```
data cholst;
input ID cholst sex    age    time;
age_at_meas = time + age;
datalines;
1       175    1       32       0
....................Data omitted..............
200     252    0       46      10
;
run;
```
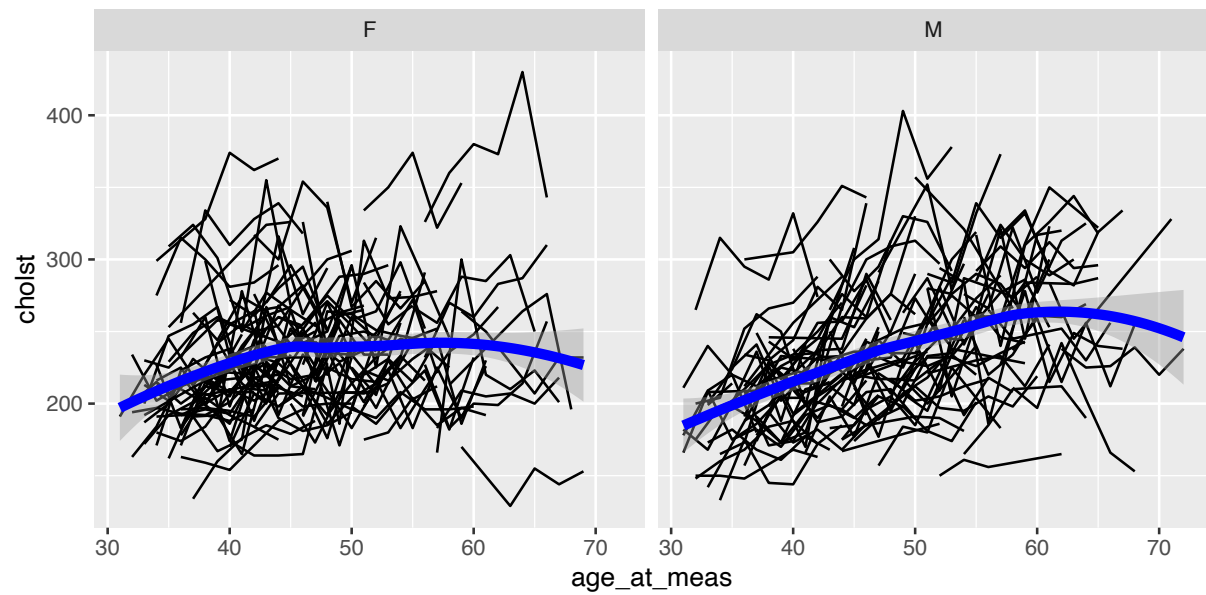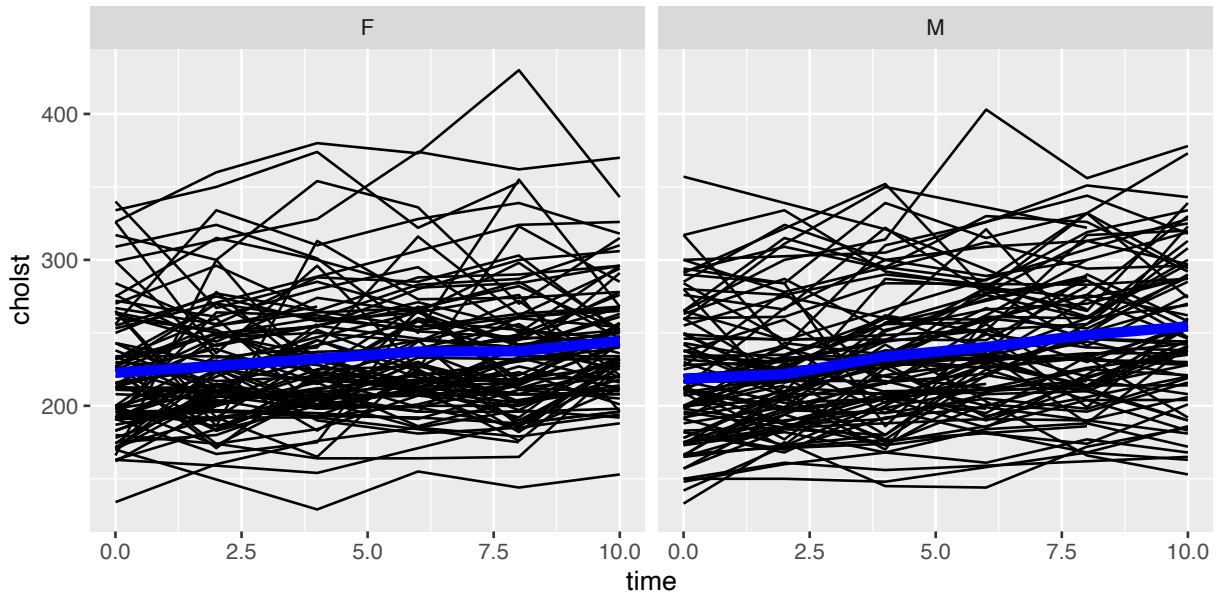
```
proc mixed data=cholst method = ml;
class ID;
model cholst = Time Sex Age/ s;
random intercept/subject=ID;
run;
```

