

12.2: ANOVA Summary Table

RM ANOVAs are still ANOVAs, we're still looking at the ratio of between groups variability to within groups variability. With repeated measures, we have even more information: How similar that person is to themselves!

RM ANOVA Summary Table

Now that you are familiar with the concept of an ANOVA table (remember the ANOVA Summary Table from last chapter where we reported all of the parts to calculate the F -value?), we can take a look at the things we need to find out to make the ANOVA table. Table 12.2.1 presents an empty Repeated Measures ANOVA Summary Table.

Table 12.2.1- RM ANOVA Summary Table

Source	SS	df	MS	F
Between Groups				
Participants				
Within Groups (Error)				
Total				

? Exercise 12.2.1

What is the biggest difference between the Repeated Measure ANOVA Summary Table and the Between Groups ANOVA Summary Table (the one we talked about in the prior chapter)?

Answer

The biggest difference is that there's a whole new row! We now also are taking into account how similar each person is to themselves (each person's average response).

ANOVA Summary Table Formulas

Since the Within-Groups variability cannot only be measured indirectly, there's a wrinkle to completing the ANOVA Summary Table. To figure out the Within Groups error you need to find it with subtraction: $SS_{W_{Error}} = SS_{tot} - SS_b - SS_{ps}$

Table 12.2.2 shows this in the Sum of Squares column, but the rest of the formulas are presented later. The formulas for Degrees of Freedom, Mean Square, and the final calculated F-score are included. There are more cells that should be blank in this version of the ANOVA Summary Table; these are labeled "N/A" in the table.

Table 12.2.2- RM ANOVA Summary Table with Formulas for df, MS, and F

Source	SS	df	MS	F
Between Groups	Formula elsewhere	$k-1$	$\frac{SS_B}{df_B}$	$\frac{MS_B}{MS_W}$
Participants	Formula elsewhere	$P-1$	N/A	N/A
Within Groups (Error)	$SS_{WG} = SS_T - SS_{BG} - SS_P$	$(k-1) \times (P-1)$	$\frac{SS_W}{df_W}$	N/A
Total	Formula elsewhere	$N-1$	N/A	N/A

Degrees of Freedom

- **N** = the number of scores (not the number of participants)
- **Participants df**: The number of participants (subjects) minus 1 ($S-1$).

So, like in a dependent t-test, df is the number of participants minus 1 (not the number of numbers we have). But, confusingly, **N** is the number of scores!

Although we won't be able to do a computation check for the Sums of Squares, we can make sure that Degrees of Freedom are correct: $df_{Total} = df_{BG} + df_P + df_{WG}$

Practicing the ANOVA Summary Table

Let's practice filling in the table if:

- k (number of groups): 3
- P (number of people): 15
- N (number of scores): 45

If you are not provided the number of scores (N), you can figure it out by multiplying the number of groups (k) with the number of people (P) since all people are in all groups.

The Sum of Squares for Between Groups, Participants, and the Total are also provided.

Table 12.2.3- Practice with RM ANOVA Summary Table

Source	SS	df	MS	F
Between Groups	4.42	$k - 1 = 3 - 1 = 2$	Between Groups $\frac{SS}{df} = \frac{4.42}{2} = 2.21$	$F_{calc} = \frac{MS_{BG}}{MS_{WG}}$ $= \frac{2.21}{0.38} = 5.83$
Participants	3.59	$P - 1 = 15 - 1 = 14$	leave blank	leave blank
Within Groups (Error)	$SS_{WG} = SS_T - SS_{BG} - SS_P$ $= 18.63 - 4.42 - 3.59 = 10.62$	$(k - 1) \times (S - 1)$ $= (3 - 1) \times (15 - 1)$ $= 2 \times 14 = 28$	Within Groups $\frac{SS}{df} = \frac{10.62}{28}$ $= 0.38$	leave blank
Total	18.63	$N - 1 = 45 - 1 = 44$	leave blank	leave blank

Make sure to do the Computation Check to make sure that you didn't make a mistake: Total=BG+P+WG

Degrees of Freedom for $BG + P + WG = 2 + 14 + 28$ should equal 44... (It does! We did it correctly!)

What you might have noticed is that we calculated the Sum of Squares for the Participants, but didn't seem to do anything with it. But we actually did! We calculated the average variation of the Participants so that we can account for it in the total variation. That's what we did when we subtracted Sum of Squares for the Participants and the Between Groups from the Total, we were saying that we know that there's a certain amount of variation within each participant, and we are taking it out of our total variation so that our within groups variation (Error) is smaller so that we can see the variation between the groups easier.

Next Steps?

What we we do next? We can compare this calculated F-value to the [critical F-value found in the page](#) from the [chapter on Between Groups ANOVAs](#) (or look for the link in the [Common Critical Value Tables](#) at the back of this book) with the Degrees of Freedom of the numerator (Between Groups MS) and denominator (Within Groups MS) to find the critical F at $p = 0.05$ of 3.34.

Note

Still:

(Critical < Calculated) = Reject null = At least one mean is different from at least one other mean. = $p < .05$

(Critical > Calculated) = Retain null = All of the means are similar. = $p > .05$

So we would reject the null hypothesis, say that at least one mean is different from at least one other mean, and use post-hoc analyses to find out which means differ.

But what we're going to do next is look at the new formula for Sum of Squares for Participants.

Contributors and Attributions

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