

How can I get ANOVA type results from mixed using the margins command?

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The ANOVA (Analysis of Variance) is a statistical test that is commonly used to compare the means of two or more groups. In order to obtain ANOVA type results from a mixed model, the margins command can be used. This command allows for the estimation of marginal means, which are the predicted values of the response variable at a specific combination of levels of the independent variables. By using the margins command, ANOVA type results can be obtained for a mixed model, providing valuable information for comparing the means of different groups and understanding the effects of the independent variables on the response variable.

How can I get ANOVA type results from mixed using the margins command? | Stata FAQ

The `anova` and `mixed` commands present their results rather differently. The `anova` command displays a single test for each factor in the model including factors that have more than one degree of freedom. The `mixed` command displays estimate for each degree of freedom. Even when you follow the `mixed` command with `test` the results often don't agree with `anova` except for the highest order interaction. This page will show you how you can get `anova` type results from `mixed` by using the `margins` command.

Example 1

Our first example will use split-plot factorial model with

one between subject factor a (2 levels) and one within subject factor b (4 levels). We will begin by loading the data and running the anova model for comparison purposes.

use <https://stats.idre.ucla.edu/stat/data/spf24>, clear

```
anova y a / s|a b a#b /
```

Number of obs = 32 R-squared = 0.9613

Root MSE = .712 Adj R-squared = 0.9333

```
Source | Partial SS df MS F Prob>F
```

```
-----+-----
```

Model | 226.375 13 17.413462 34.35 0.0000

```
|
```

a | 3.125 1 3.125 2.00 0.2070

```
s|a | 9.375 6 1.5625
```

```
-----+-----
```

b | 194.5 3 64.833333 127.89 0.0000

```
a#b | 19.375 3 6.4583333 12.74 0.0001
```

```
|
```

Residual | 9.125 18 .50694444

```
-----+-----
```

Total | 235.5 31 7.5967742

This model has two error terms s and the residual (which is technically the same as the $b \times s | a$ interaction). One advantage to using mixed for these mixed model

ANOVAs is that we do not have to specify which error term is used to test which effect. We do, however, have to be sure to include all of the necessary random effects in our mixed model.

There is an additional advantage in that you get better estimates using mixed when there is missing data for some subjects.

We will now run the mixed command followed by tests for each of the effects. The setup for mixed has the fixed effects to the left of the double pipe (||) and the random effects to the right. For each test with more than one degree of freedom we will also show the chi-square value divided by the degrees of freedom so that they are scaled the same as the F-ratio in the above ANOVA. The reml option must be used to replicate the results of the ANOVA.

```
mixed y a##b || s: , reml
```

Performing EM optimization:**Performing gradient-based optimization:****Iteration 0: log restricted-likelihood = -34.824381****Iteration 1: log restricted-likelihood = -34.824379****Computing standard errors:****Mixed-effects REML regression Number of obs = 32****Group variable: s Number of groups = 8****Obs per group:****min = 4****avg = 4.0****max = 4****Wald chi2(7) = 423.89****Log restricted-likelihood = -34.824379 Prob > chi2 = 0.0000**

y | Coef. Std. Err. z P>|z|

-----+-----

2.a | -2 .6208193 -3.22 0.001 -3.216783 -.7832165**|**

```

b |
2 | .25 .5034603 0.50 0.619 -.736764 1.236764
3 | 3.25 .5034603 6.46 0.000 2.263236 4.236764
4 | 4.25 .5034603 8.44 0.000 3.263236 5.236764
|
a#b |
2 2 | 1 .7120004 1.40 0.160 -.3954951 2.395495
2 3 | .5 .7120004 0.70 0.483 -.8954951 1.895495
2 4 | 4 .7120004 5.62 0.000 2.604505 5.395495
|
_cons | 3.75 .4389855 8.54 0.000 2.889604 4.610396
-----+-----
Random-effects Parameters | Estimate Std. Err.
-----+-----
s: Identity |
var(_cons) | .2638887 .2294499 .0480071 1.450562
-----+-----
var(Residual) | .5069445 .1689815 .2637707 .9743036
-----+-----
LR test vs. linear model: chibar2(01) = 3.30 Prob >=
chibar2 = 0.0346