Fit Statistics

-2 Log Likelihood	9964.2
AIC (Smaller is Better)	9976.2
AICC (Smaller is Better)	9976.3
BIC (Smaller is Better)	9996.0

Solution for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	157.39	15.0938	197	10.43	<.0001
time	2.8255	0.2022	843	13.98	<.0001
sex	-1.3253	5.4953	843	-0.24	0.8095
age	1.5011	0.3488	843	4.30	<.0001

```
proc mixed data=cholst method = ml;
class ID;
model cholst = Time Sex l_age/ s;
random intercept/subject=ID;
run;
```

Fit Statistics

-2 Log Likelihood	9963.6
AIC (Smaller is Better)	9975.6
AICC (Smaller is Better)	9975.6
BIC (Smaller is Better)	9995.4

Solution for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	-24.3834	55.9129	197	-0.44	0.6632

Solution for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
time	2.8264	0.2022	843	13.98	<.0001
sex	-1.2215	5.4833	843	-0.22	0.8238
l_age	65.7737	15.0094	843	4.38	<.0001

(*a 1 unit difference in log age is going from 20.1 to 54.6 years old)

```
proc mixed data=cholst method = ml;
class ID;
model cholst = Time Sex Age Time*Age / s;
random intercept/subject=ID;
run;
```

Fit Statistics

-2 Log Likelihood	9947.2
AIC (Smaller is Better)	9961.2
AICC (Smaller is Better)	9961.3
BIC (Smaller is Better)	9984.3

```
proc mixed data=cholst method = ml;
class ID;
model cholst = Time Sex l_age Time*l_age / s;
random intercept/subject=ID;
run;
```

Fit Statistics

-2 Log Likelihood	9947.7
AIC (Smaller is Better)	9961.7
AICC (Smaller is Better)	9961.8
BIC (Smaller is Better)	9984.8

```
proc mixed data=cholst method = ml;
class ID;
model cholst = Time Sex Age Time*Sex / s;
random intercept/subject=ID;
run;
```

Fit Statistics

-2 Log Likelihood	9948.3
AIC (Smaller is Better)	9962.3
AICC (Smaller is Better)	9962.4
BIC (Smaller is Better)	9985.3

```
proc mixed data=cholst method = ml;
class ID;
model cholst = Time Sex l_age Time*Sex / s;
random intercept/subject=ID;
run;
```

Fit Statistics

-2 Log Likelihood	9947.6
AIC (Smaller is Better)	9961.6
AICC (Smaller is Better)	9961.7
BIC (Smaller is Better)	9984.7

```
proc mixed data=cholst method = ml;
class ID;
model cholst = Time Sex Age Time*Sex Time*Age/ s;
random intercept/subject=ID;
run;
```

Fit Statistics

-2 Log Likelihood	9927.0
AIC (Smaller is Better)	9943.0
AICC (Smaller is Better)	9943.1
BIC (Smaller is Better)	9969.4

```
proc mixed data=cholst method = ml;
class ID;
model cholst = Time Sex l_age Time*Sex Time*l_age/ s;
random intercept/subject=ID;
run;
```

Fit Statistics

-2 Log Likelihood	9927.9
AIC (Smaller is Better)	9943.9
AICC (Smaller is Better)	9944.0
BIC (Smaller is Better)	9970.3

```
proc mixed data=cholst;
class ID;
model cholst = Time Sex Age Time*Sex Time*Age/ s;
random intercept/subject=ID;
run;
```

Fit Statistics

-2 Res Log Likelihood	9925.1
AIC (Smaller is Better)	9929.1
AICC (Smaller is Better)	9929.1
BIC (Smaller is Better)	9935.7

```
proc mixed data=cholst;
class ID;
model cholst = Time Sex Age Time*Sex Time*Age/ s;
random intercept Time/type=UN subject=ID g gcorr v vcorr;
run;
```

