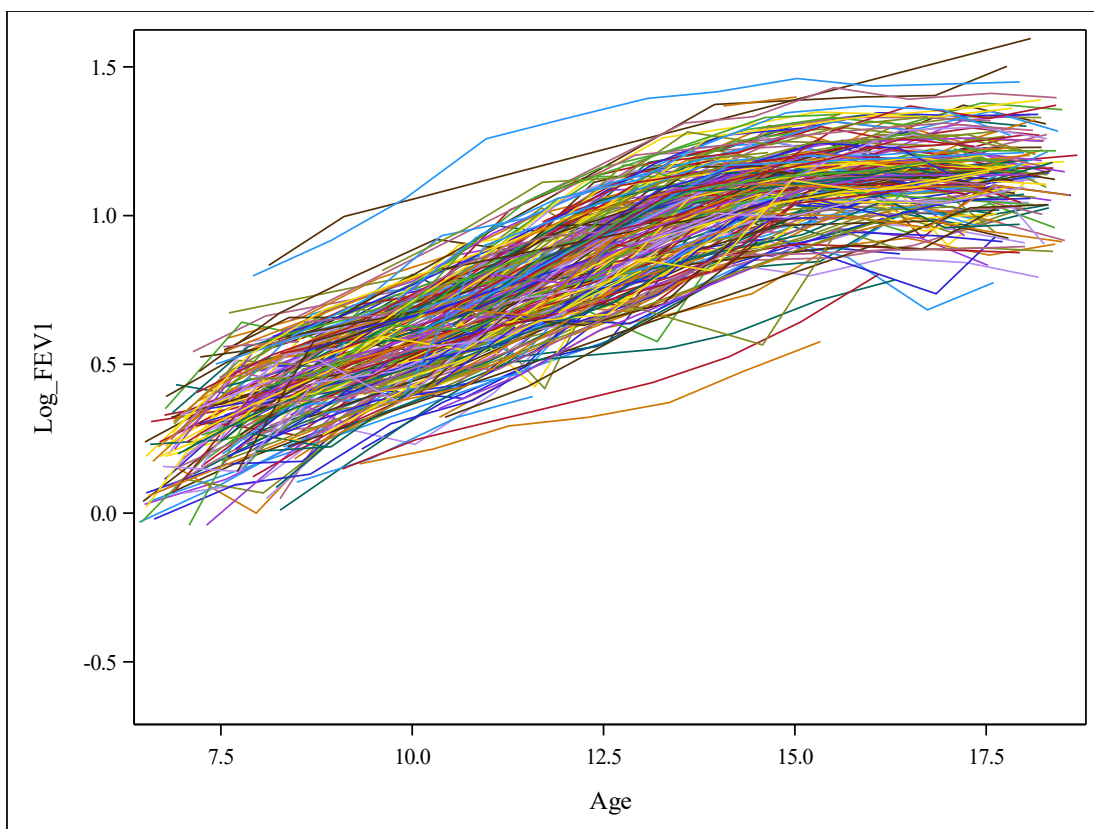
*The Six Cities Study of Air Pollution and Health was a longitudinal study designed to characterize lung growth as measured by changes in pulmonary function in children and adolescents, and the factors that influence lung function growth. A cohort of 13,379 children born on or after 1967 was enrolled in six communities across the U.S.

```
.;
```

```
data air_pol;
input  ID Height Age INI_Height  INI_Age  Log_FEV1;
datalines;
   1    1.20   9.3415    1.20    9.3415    0.21511
   1    1.28  10.3929    1.20    9.3415    0.37156
.....
  300    1.62  17.0075    1.44   11.9617    1.12817
  300    1.63  17.8645    1.44   11.9617    1.16938
;
```