```

estimates store m1 /* save estimate for use later on */

testparm a#b

(1) 2.a#2.b = 0

(2) 2.a#3.b = 0

(3) 2.a#4.b = 0

chi2(3) = 38.22

Prob > chi2 = 0.0000

display "display as F " r(chi2)/r(df)

display as F 12.739724

testparm i.b

(1) 2.b = 0

(2) 3.b = 0

(3) 4.b = 0

chi2(3) = 107.88

Prob > chi2 = 0.0000

display "display as F " r(chi2)/r(df)

display as F 35.958898

testparm i.a

(1) 2.a = 0

chi2(1) = 10.38

Prob > chi2 = 0.0013

As you can see, the only test that has the same value in both the anova and the mixed is the one for the a#b interaction. The reason for this because the factor-variables used in the mixed command use indicator (dummy) coding. The tests of the main effects for a and b are really test of simple effects for the reference level of the categorical variable.

We can easily get the "correct" tests for the main effects using the margins command.

margins b, post asbalanced

Adjusted predictions Number of obs = 32

Expression : Linear prediction, fixed portion, predict()

at : a (asbalanced)

b (asbalanced)

| Delta-method

| Margin Std. Err. z P>|z|

-----+-----

b |

1 | 2.75 .3104096 8.86 0.000 2.141608 3.358392

2 | 3.5 .3104096 11.28 0.000 2.891608 4.108392

3 | 6.25 .3104096 20.13 0.000 5.641608 6.858392

4 | 9 .3104096 28.99 0.000 8.391608 9.608392

test (1.b=2.b)(1.b=3.b)(1.b=4.b)

(1) 1bn.b - 2.b = 0

(2) 1bn.b - 3.b = 0

(3) 1bn.b - 4.b = 0

chi2(3) = 383.67

Prob > chi2 = 0.0000

display "display as F " r(chi2)/r(df)

display as F 127.89039

estimates restore m1

(results m1 are active now)

margins a, post asbalanced

Adjusted predictions Number of obs = 32

Expression : Linear prediction, fixed portion, predict()

at : a (asbalanced)

b (asbalanced)

 | Delta-method

| Margin Std. Err. z P>|z|

-----+-----
 a |

1 | 5.6875 .3124999 18.20 0.000 5.075011 6.299989

2 | 5.0625 .3124999 16.20 0.000 4.450011 5.674989

 test (1.a=2.a)

(1) 1bn.a - 2.a = 0

chi2(1) = 2.00

Prob > chi2 = 0.1573

Note that the tests for a and b main effects now agree with the anova results in the first part of this example.

For our second example, let's try a model that is a bit more complex.

Example 2

The second example is a split-plot factorial with one between subject factor a (2 levels) and two within subject factors b and c (2 levels each). The model has four separate error terms but we won't have to divide any of the chi-square values from the mixed model by their degrees of freedom because all of the tests have just a single degree of freedom.

use <https://stats.idre.ucla.edu/stat/data/spf2-22>, clear

anova y a / s|a b a#b / b#s|a c a#c / c#s|a b#c a#b#c /

Number of obs = 32 R-squared = 0.9920

Root MSE = .559017 Adj R-squared = 0.9589

Source | Partial SS df MS F Prob > F

-----+-----

Model | 233.625 25 9.345 29.90 0.0002

|

```
a | 3.125 1 3.125 2.00 0.2070
s|a | 9.375 6 1.5625
```

```
-----+-----
```

```
b | 162 1 162 199.38 0.0000
a#b | 6.125 1 6.125 7.54 0.0335
b#s|a | 4.875 6 .8125
```

```
-----+-----
```

```
c | 24.5 1 24.5 61.89 0.0002
a#c | 10.125 1 10.125 25.58 0.0023
c#s|a | 2.375 6 .395833333
```

```
-----+-----
```

```
b#c | 8 1 8 25.60 0.0023
a#b#c | 3.125 1 3.125 10.00 0.0195
```

```
|
```

```
Residual | 1.875 6 .3125
```

```
-----+-----
```

```
Total | 235.5 31 7.59677419
```

We begin this next section by using the egen group command to create combinations of variables to act as our random effects. We will need b by s, c by s and b by c by s along with s for our random effects.