Fit Statistics

-2 Res Log Likelihood	9907.9
AIC (Smaller is Better)	9915.9
AICC (Smaller is Better)	9915.9
BIC (Smaller is Better)	9929.1

```
proc mixed data=cholst;
class ID;
model cholst = Time Sex Age Time*Sex Time*Age/ s;
random intercept Age/type=UN subject=ID g gcorr v vcorr;
run;
```

Fit Statistics

-2 Res Log Likelihood	9918.7

Fit Statistics

AIC (Smaller is Better)	9926.7
AICC (Smaller is Better)	9926.7
BIC (Smaller is Better)	9939.9

```
proc mixed data=cholst;
class ID;
model cholst = Time Sex Age Time*Sex Time*Age/ s;
random intercept Time Age/type=UN subject=ID g gcorr;
run;
```

Fit Statistics

-2 Res Log Likelihood	9901.4
AIC (Smaller is Better)	9915.4
AICC (Smaller is Better)	9915.5
BIC (Smaller is Better)	9938.5

```
proc mixed data=cholst method = ml;
class ID;
model cholst = Time Sex Age Time*Sex Time*Age/ s;
random intercept Time/type=UN subject=ID g gcorr v vcorr;
run;
```

Fit Statistics

-2 Log Likelihood	9910.3
AIC (Smaller is Better)	9930.3
AICC (Smaller is Better)	9930.5
BIC (Smaller is Better)	9963.3

```
proc mixed data=cholst method = ml;
class ID;
model cholst = Time Sex l_age Time*Sex Time*l_age/ s;
random intercept Time/type=UN subject=ID g gcorr v vcorr;
run;
```

Fit Statistics

-2 Log Likelihood	9911.0
AIC (Smaller is Better)	9931.0

Fit Statistics

AICC (Smaller is Better)	9931.2
BIC (Smaller is Better)	9964.0

```
proc mixed data=cholst;
class ID;
model cholst = Time Sex l_age Time*Sex Time*l_age/ s;
random intercept l_age/type=UN subject=ID g gcorr v vcorr;
run;
```

Fit Statistics

-2 Res Log Likelihood	9905.3
AIC (Smaller is Better)	9913.3
AICC (Smaller is Better)	9913.4
BIC (Smaller is Better)	9926.5

```
proc mixed data=cholst;
class ID;
model cholst = Time Sex l_age Time*Sex Time*l_age/ s;
random intercept l_age Time/type=UN subject=ID g gcorr v vcorr;
run;
```

Fit Statistics

-2 Res Log Likelihood	9887.7
AIC (Smaller is Better)	9901.7
AICC (Smaller is Better)	9901.8
BIC (Smaller is Better)	9924.8

```
proc mixed data=cholst;
class ID;
model cholst = Time Sex Age Time*Sex Time*Age/ s;
random intercept Time/type=UN subject=ID g gcorr v=26,34 vcorr=26,34;
* ID 26 is 56 years old;
* ID 34 is 31 years old;
run;
```

The Mixed Procedure

Model Information

Data Set	WORK.CHOLST
Dependent Variable	cholst
Covariance Structure	Unstructured
Subject Effect	ID
Estimation Method	REML
Residual Variance Method	Profile
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Containment

Class Level Information

Class	Levels	Values
ID	200	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 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200

Dimensions

Covariance Parameters	4
Columns in X	6
Columns in Z per Subject	2
Subjects	200
Max Obs per Subject	6

Number of Observations

Number of Observations Read	1044
Number of Observations Used	1044
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	10813.99587154	
1	2	9907.91171335	0.00001167
2	1	9907.86372303	0.00000002
3	1	9907.86363199	0.00000000

Convergence criteria met.

Estimated G Matrix

Row	Effect	ID	Col1	Col2
1	Intercept	1	1210.21	13.5403
2	time	1	13.5403	2.5226

Estimated G Correlation Matrix

Row	Effect	ID	Col1	Col2
1	Intercept	1	1.0000	0.2451
2	time	1	0.2451	1.0000

Estimated V Matrix for ID 26

Row	Col1	Col2	Col3	Col4	Col5	Col6
1	1644.38	1237.29	1264.37	1291.45	1318.53	1345.61
2	1237.29	1708.63	1311.63	1348.81	1385.98	1423.15
3	1264.37	1311.63	1793.06	1406.16	1453.42	1500.68
4	1291.45	1348.81	1406.16	1897.67	1520.86	1578.21
5	1318.53	1385.98	1453.42	1520.86	2022.47	1655.74
6	1345.61	1423.15	1500.68	1578.21	1655.74	2167.44