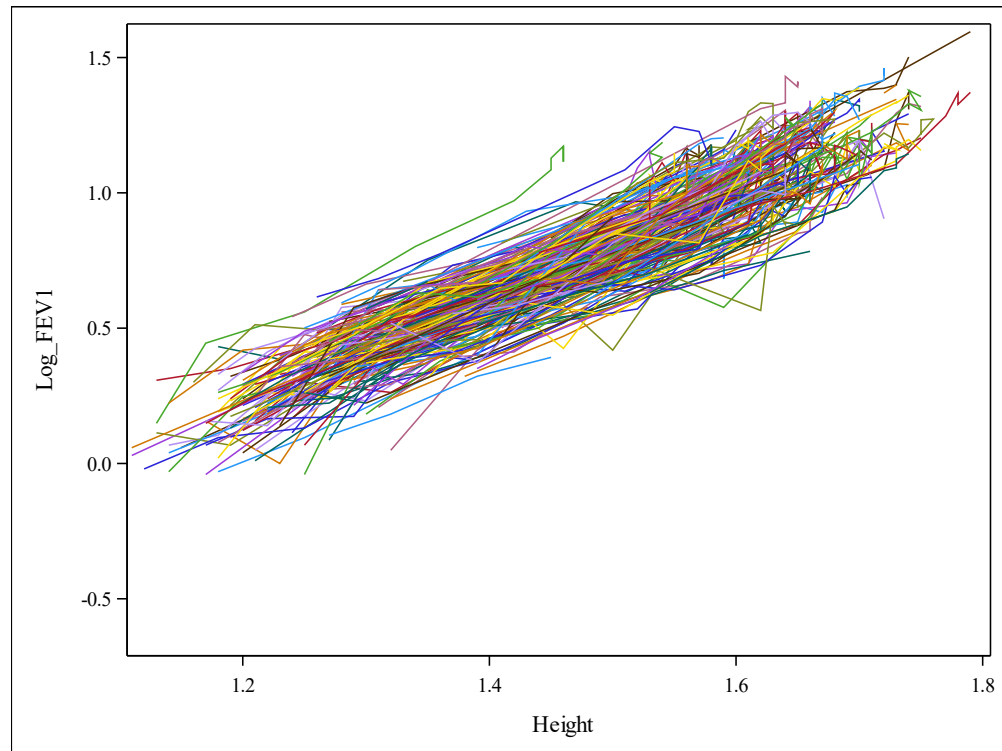
```
run;
```

```
Proc SGplot data = air_pol;
series x=Age y=Log_FEV1 / group =ID LineAttrs= (pattern=1 );
run;
```



```
Proc SGplot data = air_pol;
series x=Height y=Log_FEV1 / group =ID LineAttrs= (pattern=1 );
```

```
run;
```



```
data air_pol2;
  set air_pol;
  lAge = log(Age);
  Age_fl = floor(Age);
run;
```

```
proc print data = air_pol2 (obs=10);
run;
```

Obs	ID	Height	Age	INI_Height	INI_Age	Log_FEV1	lAge	Age_fl
1	1	1.20	9.3415	1.20	9.3415	0.21511	2.23447	9
2	1	1.28	10.3929	1.20	9.3415	0.37156	2.34112	10
3	1	1.33	11.4524	1.20	9.3415	0.48858	2.43820	11
4	1	1.42	12.4600	1.20	9.3415	0.75142	2.52252	12
5	1	1.48	13.4182	1.20	9.3415	0.83291	2.59661	13
6	1	1.50	15.4743	1.20	9.3415	0.89200	2.73918	15
7	1	1.52	16.3723	1.20	9.3415	0.87129	2.79559	16
8	2	1.13	6.5873	1.13	6.5873	0.30748	1.88514	6
9	2	1.19	7.6496	1.13	6.5873	0.35066	2.03465	7
10	2	1.49	12.7392	1.13	6.5873	0.75612	2.54468	12

```
proc mixed data=air_pol2;
class ID Age_fl (ref='6');
model Log_FEV1 = Height/solution;
random ID;
repeated Age_fl/ subject=ID type=UN r rcorr;
run;
```

From log:

NOTE: An infinite likelihood is assumed in iteration 0 because of a nonpositive definite estimated R matrix for ID 6.

NOTE: PROCEDURE MIXED used (Total process time):

real time	0.09 seconds
cpu time	0.06 seconds

```
proc mixed data=air_pol2 method=ml;
class ID Age_fl (ref='6');
model Log_FEV1 = Height/solution;
repeated Age_fl / subject=ID type=CS rcorr;
run;
```

Dimensions	
Covariance Parameters	2
Columns in X	2
Columns in Z	0
Subjects	300
Max Obs per Subject	12

Number of Observations	
Number of Observations Read	1994
Number of Observations Used	1994
Number of Observations Not Used	0

Iteration History			
Iteration	Evaluations	-2 Log Like	Criterion
0	1	-2776.46631068	
1	2	-4293.41265567	0.00032212
2	1	-4294.82400322	0.00000964
3	1	-4294.86318523	0.00000001
4	1	-4294.86322549	0.00000000

Convergence criteria met.

