

# Learn How to Conduct a Repeated Measures ANOVA in SPSS

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The [Repeated Measures ANOVA](#) (Analysis of Variance) is an exceptionally powerful statistical framework utilized extensively in experimental research. It is specifically designed for scenarios where researchers measure the **same subjects** under three or more distinct experimental conditions. By employing this **within-subjects design**, the technique effectively isolates the effect of the intervention from the noise introduced by individual differences, significantly enhancing the statistical power compared to its independent groups counterpart. This method allows for a precise determination of whether a **statistically significant difference** exists between the mean scores across these repeated measurements.

This comprehensive guide offers a step-by-step walkthrough detailing how to execute and rigorously interpret a **one-way repeated measures ANOVA**. We will be using [SPSS](#) (Statistical Package for the Social Sciences), a statistical software package widely relied upon across the social, behavioral, and health sciences for its robust analytical capabilities.

## Designing the Experiment: A Psychopharmacology Example

To illustrate the practical application of this analysis, consider a hypothetical study in **psychopharmacology**. Researchers are tasked with assessing the differential impact of four distinct pharmaceutical interventions (Drug 1, Drug 2, Drug 3, and Drug 4) on human reaction time. To ensure maximum control over extraneous variables, the researchers employed a **within-subjects design**, meaning a small cohort of five participants received all four drugs sequentially, with their reaction time measured after each administration.

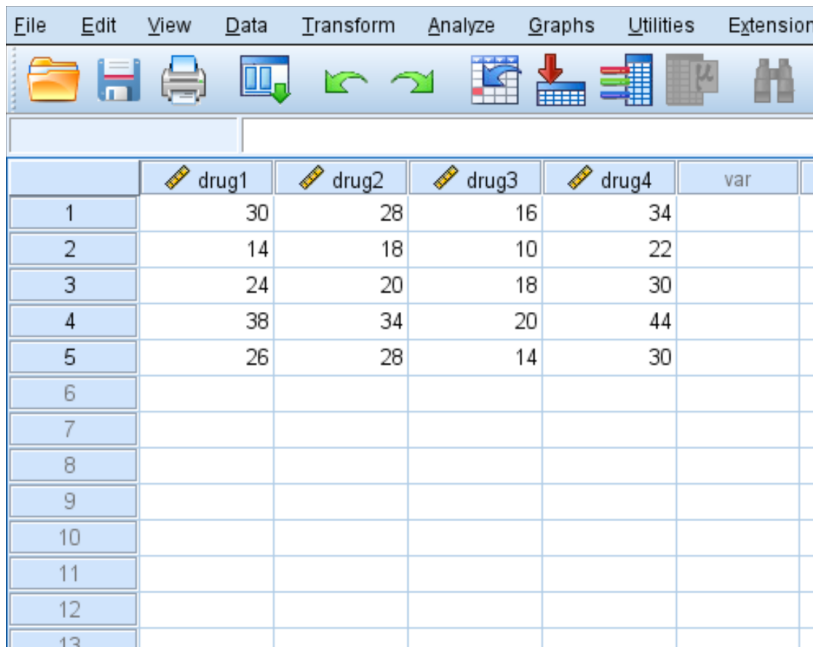
Because the response variable--reaction time--is measured repeatedly on the identical set of individuals, the **repeated measures ANOVA** becomes the indispensable statistical tool. The goal is to isolate and quantify the variance attributable solely to the pharmacological intervention.

The primary objective of this specific analysis is to establish if the **mean reaction time** differs significantly across the four drug conditions. Statistically, this translates into testing two competing hypotheses. The [null hypothesis](#) ( $H_0$ ) posits that there is absolutely no difference in mean reaction times among the drugs. Conversely, the alternative hypothesis ( $H_1$ ) suggests that at least one drug regimen results in a significantly different mean reaction time when compared to the others. The following structured steps guide the execution of this crucial test within the [SPSS](#) environment.