Estimated V Correlation Matrix for ID 26

Row	Col1	Col2	Col3	Col4	Col5	Col6
1	1.0000	0.7382	0.7363	0.7311	0.7230	0.7128
2	0.7382	1.0000	0.7494	0.7491	0.7456	0.7395
3	0.7363	0.7494	1.0000	0.7623	0.7632	0.7612
4	0.7311	0.7491	0.7623	1.0000	0.7763	0.7782
5	0.7230	0.7456	0.7632	0.7763	1.0000	0.7908
6	0.7128	0.7395	0.7612	0.7782	0.7908	1.0000

Estimated V Matrix for ID 34

Row	Col1	Col2	Col3	Col4	Col5	Col6
1	1644.38	1237.29	1264.37	1291.45	1318.53	1345.61
2	1237.29	1708.63	1311.63	1348.81	1385.98	1423.15
3	1264.37	1311.63	1793.06	1406.16	1453.42	1500.68
4	1291.45	1348.81	1406.16	1897.67	1520.86	1578.21
5	1318.53	1385.98	1453.42	1520.86	2022.47	1655.74
6	1345.61	1423.15	1500.68	1578.21	1655.74	2167.44

Estimated V Correlation Matrix for ID 34

Row	Col1	Col2	Col3	Col4	Col5	Col6
1	1.0000	0.7382	0.7363	0.7311	0.7230	0.7128
2	0.7382	1.0000	0.7494	0.7491	0.7456	0.7395
3	0.7363	0.7494	1.0000	0.7623	0.7632	0.7612
4	0.7311	0.7491	0.7623	1.0000	0.7763	0.7782
5	0.7230	0.7456	0.7632	0.7763	1.0000	0.7908
6	0.7128	0.7395	0.7612	0.7782	0.7908	1.0000

Covariance Parameter Estimates

Cov Parm	Subject	Estimate
UN(1,1)	ID	1210.21
UN(2,1)	ID	13.5403

Covariance Parameter Estimates

Cov Parm	Subject	Estimate
UN(2,2)	ID	2.5226
Residual		434.17

Fit Statistics

-2 Res Log Likelihood	9907.9
AIC (Smaller is Better)	9915.9
AICC (Smaller is Better)	9915.9
BIC (Smaller is Better)	9929.1

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
3	906.13	<.0001

Solution for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	138.18	14.9165	197	9.26	<.0001
time	6.8003	1.2230	190	5.56	<.0001
sex	-9.6393	5.4358	651	-1.77	0.0766
age	2.0509	0.3454	651	5.94	<.0001
time*sex	1.7995	0.4536	651	3.97	<.0001
time*age	-0.1145	0.02835	651	-4.04	<.0001

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
time	1	190	30.92	<.0001
sex	1	651	3.14	0.0766
age	1	651	35.25	<.0001
time*sex	1	651	15.73	<.0001
time*age	1	651	16.30	<.0001

Model with log(baseline age) as a random effect.

```
proc mixed data=cholst;
class ID;
model cholst = Time Sex l_age Time*Sex Time*l_age/ s;
random intercept l_age Time/type=UN subject=ID g gcorr v=26,34 vcorr=26,34 s;
run;
```

The Mixed Procedure

Model Information

Data Set	WORK.CHOLST
Dependent Variable	cholst
Covariance Structure	Unstructured
Subject Effect	ID
Estimation Method	REML
Residual Variance Method	Profile
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Containment

Class Level Information

Class	Levels	Values
ID	200	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 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200

Dimensions

Covariance Parameters	7
Columns in X	6
Columns in Z per Subject	3
Subjects	200

Dimensions

Max Obs per Subject	6

Number of Observations

Number of Observations Read	1044
Number of Observations Used	1044
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	10796.64307098	
1	2	9887.79574856	0.00001911
2	1	9887.71615647	0.00000010
3	1	9887.71576269	0.00000000

Convergence criteria met.