We will then run the mixed command followed by test of the a#b#c interaction to show that the results for the

highest order interaction is the same as the anova results.

```
egen bs = group(b s)
```

```
egen cs = group(c s)
```

```
egen bcs= group(b c s)
```

```
mixed y a##b##c || _all: R.bs || _all: R.cs || _all: R.bcs ||  
s:, reml
```

Performing EM optimization:

Performing gradient-based optimization:

Iteration 0: log restricted-likelihood = -34.084157 (not concave)

Iteration 1: log restricted-likelihood = -34.049357 (not concave)

Iteration 2: log restricted-likelihood = -34.046954

Iteration 3: log restricted-likelihood = -34.046003 (not concave)

Iteration 4: log restricted-likelihood = -34.045909

Iteration 5: log restricted-likelihood = -34.045907

Computing standard errors:

Mixed-effects REML regression Number of obs = 32

| No. of Observations per Group

Group Variable | Groups Minimum Average Maximum

-----+-----
 _all | 1 32 32.0 32

s | 8 4 4.0 4

Wald chi2(7) = 332.00

Log restricted-likelihood = -34.045907 Prob > chi2 = 0.0000

y | Coef. Std. Err. z P>|z|

-----+-----
 2.a | -2 .6208194 -3.22 0.001 -3.216784 -.7832163

2.b | 3.25 .5303299 6.13 0.000 2.210572 4.289428

|
a#b |

2 2 | .5 .7499998 0.67 0.505 -.9699725 1.969973

|
 2.c | .25 .4208128 0.59 0.552 -.5747779 1.074778

|

```

a#c |
2 2 | 1 .5951191 1.68 0.093 -.1664121 2.166412
|
b#c |
2 2 | .75 .5590141 1.34 0.180 -.3456476 1.845648
|
a#b#c |
2 2 2 | 2.5 .7905654 3.16 0.002 .9505203 4.04948
|
_cons | 3.75 .4389856 8.54 0.000 2.889604 4.610396

```

```

-----
-----
Random-effects Parameters | Estimate Std. Err.

```

```

-----+-----
_all: Identity |
var(R.bs) | .2500028 .2512985 .0348603 1.792908

```

```

-----+-----
_all: Identity |
var(R.cs) | .04167 .1455805 .0000443 39.23096

```

```

-----+-----
_all: Identity |
var(R.bcs) | .2498766 .180416 .0606933 1.028752

```

s: Identity |

var(_cons) | .1666639 .2644133 .0074371 3.734895

-----+-----
var(Residual) | .0626203 . . .

LR test vs. linear model: chi2(4) = 4.86 Prob > chi2 = 0.3019

Note: LR test is conservative and provided only for reference.

estimates store m1 /* save estimate for use later on */

testparm a#b#c

(1) 2.a#2.b#2.c = 0

chi2(1) = 10.00

Prob > chi2 = 0.0016

Yes indeed, the result for the a#b#c interaction is the same in both the mixed and the anova. Next, we will test each of the main effects and two-way interactions to show that these results are not equivalent to those in the anova

above.

testparm i.a

(1) 2.a = 0

chi2(1) = 10.38

Prob > chi2 = 0.0013

testparm i.b

(1) 2.b = 0

chi2(1) = 37.56

Prob > chi2 = 0.0000

testparm a#b

(1) 2.a#2.b = 0

chi2(1) = 0.44

Prob > chi2 = 0.5050

testparm i.c

(1) 2.c = 0

chi2(1) = 0.35

Prob > chi2 = 0.5525

testparm a#c

(1) 2.a#2.c = 0

chi2(1) = 2.82

Prob > chi2 = 0.0929

testparm b#c

(1) 2.b#2.c = 0

chi2(1) = 1.80

Prob > chi2 = 0.1797

Having verified that the tests for the main effects and two-way interactions differ between mixed and anova, we will finish up by running a series of margin commands testing the main effects and two-way interactions correctly.