Estimated R Correlation Matrix for ID 1							
Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7
1	1.0000	0.7130	0.7130	0.7130	0.7130	0.7130	0.7130
2	0.7130	1.0000	0.7130	0.7130	0.7130	0.7130	0.7130
3	0.7130	0.7130	1.0000	0.7130	0.7130	0.7130	0.7130
4	0.7130	0.7130	0.7130	1.0000	0.7130	0.7130	0.7130
5	0.7130	0.7130	0.7130	0.7130	1.0000	0.7130	0.7130
6	0.7130	0.7130	0.7130	0.7130	0.7130	1.0000	0.7130
7	0.7130	0.7130	0.7130	0.7130	0.7130	0.7130	1.0000

Covariance Parameter Estimates		
Cov Parm	Subject	Estimate
CS	ID	0.01136
Residual		0.004572

Fit Statistics	
-2 Log Likelihood	-4294.9
AIC (Smaller is Better)	-4286.9
AICC (Smaller is Better)	-4286.8
BIC (Smaller is Better)	-4272.0

Null Model Likelihood Ratio Test		
DF	Chi-Square	Pr > ChiSq
1	1518.40	<.0001

Solution for Fixed Effects					
Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	-2.2442	0.01787	299	-125.61	<.0001
Height	2.0428	0.01136	1693	179.85	<.0001

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Height	1	1693	32346.4	<.0001

```
proc mixed data=air_pol2 method=ml;
class ID Age_fl (ref='6');
model Log_FEV1 = Height lAge/solution;
repeated Age_fl / subject=ID type=CS rcorr;
run;
```

Dimensions	
Covariance Parameters	2
Columns in X	3
Columns in Z	0
Subjects	300
Max Obs per Subject	12

Number of Observations	
Number of Observations Read	1994
Number of Observations Used	1994
Number of Observations Not Used	0

Iteration History			
Iteration	Evaluations	-2 Log Like	Criterion
0	1	-2907.87613326	
1	2	-4492.64029483	0.00069964
2	1	-4495.88336641	0.00004217
3	1	-4496.06274862	0.00000019
4	1	-4496.06352901	0.00000000

Convergence criteria met.

Estimated R Correlation Matrix for ID 1							
Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7
1	1.0000	0.7379	0.7379	0.7379	0.7379	0.7379	0.7379
2	0.7379	1.0000	0.7379	0.7379	0.7379	0.7379	0.7379
3	0.7379	0.7379	1.0000	0.7379	0.7379	0.7379	0.7379
4	0.7379	0.7379	0.7379	1.0000	0.7379	0.7379	0.7379
5	0.7379	0.7379	0.7379	0.7379	1.0000	0.7379	0.7379
6	0.7379	0.7379	0.7379	0.7379	0.7379	1.0000	0.7379
7	0.7379	0.7379	0.7379	0.7379	0.7379	0.7379	1.0000

Covariance Parameter Estimates		
Cov Parm	Subject	Estimate
CS	ID	0.01144
Residual		0.004064

Fit Statistics	
-2 Log Likelihood	-4496.1
AIC (Smaller is Better)	-4486.1
AICC (Smaller is Better)	-4486.0
BIC (Smaller is Better)	-4467.5

Null Model Likelihood Ratio Test		
DF	Chi-Square	Pr > ChiSq
1	1588.19	<.0001

Solution for Fixed Effects					
Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	-2.1668	0.01781	299	-121.64	<.0001
Height	1.4985	0.03880	1692	38.62	<.0001
lAge	0.2955	0.02023	1692	14.61	<.0001

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Height	1	1692	1491.45	<.0001
lAge	1	1692	213.37	<.0001

```
proc mixed data=air_pol2 method=ml;
class ID Age_fl (ref='6');
model Log_FEV1 = Height Age/solution;
repeated Age_fl / subject=ID type=CS rcorr;
run;
```

