

How can I do repeated measures ANOVA with covariates in SPSS?

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Repeated measures ANOVA with covariates is a statistical analysis method used to determine the effects of one or more independent variables on a dependent variable that is measured multiple times. In SPSS, this can be done by selecting the "Mixed Models" option under the "General Linear Model" menu. This allows for the inclusion of covariates, which are additional variables that may influence the relationship between the independent and dependent variables. The results of this analysis can provide valuable insights into the effects of the independent variables, while also controlling for the influence of the covariates.

How can I do repeated measures ANOVA with covariates in SPSS? | SPSS FAQ

SPSS provides several ways to analyze repeated measures ANOVA that include covariates.

This FAQ page will

look at ways of analyzing data in either wide form, i.e., all of the repeated measures for a subject are in one row of the data, or in long form where each of the repeated values are found on a separate row of the data.

There are two kinds of covariates found in repeated measures analyses; 1) time-invariant covariates or 2) time-varying covariates.

With time-invariant covariates there is just one value that is used for all the repeated observations for a given subject. Time-varying covariates, on the

other hand, can take on a different value for each of the repeated observations.

Time-invariant covariates can be analyzed with either wide data or long data. However, time-varying covariates require the data to be in the long form.

Here is an example of what one subject's data with a time-varying covariate looks like in wide form.

```
sub group dv1 dv2 dv3 cv1 cv2 cv3
1 1 3 4 7 3 1 2
```

And here is what the same data for the same subject looks like in long form.

```
sub group trial dv cv
1 1 1 3 3
1 1 2 4 1
1 1 3 7 2
```

Now we can begin by reading in the example data in wide form.

data list list

```
/ sub group dv1 dv2 dv3 cv1 cv2 cv3.
```

```
begin data.
```

```
1 1 3 4 7 3 1 2
```

```
2 1 6 8 12 9 3 1
```

```
3 1 7 13 11 11 8 4
```

```
4 1 0 3 6 6 2 1
```

```
5 2 5 6 11 7 8 3
```

```
6 2 10 12 18 15 9 5
```

```
7 2 10 15 15 14 8 6
```

```
8 2 5 7 11 9 2 8
```

```
end data.
```

Model 1

We will begin by using the glm procedure keeping the data in the wide form. We will use cv1 as the time-invariant covariate. When the data are wide you cannot use a time-varying covariate. To include the covariate in the model we use the with term in the first line of the command. For the purposes of this FAQ page, we will display only the univariate ANOVA tables for within-subjects and between subjects effects.

glm dv1 dv2 dv3 by group with cv1**/wsfactors=trial 3****/wsdesign=trial****/design=group cv1.**

Tests of Within-Subjects Effects						
Measure: MEASURE_1						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	
trial	Sphericity Assumed	16.325	2	8.163	4.439	.042
Greenhouse-Geisser	16.325	1.081	15.098	4.439	.084	
Huynh-Feldt	16.325	1.697	9.620	4.439	.052	
Lower-bound	16.325	1.000	16.325	4.439	.089	
trial * group	Sphericity Assumed	6.565	2	3.282	1.785	.217
Greenhouse-Geisser	6.565	1.081	6.071	1.785	.238	
Huynh-Feldt	6.565	1.697	3.868	1.785	.225	
Lower-bound	6.565	1.000	6.565	1.785	.239	
trial * cv1	Sphericity Assumed	6.445	2	3.223	1.753	.223
Greenhouse-Geisser	6.445	1.081	5.961	1.753	.242	
Huynh-Feldt	6.445	1.697	3.798	1.753	.230	
Lower-bound	6.445	1.000	6.445	1.753	.243	
Error(trial)	Sphericity Assumed	18.388	10	1.839		
Greenhouse-Geisser	18.388	5.406	3.401			
Huynh-Feldt	18.388	8.485	2.167			
Lower-bound	18.388	5.000	3.678			

Tests of Between-Subjects Effects						

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1.466	1	1.466	.217	.661
group	.635	1	.635	.094	.771
cv1	173.141	1	173.141	25.631	.004
Error	33.775	5	6.755		

Note that the output above includes the trial*cv1 interaction as part of the within-subjects effects. If this is what you want, fine. But if you don't want this interaction term you will need to run the model with a different procedure, the manova command.

Model 2

The manova command can only be run from syntax, it cannot be run using the pull-down menus. The manova command is much older than glm and its syntax is a bit fussier. For example, you have to declare the range of levels for each of the by factors and the covariate needs to be placed inside parentheses.