Estimated G Matrix

Row	Effect	ID	Col1	Col2	Col3
1	Intercept	1	111197	-30186	21.7122
2	l_age	1	-30186	8260.16	-2.5019
3	time	1	21.7122	-2.5019	2.6018

Estimated G Correlation Matrix

Row	Effect	ID	Col1	Col2	Col3
1	Intercept	1	1.0000	-0.9960	0.04037
2	l_age	1	-0.9960	1.0000	-0.01707
3	time	1	0.04037	-0.01707	1.0000

Estimated V Matrix for ID 26

Row	Col1	Col2	Col3	Col4	Col5	Col6
1	2457.94	2047.33	2070.61	2093.89	2117.18	2140.46
2	2047.33	2514.91	2114.71	2148.40	2182.09	2215.77
3	2070.61	2114.71	2592.70	2202.90	2247.00	2291.09
4	2093.89	2148.40	2202.90	2691.30	2311.91	2366.41
5	2117.18	2182.09	2247.00	2311.91	2810.71	2441.73
6	2140.46	2215.77	2291.09	2366.41	2441.73	2950.94

Estimated V Correlation Matrix for ID 26

Row	Col1	Col2	Col3	Col4	Col5	Col6
1	1.0000	0.8235	0.8202	0.8141	0.8055	0.7948
2	0.8235	1.0000	0.8282	0.8258	0.8207	0.8134
3	0.8202	0.8282	1.0000	0.8339	0.8324	0.8283
4	0.8141	0.8258	0.8339	1.0000	0.8406	0.8397
5	0.8055	0.8207	0.8324	0.8406	1.0000	0.8478
6	0.7948	0.8134	0.8283	0.8397	0.8478	1.0000

Estimated V Matrix for ID 34

Row	Col1	Col2	Col3	Col4	Col5	Col6
1	1722.27	1314.61	1340.85	1367.09	1393.33	1419.58
2	1314.61	1785.16	1387.91	1424.56	1461.20	1497.85
3	1340.85	1387.91	1868.86	1482.02	1529.07	1576.13
4	1367.09	1424.56	1482.02	1973.38	1596.94	1654.41
5	1393.33	1461.20	1529.07	1596.94	2098.71	1732.68
6	1419.58	1497.85	1576.13	1654.41	1732.68	2244.85

Estimated V Correlation Matrix for ID 34

Row	Col1	Col2	Col3	Col4	Col5	Col6
1	1.0000	0.7497	0.7474	0.7416	0.7329	0.7220
2	0.7497	1.0000	0.7599	0.7590	0.7549	0.7482

Estimated V Correlation Matrix for ID 34

Row	Col1	Col2	Col3	Col4	Col5	Col6
3	0.7474	0.7599	1.0000	0.7717	0.7721	0.7695
4	0.7416	0.7590	0.7717	1.0000	0.7847	0.7860
5	0.7329	0.7549	0.7721	0.7847	1.0000	0.7983
6	0.7220	0.7482	0.7695	0.7860	0.7983	1.0000

Covariance Parameter Estimates

Cov Parm	Subject	Estimate
UN(1,1)	ID	111197
UN(2,1)	ID	-30186
UN(2,2)	ID	8260.16
UN(3,1)	ID	21.7122
UN(3,2)	ID	-2.5019
UN(3,3)	ID	2.6018
Residual		433.90

Fit Statistics

-2 Res Log Likelihood	9887.7
AIC (Smaller is Better)	9901.7
AICC (Smaller is Better)	9901.8
BIC (Smaller is Better)	9924.8

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
6	908.93	<.0001

Solution for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	-103.98	58.8262	197	-1.77	0.0787
time	19.7675	4.5805	189	4.32	<.0001

Solution for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
sex	-11.9582	5.2892	652	-2.26	0.0241
l_age	88.5397	15.8994	0	5.57	.
time*sex	1.7804	0.4551	652	3.91	0.0001
time*l_age	-4.7745	1.2303	652	-3.88	0.0001

Solution for Random Effects

Effect	ID	Estimate	Std Err Pred	DF	t Value	Pr > |t|
Intercept	1	-35.3196	282.56	652	-0.12	0.9006
l_age	1	7.9757	80.7260	652	0.10	0.9213
time	1	-0.4447	1.2698	652	-0.35	0.7263
Intercept	2	427.27	305.05	652	1.40	0.1618
l_age	2	-93.4309	85.8740	652	-1.09	0.2770
time	2	2.9678	1.2692	652	2.34	0.0197
Intercept	3	-28.6208	332.40	652	-0.09	0.9314
l_age	3	14.5309	89.7224	652	0.16	0.8714
time	3	0.07610	1.2468	652	0.06	0.9513
Intercept	200	-87.6297	311.78	652	-0.28	0.7787
l_age	200	28.7091	82.0249	652	0.35	0.7264
time	200	0.1658	1.2687	652	0.13	0.8961

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
time	1	189	18.62	<.0001
sex	1	652	5.11	0.0241
l_age	1	0	31.01	.
time*sex	1	652	15.30	0.0001
time*l_age	1	652	15.06	0.0001