Dimensions	
Covariance Parameters	2
Columns in X	3
Columns in Z	0
Subjects	300
Max Obs per Subject	12

Number of Observations	
Number of Observations Read	1994
Number of Observations Used	1994
Number of Observations Not Used	0

Iteration History			
Iteration	Evaluations	-2 Log Like	Criterion
0	1	-2922.17092237	
1	2	-4506.79100602	0.00051575
2	1	-4509.15569516	0.00002392
3	1	-4509.25663085	0.00000006
4	1	-4509.25688638	0.00000000

Convergence criteria met.

Estimated R Correlation Matrix for ID 1							
Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7
1	1.0000	0.7328	0.7328	0.7328	0.7328	0.7328	0.7328
2	0.7328	1.0000	0.7328	0.7328	0.7328	0.7328	0.7328
3	0.7328	0.7328	1.0000	0.7328	0.7328	0.7328	0.7328
4	0.7328	0.7328	0.7328	1.0000	0.7328	0.7328	0.7328
5	0.7328	0.7328	0.7328	0.7328	1.0000	0.7328	0.7328
6	0.7328	0.7328	0.7328	0.7328	0.7328	1.0000	0.7328
7	0.7328	0.7328	0.7328	0.7328	0.7328	0.7328	1.0000

Covariance Parameter Estimates		
Cov Parm	Subject	Estimate
CS	ID	0.01111
Residual		0.004051

Fit Statistics	
-2 Log Likelihood	-4509.3
AIC (Smaller is Better)	-4499.3
AICC (Smaller is Better)	-4499.2
BIC (Smaller is Better)	-4480.7

Null Model Likelihood Ratio Test		
DF	Chi-Square	Pr > ChiSq
1	1587.09	<.0001

Solution for Fixed Effects					
Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	-1.8585	0.03070	299	-60.53	<.0001
Height	1.6187	0.03011	1692	53.75	<.0001
Age	0.01977	0.001311	1692	15.08	<.0001

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Height	1	1692	2889.37	<.0001
Age	1	1692	227.39	<.0001

```
proc mixed data=air_pol2 method=ml;
class ID;
model Log_FEV1 = INI_Height Age/solution;
repeated Age_f1 / subject=ID type=CS rcorr;
run;
```

Dimensions	
Covariance Parameters	2
Columns in X	3
Columns in Z	300
Subjects	1
Max Obs per Subject	1994

Number of Observations	
Number of Observations Read	1994
Number of Observations Used	1994
Number of Observations Not Used	0

Iteration History			
Iteration	Evaluations	-2 Log Like	Criterion
0	1	-1867.32258825	
1	2	-2799.07527578	0.00031523
2	1	-2800.19055040	0.00000813
3	1	-2800.21728812	0.00000001

Convergence criteria met.

Covariance Parameter Estimates	
Cov Parm	Estimate
ID	0.01412
Residual	0.01048

Fit Statistics	
-2 Log Likelihood	-2800.2
AIC (Smaller is Better)	-2790.2
AICC (Smaller is Better)	-2790.2
BIC (Smaller is Better)	-2771.7

Solution for Fixed Effects					
Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	-1.0950	0.1033	299	-10.60	<.0001
INI_Height	0.6421	0.08009	1692	8.02	<.0001
Age	0.08552	0.000745	1692	114.83	<.0001

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
INI_Height	1	1692	64.27	<.0001
Age	1	1692	13186.3	<.0001

```
proc mixed data=air_pol2 method=ml;
class ID;
model Log_FEV1 = INI_Height lAge/solution;
repeated Age_f1 / subject=ID type=CS rcorr;
run;
```

Dimensions	
Covariance Parameters	2
Columns in X	3
Columns in Z	300
Subjects	1
Max Obs per Subject	1994

Number of Observations	
Number of Observations Read	1994
Number of Observations Used	1994
Number of Observations Not Used	0

Iteration History			
Iteration	Evaluations	-2 Log Like	Criterion
0	1	-2067.44084141	
1	2	-3414.39048922	0.00125694
2	1	-3419.55057200	0.00011120
3	1	-3419.96890425	0.00000113
4	1	-3419.97292154	0.00000000

Convergence criteria met.