### Step 1: Preparing Your Data in SPSS (Wide Format)

Before commencing any statistical procedure in [SPSS](#), meticulous data preparation is mandatory. For a repeated measures analysis, the data must be organized in the 'wide' format within the Data View interface. This unique structure mandates that each level of the independent variable (each condition) occupies its own dedicated column. The rows, meanwhile, must represent the individual research participants or subjects.

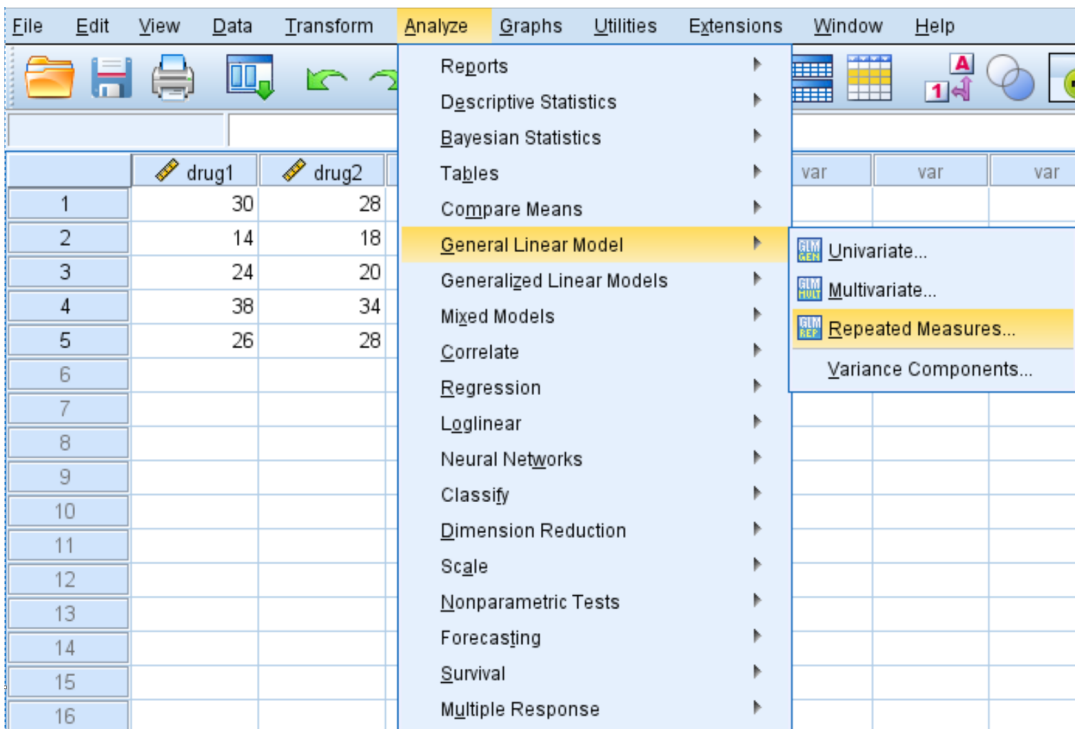
In the context of our psychopharmacology study, we will have four columns corresponding to the four drug conditions (Drug 1 through Drug 4). Input the sample data below into your [SPSS](#) Data View, where the recorded values represent response time measured in seconds for the five patients across the four experimental conditions:



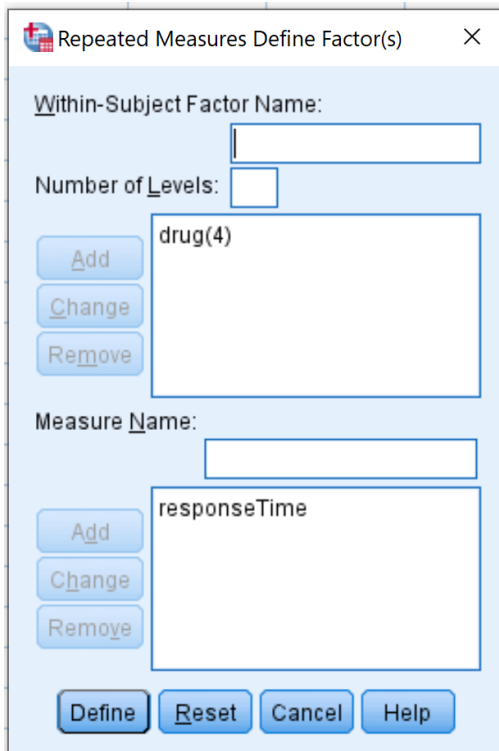
	drug1	drug2	drug3	drug4	var
1	30	28	16	34	
2	14	18	10	22	
3	24	20	18	30	
4	38	34	20	44	
5	26	28	14	30	
6					
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## Step 2: Defining the Model in General Linear Model (GLM)