margins a, post asbalanced

Adjusted predictions Number of obs = 32

Expression : Linear prediction, fixed portion, predict()

at : a (asbalanced)

b (asbalanced)

c (asbalanced)

| Delta-method

| Margin Std. Err. z P>|z|

a |

1 | 5.6875 .3124997 18.20 0.000 5.075012 6.299988

2 | 5.0625 .3124997 16.20 0.000 4.450012 5.674988

test (1.a = 2.a) /* a main effect */

(1) 1bn.a - 2.a = 0

chi2(1) = 2.00

Prob > chi2 = 0.1573

estimates restore m1

margins b, post asbalanced

Adjusted predictions Number of obs = 32

Expression : Linear prediction, fixed portion, predict()

at : a (asbalanced)

b (asbalanced)

c (asbalanced)

| Delta-method

| Margin Std. Err. z P>|z|

b |

1 | 3.125 .2724312 11.47 0.000 2.591045 3.658955

2 | 7.625 .2724312 27.99 0.000 7.091045 8.158955

test (1.b = 2.b) /* b main effect */

(1) 1bn.b - 2.b = 0

chi2(1) = 199.38

Prob > chi2 = 0.0000

estimates restore m1

margins c, post asbalanced

Adjusted predictions Number of obs = 32**Expression : Linear prediction, fixed portion, predict()****at : a (asbalanced)****b (asbalanced)****c (asbalanced)****| Delta-method****| Margin Std. Err. z P>|z|****c |****1 | 4.5 .2473822 18.19 0.000 4.01514 4.98486****2 | 6.25 .2473822 25.26 0.000 5.76514 6.73486****test (1.c = 2.c) /* c main effect */****(1) 1bn.c - 2.c = 0****chi2(1) = 61.89****Prob > chi2 = 0.0000****estimates restore m1****margins a#b, post asbalanced**

Adjusted predictions Number of obs = 32**Expression : Linear prediction, fixed portion, predict()****at : a (asbalanced)****b (asbalanced)****c (asbalanced)****| Delta-method****| Margin Std. Err. z P>|z|****a#b |****1 1 | 3.875 .3852758 10.06 0.000 3.119873 4.630127****1 2 | 7.5 .3852758 19.47 0.000 6.744873 8.255127****2 1 | 2.375 .3852758 6.16 0.000 1.619873 3.130127****2 2 | 7.75 .3852758 20.12 0.000 6.994873 8.505127****test (1.a#1.b - 1.a#2.b - 2.a#1.b + 2.a#2.b = 0) /* a#b
interaction */****(1) 1bn.a#1bn.b - 1bn.a#2.b - 2.a#1bn.b + 2.a#2.b = 0****chi2(1) = 7.54****Prob > chi2 = 0.0060**

estimates restore m1

margins a#c, post asbalanced

Adjusted predictions Number of obs = 32

Expression : Linear prediction, fixed portion, predict()

at : a (asbalanced)

b (asbalanced)

c (asbalanced)

| Delta-method

| Margin Std. Err. z P>|z|
 -----+

a#c |

1 1 | 5.375 .3498513 15.36 0.000 4.689304 6.060696

1 2 | 6 .3498513 17.15 0.000 5.314304 6.685696

2 1 | 3.625 .3498513 10.36 0.000 2.939304 4.310696

2 2 | 6.5 .3498513 18.58 0.000 5.814304 7.185696

**test (1.a#1.c - 1.a#2.c - 2.a#1.c + 2.a#2.c = 0) /* a#c
 interaction */**

(1) 1bn.a#1bn.c - 1bn.a#2.c - 2.a#1bn.c + 2.a#2.c = 0

chi2(1) = 25.58

Prob > chi2 = 0.0000

estimates restore m1

margins b#c, post asbalanced

Adjusted predictions Number of obs = 32

Expression : Linear prediction, fixed portion, predict()

at : a (asbalanced)

b (asbalanced)

c (asbalanced)

| **Delta-method**

| **Margin Std. Err. z P>|z|**
-----+

b#c |

1 1 | 2.75 .3104097 8.86 0.000 2.141608 3.358392

1 2 | 3.5 .3104097 11.28 0.000 2.891608 4.108392

2 1 | 6.25 .3104097 20.13 0.000 5.641608 6.858392

2 2 | 9 .3104097 28.99 0.000 8.391608 9.608392

```
test (1.b#1.c - 1.b#2.c - 2.b#1.c + 2.b#2.c = 0) /* b#c  
interaction */
```

```
( 1) 1bn.b#1bn.c - 1bn.b#2.c - 2.b#1bn.c + 2.b#2.c = 0
```

```
chi2( 1) = 25.60
```

```
Prob > chi2 = 0.0000
```

These two examples should give you a good feel for how to use the margins command to get anova type results from mixed.