Covariance Parameter Estimates	
Cov Parm	Estimate
ID	0.01659
Residual	0.007157

Fit Statistics	
-2 Log Likelihood	-3420.0
AIC (Smaller is Better)	-3410.0
AICC (Smaller is Better)	-3409.9
BIC (Smaller is Better)	-3391.5

Solution for Fixed Effects					
Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	-2.4773	0.1085	299	-22.82	<.0001
INI_Height	0.5295	0.08359	1692	6.33	<.0001
lAge	1.0443	0.007418	1692	140.78	<.0001

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
INI_Height	1	1692	40.12	<.0001
lAge	1	1692	19819.3	<.0001

```
proc mixed data=air_pol2 method=ml;
class ID Age_f1 (ref='6');
model Log_FEV1 = Height Age Height*Height Age*Age/solution;
repeated Age_f1 / subject=ID type=CS rcorr;
run;
```

Fit Statistics	
-2 Log Likelihood	-4515.3
AIC (Smaller is Better)	-4501.3
AICC (Smaller is Better)	-4501.3
BIC (Smaller is Better)	-4475.4

Null Model Likelihood Ratio Test		
DF	Chi-Square	Pr > ChiSq
1	1591.38	<.0001

Solution for Fixed Effects					
Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	-1.5609	0.1952	299	-8.00	<.0001
Height	1.0883	0.3007	1690	3.62	0.0003
Age	0.04340	0.009653	1690	4.50	<.0001
Height*Height	0.1454	0.09533	1690	1.53	0.1274
Age*Age	-0.00077	0.000310	1690	-2.48	0.0133

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Height	1	1690	13.10	0.0003
Age	1	1690	20.22	<.0001
Height*Height	1	1690	2.33	0.1274
Age*Age	1	1690	6.14	0.0133

```
proc mixed data=air_pol2;
class ID Age_f1 (ref='6');
model Log_FEV1 = Height Age Height*Height Age*Age/solution;
repeated Age_f1 / subject=ID type=CS rcorr;
run;
```

Estimated R Correlation Matrix for ID 1							
Row	Col1	Col2	Col3	Col4	Col5	Col6	Col7
1	1.0000	0.7381	0.7381	0.7381	0.7381	0.7381	0.7381
2	0.7381	1.0000	0.7381	0.7381	0.7381	0.7381	0.7381
3	0.7381	0.7381	1.0000	0.7381	0.7381	0.7381	0.7381
4	0.7381	0.7381	0.7381	1.0000	0.7381	0.7381	0.7381
5	0.7381	0.7381	0.7381	0.7381	1.0000	0.7381	0.7381
6	0.7381	0.7381	0.7381	0.7381	0.7381	1.0000	0.7381
7	0.7381	0.7381	0.7381	0.7381	0.7381	0.7381	1.0000

Covariance Parameter Estimates		
Cov Parm	Subject	Estimate
CS	ID	0.01137
Residual		0.004034

Fit Statistics	
-2 Res Log Likelihood	-4470.8
AIC (Smaller is Better)	-4466.8
AICC (Smaller is Better)	-4466.8
BIC (Smaller is Better)	-4459.4

Null Model Likelihood Ratio Test		
DF	Chi-Square	Pr > ChiSq
1	1590.42	<.0001

Solution for Fixed Effects					
Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	-1.5607	0.1954	299	-7.99	<.0001
Height	1.0879	0.3010	1690	3.61	0.0003
Age	0.04342	0.009665	1690	4.49	<.0001
Height*Height	0.1455	0.09544	1690	1.52	0.1276
Age*Age	-0.00077	0.000311	1690	-2.48	0.0134

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Height	1	1690	13.06	0.0003
Age	1	1690	20.19	<.0001
Height*Height	1	1690	2.32	0.1276
Age*Age	1	1690	6.13	0.0134

The datasets can be found at <http://www.biostat.jhsph.edu/~fdominic/teaching/LDA/lda.html> under "DATA SETS";

```
data hiv;  
infile "C:\...\hivstudy.txt" dlm=tab;  
input ID Month CD4 Group;  
run;
```

```
ods rtf file="C:\...\Examples\09 - Profile and Parametric examples2.rtf";
```

```
proc print data = hiv (obs=10);  
run;
```