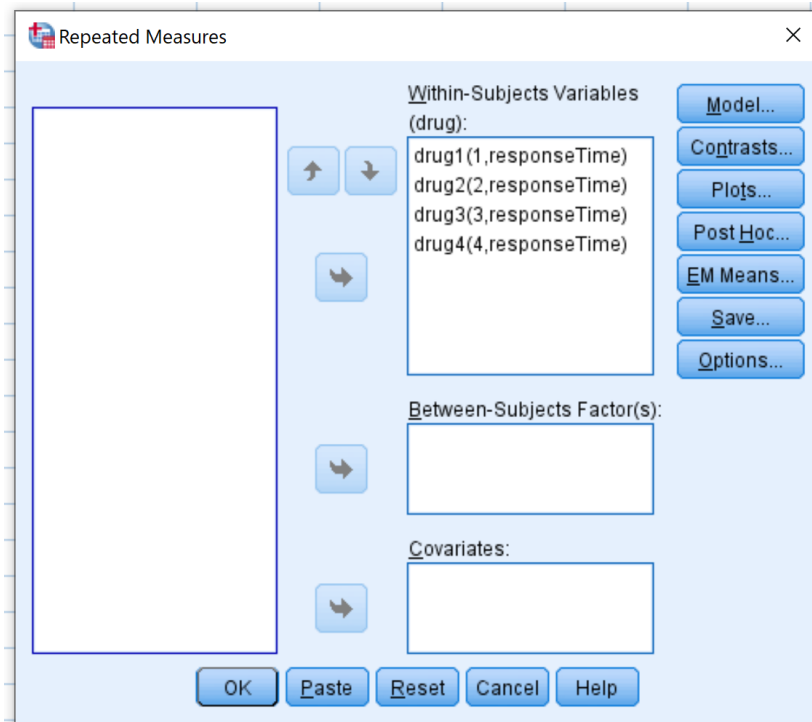
The execution of the repeated measures analysis in SPSS is initiated through the General Linear Model (GLM) menu, which handles complex variance structures. Navigate to the following sequence: **Analyze** → **General Linear Model** → **Repeated Measures....** This action opens the necessary initial dialog box required for defining the structure of the within-subjects factor.



Within the "Define Factor(s)" window, you must assign a name to the manipulated independent variable. For the **Within-Subject Factor Name**, input `drug`. Since our study incorporates four distinct drug conditions, set the **Number of Levels** to `4`, and then click **Add**. Following this, define the dependent measure by typing `responseTime` into the **Measure Name** field and clicking **Add**. After successfully specifying both the factor structure and the measure, click **Define** to transition to the main model setup window.