Again, we will focus on the univariate between- and within-subject effects.

```
manova dv1 dv2 dv3 by group(1,2) with (cv1)
/wsrfactors trial (3)
/wsdesign trial
/design.
```

```
***** Analysis of Variance --
Design 1 *****
```

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation SS DF MS F Sig of F

WITHIN+RESIDUAL 33.78 5 6.76

REGRESSION 173.14 1 173.14 25.63 .004

group .64 1 .64 .09 .771

Regression analysis for WITHIN+RESIDUAL error term

--- Individual Univariate .9500 confidence intervals

Dependent variable .. T1

**COVARIATE B Beta Std. Err. t-Value Sig. of t Lower
 -95% CL- Upper**

Tcv1 .8415132924 .9098200606 .16622 5.06274 .004
.41424 1.26879

***** Analysis of Variance --
Design 1 *****

Tests involving 'TRIAL' Within-Subject Effect.

Mauchly sphericity test, W = .36971
Chi-square approx. = 4.97514 with 2 D. F.
Significance = .083

Greenhouse-Geisser Epsilon = .61339
Huynh-Feldt Epsilon = .81855
Lower-bound Epsilon = .50000

AVERAGED Tests of Significance that follow multivariate tests are equivalent to univariate or split-plot or mixed-model approach to repeated measures.

Epsilons may be used to adjust d.f. for the AVERAGED results.

 ***** **Analysis of Variance** --
Design 1 *****

Tests involving 'TRIAL' Within-Subject Effect.

AVERAGED Tests of Significance for dv using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
---------------------	----	----	----	---	----------

WITHIN+RESIDUAL	24.83	12	2.07		
TRIAL	126.58	2	63.29	30.58	.000
group BY TRIAL	3.25	2	1.63	.79	.478

 The t-test for for cv1 is 5.06274 and is found on the row beginning with Tcv1.

Model 3

We used glm and manova with data in the wide form. It is also possible to analyze

these two models with data in the long form using the mixed command. In fact, if you want to include time-varying covariates you will need to use mixed. The varstocases command below will handle the data conversion from wide to long but before we run the command we will create a new variable, cvone, that we will use in the models with a time-invariant covariate.

```
compute cvone=cv1.
```

```
varstocases
```

```
/make dv from dv1 dv2 dv3
```

```
/make cv from cv1 cv2 cv3
```

```
/index = trial.
```

For Model 3, we will use the mixed command to duplicate the analysis from Model 1. The first line of the command looks very much like the glm command. The fixed subcommand lists all of the fixed effects including the trial*cvone interaction. The repeated line declares the name of the repeated effect while the subject() option is used

for the subject identifier. To reproduce the glm output we also include the `covtype(cs)` option which select the compound symmetry covariance structure.

`mixed dv by group trial with cvone`
`/fixed= group trial group*trial cvone trial*cvone`
`/repeated= trial | subject(sub) covtype(cs).`

Type III Tests of Fixed Effects ^a				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	5	.217	.661
group	1	5	.094	.771
trial	2	10.000	4.439	.042
group * trial	2	10.000	1.785	.217
cvone	1	5	25.631	.004
trial * cvone	2	10.000	1.753	.223
a. Dependent Variable: dv.				

Model 4

Next, to reproduce the results from Model 2, the manova command with wide data, we will run the same model as Model 3 but drop the `trial*cvone` interaction term. The F-ratio for `cvone` of 25.631 is the same as the t-value squared for `cv1` from Model 2, i.e.,

$$5.06274^2 = 25.631336.$$

mixed dv by group trial with cvone

/fixed= group trial group*trial cvone

/repeated= trial | subject(sub) covtype(cs).

Type III Tests of Fixed Effects ^a				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	5	.217	.661
group	1	5	.094	.771
trial	2	12.000	30.584	.000
group * trial	2	12.000	.785	.478
cvone	1	5	25.631	.004

Model 5

Our final example shows how to analyze the repeated measures ANOVA with a time-varying covariate.

The covariate cv has a different value for each of the repeated trials.

mixed dv by group trial with cv

/fixed= group trial group*trial cv

/repeated= trial | subject(sub) covtype(cs).

Type III Tests of Fixed Effects ^a				
Source	Numerator df	Denominator df	F	Sig.
Intercept	1	12.801	27.746	.000

group	1	5.881	2.177	.191
trial	2	10.858	12.708	.001
group * trial	2	10.287	.704	.517
cv	1	12.235	.081	.780

The results from Models 1 and 3 are identical as are the results from Models 2 and 4. However, the results for Models 1 and 3 cannot be directly compared with the results from Models 2 and 4, Nor, can either of those be compared with Model 5. The models differ in the number of predictors and the type of covariate and so are not comparable.