Obs	ID	Month	CD4	Group
1	1	0	658	1
2	1	2	543	1
3	1	4	520	1
4	1	6	563	1
5	1	8	389	1
6	1	10	371	1
7	2	0	500	1
8	2	2	419	1
9	2	4	431	1
10	2	6	285	1

*Now we will include the mean line on the graph by TRT;

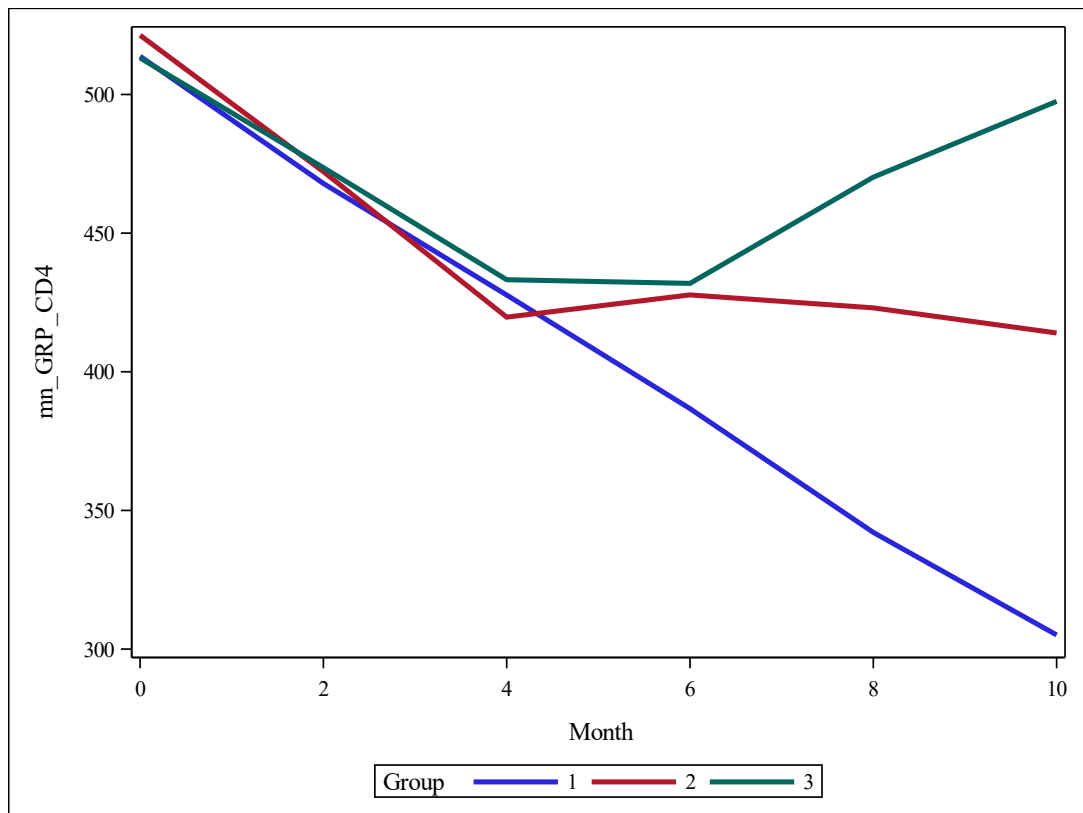
```
proc sort data=hiv;  
by Group Month;
```

*Calculate the mean by week;

```
proc means mean data=hiv noprint;  
by Group Month;  
var CD4;  
output out = MN_GRP_dat mean = mn_GRP_CD4;  
run;
```

*First, let's look at the mean by TRT group;

```
Proc SGplot data = MN_GRP_dat;  
series x=Month y=mn_GRP_CD4 / group =Group LineAttrs= (pattern=1 thickness=3);  
run;
```



```

data hiv_spline;
set hiv;
sp_mn1 = min(month,4);
sp_mn2 = max(0,month-4);
run;

proc mixed data=hiv_spline;
class ID month group(ref='1');
model CD4 = group sp_mn1 sp_mn2 group*sp_mn1 group*sp_mn2/solution;
repeated month/ subject=ID type=UN r rcorr;
run;