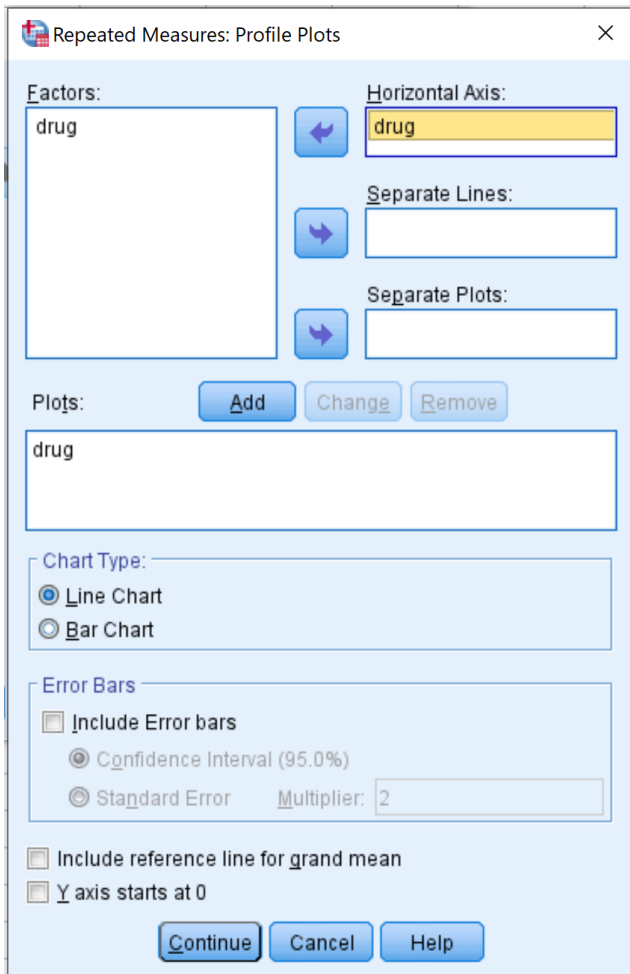


The subsequent step involves mapping the defined theoretical factors to the actual variable columns in your data file. Carefully select and drag all four drug variables (Drug 1, Drug 2, Drug 3, and Drug 4) from the left pane into the **Within-Subjects Variables (drug)** box on the right. It is paramount that these variables are placed in the correct sequential order, as this arrangement directly corresponds to the levels defined in the preceding dialog box, ensuring the integrity of the analysis.



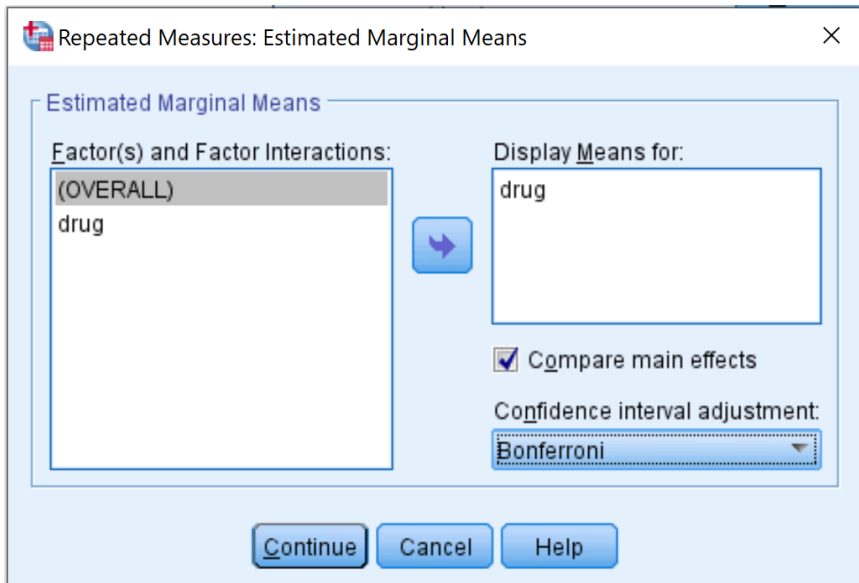
### Step 3: Requesting Outputs (Plots and Post Hoc Tests)

A crucial part of statistical analysis involves generating outputs that aid both interpretation and visualization. To graphically represent the estimated marginal means across the conditions, click the **Plots** button within the main GLM dialog box. Transfer the `drug` variable, which serves as our within-subjects factor, into the **Horizontal Axis** box, then click **Add** to finalize the plot configuration. Click **Continue** to return to the main menu.



Next, it is essential to configure the **Options** menu. Here, request descriptive statistics to summarize the data. More importantly, this menu is where the necessary **Post Hoc tests** are defined. If the omnibus test leads to the rejection of the [null hypothesis](#), we must perform follow-up comparisons to identify precisely which pairs of conditions are different. Select **Pairwise Comparisons** for the within-subjects factor and apply a suitable correction, such as the [Bonferroni correction](#), to control for the inflation of Type I error rate that occurs when conducting multiple comparisons.

