```
/*  SAS program for a mixed model, unbalanced AOV     */
/*  PROC GLM as well as PROC MIXED.                   */
/*  Example is from the SAS GLM documentation;  data  */
/*  are from Milliken and Johnson (1984 Analysis of   */
/*  Messy Data, Volume I:  Designed Experiments.)     */
/*  Three machines are fixed effects;  six randomly   */
/*  selected employees are random effects.  Each      */
/*  selected employee had productivity rating (y)     */
/*  measured on various machines.                     */
options nocenter ls=72;
data;
input machine person y @@;
cards;
1 1 52.0 1 2 51.8 1 2 52.8 1 3 60.0 1 4 51.1 1 4 52.3
1 5 50.9 1 5 51.8 1 5 51.4 1 6 46.4 1 6 44.8 1 6 49.2
2 1 64.0 2 2 59.7 2 2 60.0 2 2 59.0 2 3 68.6 2 3 65.8
2 4 63.2 2 4 62.8 2 4 62.2 2 5 64.8 2 5 65.0 2 6 43.7
2 6 44.2 2 6 43.0 3 1 67.5 3 1 67.2 3 1 66.9 3 2 61.5
3 2 61.7 3 2 62.3 3 3 70.8 3 3 70.6 3 3 71.0 3 4 64.1
3 4 66.2 3 4 64.0 3 5 72.1 3 5 72.0 3 5 71.1 3 6 62.0
3 6 61.4 3 6 60.5
;
proc glm;
class machine person;
model y=machine person machine*person;
random person machine*person /test;
proc mixed method=reml covtest;
class machine person;
model y=machine / ddfm=satterth;
random person machine*person;
run;
```

```
The GLM Procedure

     Class Level Information

Class         Levels    Values

machine            3    1 2 3

person             6    1 2 3 4 5 6


Number of observations    44
Dependent Variable: y
```

Source	DF	Sum of Squares	Mean Square	F Value
Model	17	3061.743333	180.102549	206.41
Error	26	22.686667	0.872564	
Corrected Total	43	3084.430000		

Source	Pr > F
Model	<.0001
Error	
Corrected Total	

R-Square	Coeff Var	Root MSE	y Mean
0.992645	1.560754	0.934111	59.85000

Source	DF	Type I SS	Mean Square	F Value
machine	2	1648.664722	824.332361	944.72
person	5	1008.763583	201.752717	231.22
machine*person	10	404.315028	40.431503	46.34

Source	Pr > F
machine	<.0001
person	<.0001
machine*person	<.0001

Source	DF	Type III SS	Mean Square	F Value
machine	2	1238.197626	619.098813	709.52
person	5	1011.053834	202.210767	231.74
machine*person	10	404.315028	40.431503	46.34

Source	Pr > F
machine	<.0001
person	<.0001
machine*person	<.0001

Source	Type III Expected Mean Square
machine	Var(Error) + 2.137 Var(machine*person) + Q(machine)
person	Var(Error) + 2.2408 Var(machine*person) + 6.7224 Var(person)
machine*person	Var(Error) + 2.3162 Var(machine*person)

Tests of Hypotheses for Mixed Model Analysis of Variance

Dependent Variable: y

Source	DF	Type III SS	Mean Square	F Value
machine	2	1238.197626	619.098813	16.57
Error	10.036	375.057436	37.370384	

Error: 0.9226*MS(machine*person) + 0.0774*MS(Error)

Source	Pr > F
machine	0.0007

Error
Error:
0.9226*MS(machine*person)
+ 0.0774*MS(Error)

Source	DF	Type III SS	Mean Square	F Value
person	5	1011.053834	202.210767	5.17
Error	10.015	392.005726	39.143708	

Error: 0.9674*MS(machine*person) + 0.0326*MS(Error)

Source	Pr > F
person	0.0133

Error
Error:
0.9674*MS(machine*person)
+ 0.0326*MS(Error)

Source	DF	Type III SS	Mean Square	F Value
machine*person	10	404.315028	40.431503	46.34
Error: MS(Error)	26	22.686667	0.872564	

Source	Pr > F
machine*person	<.0001

Error: MS(Error)

The Mixed Procedure

Model Information

Data Set	WORK.DATA4
Dependent Variable	y
Covariance Structure	Variance Components
Estimation Method	REML
Residual Variance Method	Profile
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Satterthwaite

Class Level Information

Class	Levels	Values
machine	3	1 2 3
person	6	1 2 3 4 5 6

Dimensions

Covariance Parameters	3
Columns in X	4
Columns in Z	24
Subjects	1
Max Obs Per Subject	44
Observations Used	44
Observations Not Used	0
Total Observations	44

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	270.15842523	
1	2	181.87153357	0.00000064
2	1	181.87149943	0.00000000

Convergence criteria met.

Covariance Parameter Estimates

Cov Parm	Estimate	Standard Error	Z Value	Pr Z
person	22.4551	17.4132	1.29	0.0986
machine*person	14.2340	6.5152	2.18	0.0145
Residual	0.8709	0.2411	3.61	0.0002

Fit Statistics

-2 Res Log Likelihood	181.9
AIC (smaller is better)	187.9
AICC (smaller is better)	188.5
BIC (smaller is better)	187.2

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
machine	2	10.1	19.97	0.0003