```

Estimated R Matrix for ID 1						
Row	Col1	Col2	Col3	Col4	Col5	Col6
1	7117.69	3537.34	3177.50	4137.80	4777.74	3782.56
2	3537.34	6983.79	3060.69	5319.00	4664.03	3768.19
3	3177.50	3060.69	6584.21	3731.95	4082.94	3125.07
4	4137.80	5319.00	3731.95	9845.98	5991.41	5417.86
5	4777.74	4664.03	4082.94	5991.41	9356.51	5239.18
6	3782.56	3768.19	3125.07	5417.86	5239.18	7730.21

Estimated R Correlation Matrix for ID 1						
Row	Col1	Col2	Col3	Col4	Col5	Col6
1	1.0000	0.5017	0.4642	0.4943	0.5855	0.5099
2	0.5017	1.0000	0.4514	0.6414	0.5770	0.5129
3	0.4642	0.4514	1.0000	0.4635	0.5202	0.4380
4	0.4943	0.6414	0.4635	1.0000	0.6242	0.6210
5	0.5855	0.5770	0.5202	0.6242	1.0000	0.6160
6	0.5099	0.5129	0.4380	0.6210	0.6160	1.0000

Fit Statistics	
-2 Res Log Likelihood	8126.7
AIC (Smaller is Better)	8168.7
AICC (Smaller is Better)	8170.1
BIC (Smaller is Better)	8227.3

```
proc mixed data=hiv_spline;
class ID month group(ref='1');
model CD4 = group sp_mn1 sp_mn2 group*sp_mn1 group*sp_mn2/solution;
repeated month/ subject=ID type=CSH r rcorr;
run;
```

Fit Statistics	
-2 Res Log Likelihood	8146.2
AIC (Smaller is Better)	8160.2
AICC (Smaller is Better)	8160.4
BIC (Smaller is Better)	8179.7

```
proc mixed data=hiv_spline; *This is the final model;
class ID month group(ref='1');
model CD4 = group sp_mn1 sp_mn2 group*sp_mn1 group*sp_mn2/solution outpm=pred;
repeated month/ subject=ID type=CS r rcorr;
run;
```

Estimated R Matrix for ID 1						
Row	Col1	Col2	Col3	Col4	Col5	Col6
1	7932.96	4252.14	4252.14	4252.14	4252.14	4252.14
2	4252.14	7932.96	4252.14	4252.14	4252.14	4252.14
3	4252.14	4252.14	7932.96	4252.14	4252.14	4252.14
4	4252.14	4252.14	4252.14	7932.96	4252.14	4252.14

Estimated R Matrix for ID 1						
Row	Col1	Col2	Col3	Col4	Col5	Col6
5	4252.14	4252.14	4252.14	4252.14	7932.96	4252.14
6	4252.14	4252.14	4252.14	4252.14	4252.14	7932.96

Estimated R Correlation Matrix for ID 1						
Row	Col1	Col2	Col3	Col4	Col5	Col6
1	1.0000	0.5360	0.5360	0.5360	0.5360	0.5360
2	0.5360	1.0000	0.5360	0.5360	0.5360	0.5360
3	0.5360	0.5360	1.0000	0.5360	0.5360	0.5360
4	0.5360	0.5360	0.5360	1.0000	0.5360	0.5360
5	0.5360	0.5360	0.5360	0.5360	1.0000	0.5360
6	0.5360	0.5360	0.5360	0.5360	0.5360	1.0000

Covariance Parameter Estimates		
Cov Parm	Subject	Estimate
CS	ID	4252.14
Residual		3680.82

Fit Statistics	
-2 Res Log Likelihood	8153.7
AIC (Smaller is Better)	8157.7
AICC (Smaller is Better)	8157.7
BIC (Smaller is Better)	8163.3

Null Model Likelihood Ratio Test		
DF	Chi-Square	Pr > ChiSq
1	298.84	<.0001

Solution for Fixed Effects						
Effect	Group	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept		512.86	13.4974	117	38.00	<.0001
Group	2	8.2469	19.0882	117	0.43	0.6665
Group	3	2.1689	19.0882	117	0.11	0.9097
Group	1	0	.	.	.	.
sp_mn1		-21.5651	3.1123	594	-6.93	<.0001
sp_mn2		-20.4803	2.0586	594	-9.95	<.0001
sp_mn1*Group	2	-2.6579	4.4014	594	-0.60	0.5462
sp_mn1*Group	3	-0.9908	4.4014	594	-0.23	0.8220
sp_mn1*Group	1	0	.	.	.	.
sp_mn2*Group	2	19.4280	2.9113	594	6.67	<.0001
sp_mn2*Group	3	31.7622	2.9113	594	10.91	<.0001
sp_mn2*Group	1	0	.	.	.	.