After confirming all desired options, including requesting the descriptive statistics and Bonferroni adjustments as illustrated below, click **Continue** and then click **OK** to execute the analysis and generate the detailed output viewer.



Finally, click **OK** to run the procedure.

#### Step 4: Interpreting the Main Effect and Sphericity

The first critical section of the [SPSS](#) output is the **Tests of Within-Subjects Effects** table. This table summarizes the omnibus test, providing the overall assessment of whether the independent variable (drug) had a significant effect on the dependent variable (response time). Before interpreting the primary [F-statistic](#), we must address the critical assumption of **Sphericity**.

Sphericity implies that the variances of the differences between all pairs of within-subjects levels are equal. If Mauchly's Test indicates a violation of this assumption (which is common, especially with more than two levels), we must rely on adjusted results to maintain accuracy. We look specifically at the row labeled **Greenhouse-Geisser correction**, as this adjustment accounts for the violation of sphericity, providing a more conservative and reliable test statistic.

Based on the corrected statistics provided by the **Greenhouse-Geisser** adjustment, we observe an [F-statistic](#) of **24.759**, associated with a [p-value](#) of **.001**. Since this [p-value](#) is significantly lower than the standard alpha threshold of .05, we possess sufficient evidence to confidently reject the [null hypothesis](#). This finding definitively establishes that there is a **statistically significant difference** in the mean response times elicited by the four experimental drugs.

### Tests of Within-Subjects Effects

Measure: responseTime

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
drug	Sphericity Assumed	698.200	3	232.733	24.759	.000
	Greenhouse-Geisser	698.200	1.815	384.763	24.759	.001
	Huynh-Feldt	698.200	3.000	232.733	24.759	.000
	Lower-bound	698.200	1.000	698.200	24.759	.008
Error(drug)	Sphericity Assumed	112.800	12	9.400		
	Greenhouse-Geisser	112.800	7.258	15.540		
	Huynh-Feldt	112.800	12.000	9.400		
	Lower-bound	112.800	4.000	28.200		

### Step 5: Analyzing Pairwise Differences and Visual Confirmation

Rejecting the overall [null hypothesis](#) confirms that the means are not all equal, but it does not specify which particular drug means differ from each other. To isolate these specific differences, we turn to the **Pairwise Comparisons** table, which contains the results of our pre-requested post hoc analysis utilizing the rigorous [Bonferroni correction](#).

### Pairwise Comparisons

Measure: responseTime

(I) drug	(J) drug	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	95% Confidence Interval for Difference <sup>b</sup>	
					Lower Bound	Upper Bound
1	2	.800	1.625	1.000	-7.082	8.682
	3	10.800	2.577	.083	-1.700	23.300
	4	-5.600*	.748	.010	-9.230	-1.970
2	1	-.800	1.625	1.000	-8.682	7.082
	3	10.000	2.280	.071	-1.062	21.062
	4	-6.400	1.600	.097	-14.162	1.362
3	1	-10.800	2.577	.083	-23.300	1.700
	2	-10.000	2.280	.071	-21.062	1.062
	4	-16.400*	2.227	.011	-27.204	-5.596
4	1	5.600*	.748	.010	1.970	9.230
	2	6.400	1.600	.097	-1.362	14.162
	3	16.400*	2.227	.011	5.596	27.204

Based on estimated marginal means

\*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

A detailed examination of the adjusted [p-values](#) reveals the following key findings regarding the relationships between the drug pairings:

Drug 1 vs. Drug 2 | p-value = **1.000** (No statistical significance)

Drug 1 vs. Drug 3 | p-value = **.083** (No statistical significance)

Drug 1 vs. Drug 4 | p-value = **.010 (Statistically Significant)**

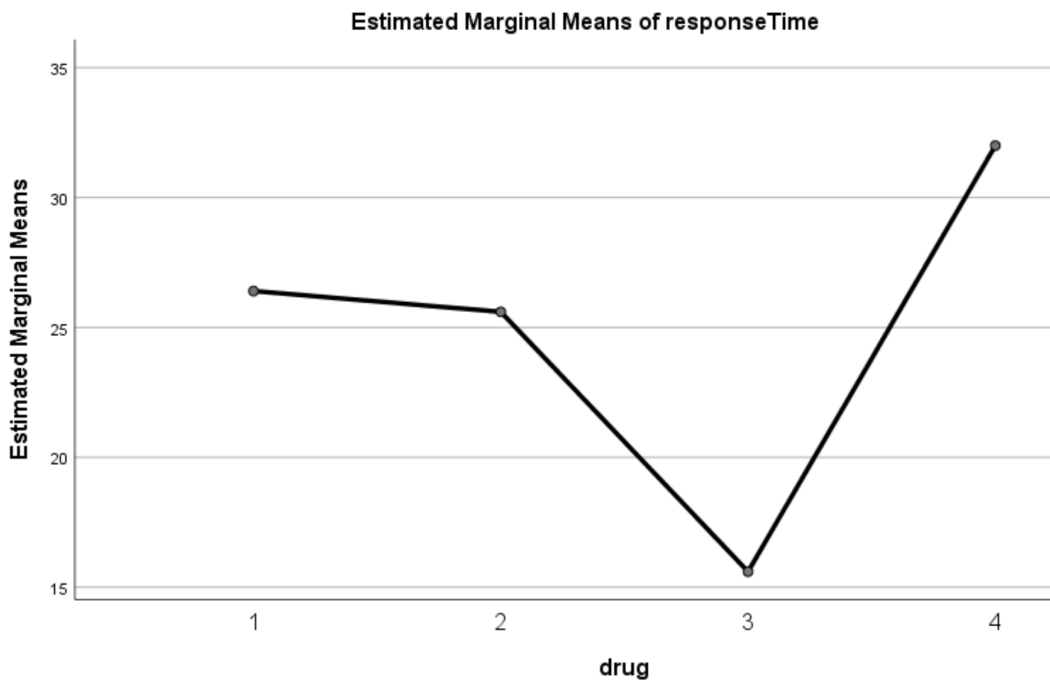
Drug 2 vs. Drug 3 | p-value = **.071** (No statistical significance)

Drug 2 vs. Drug 4 | p-value = **.097** (No statistical significance)

Drug 3 vs. Drug 4 | p-value = **.011 (Statistically Significant)**

Based on these results, only two pairs demonstrated a reliable, **statistically significant difference** in mean reaction time at the alpha = .05 level: the comparison between Drug 1 and Drug 4, and the comparison between Drug 3 and Drug 4. All other combinations failed to reach this threshold.

These statistical conclusions are powerfully reinforced by the **Plot of Estimated Marginal Means**. This visual representation clearly illustrates the trajectory of mean response times across the four conditions, confirming that Drug 4 stands out as having the most distinct mean compared to the other interventions, driving the significant main effect observed in the omnibus test.



## Step 6: Reporting Results in APA Format

The final and equally important stage of statistical analysis involves reporting the findings accurately and concisely, typically adhering to the standards set by [APA style](#) for academic or formal documentation. When communicating the results of a [Repeated Measures ANOVA](#), the report must include the type of test, the overall main effect statistics (F, degrees of freedom, and p-value), and the specifics of the post hoc tests.

It is crucial to note that due to the violation of sphericity, the degrees of freedom must be adjusted using the [Greenhouse-Geisser correction](#). Below is the exemplary format for reporting the findings derived from our psychopharmacology study:

A one-way repeated measures ANOVA was conducted to assess whether the mean reaction time of participants differed significantly across the four distinct drug conditions.

The analysis revealed that the type of drug administered had a **statistically significant difference** on patient response time ( $F(2.26, 9.03) = 24.759, p = 0.001$ ).

Subsequent [Bonferroni's test](#) for multiple comparisons found statistically significant differences in response times between Drug 1 and Drug 4 ( $p = 0.010$ ), and between Drug 3 and Drug 4 ( $p = 0.011$ ). No other comparisons were statistically significant.