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Group	2	117	0.10	0.9046
sp_mn1	1	594	160.74	<.0001
sp_mn2	1	594	8.27	0.0042
sp_mn1*Group	2	594	0.19	0.8301
sp_mn2*Group	2	594	60.50	<.0001

```
proc mixed data=hiv_spline method=ml;
class ID month group(ref='1');
model CD4 = group month group*month/solution;
repeated month/ subject=ID type=CS r rcorr;
run;
```

Fit Statistics	
-2 Log Likelihood	8189.6
AIC (Smaller is Better)	8229.6
AICC (Smaller is Better)	8230.8
BIC (Smaller is Better)	8285.4

Null Model Likelihood Ratio Test		
DF	Chi-Square	Pr > ChiSq
1	302.11	<.0001

Solution for Fixed Effects							
Effect	Month	Group	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			305.10	13.9247	117	21.91	<.0001
Group		2	108.90	19.6926	117	5.53	<.0001
Group		3	192.40	19.6926	117	9.77	<.0001
Group		1	0	.	.	.	.
Month	0		208.68	13.4431	585	15.52	<.0001
Month	2		162.80	13.4431	585	12.11	<.0001
Month	4		122.58	13.4431	585	9.12	<.0001
Month	6		81.6000	13.4431	585	6.07	<.0001
Month	8		36.9750	13.4431	585	2.75	0.0061
Month	10		0	.	.	.	.
Month*Group	0	2	-101.33	19.0115	585	-5.33	<.0001
Month*Group	0	3	-193.00	19.0115	585	-10.15	<.0001
Month*Group	0	1	0	.	.	.	.
Month*Group	2	2	-104.63	19.0115	585	-5.50	<.0001
Month*Group	2	3	-186.68	19.0115	585	-9.82	<.0001
Month*Group	2	1	0	.	.	.	.
Month*Group	4	2	-116.88	19.0115	585	-6.15	<.0001
Month*Group	4	3	-186.88	19.0115	585	-9.83	<.0001
Month*Group	4	1	0	.	.	.	.
Month*Group	6	2	-67.8750	19.0115	585	-3.57	0.0004
Month*Group	6	3	-147.23	19.0115	585	-7.74	<.0001
Month*Group	6	1	0	.	.	.	.
Month*Group	8	2	-27.9250	19.0115	585	-1.47	0.1424
Month*Group	8	3	-64.3000	19.0115	585	-3.38	0.0008
Month*Group	8	1	0	.	.	.	.
Month*Group	10	2	0	.	.	.	.
Month*Group	10	3	0	.	.	.	.
Month*Group	10	1	0	.	.	.	.

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Group	2	117	8.46	0.0004
Month	5	585	63.21	<.0001
Month*Group	10	585	18.11	<.0001

```
proc mixed data=hiv_spline method=ml;
class ID month group(ref='1');
model CD4 = group sp_mn1 sp_mn2 group*sp_mn1 group*sp_mn2/solution outpm=pred;
repeated month/ subject=ID type=CS r rcorr;
run;
```

Fit Statistics	
-2 Log Likelihood	8199.6
AIC (Smaller is Better)	8233.3
AICC (Smaller is Better)	8233.8
BIC (Smaller is Better)	8285.4

Let's compare these two models graphically:

```
proc mixed data=hiv_spline;
class ID month group(ref='1');
model CD4 = group month group*month/solution outpm=pred2;
repeated month/ subject=ID type=CS r rcorr;
run;
```

```
proc sgplot data=pred;
series y=pred x=month / group=group;
run;
```

```
proc sgplot data=pred2;
series y=pred x=month / group=group;
run;
```

