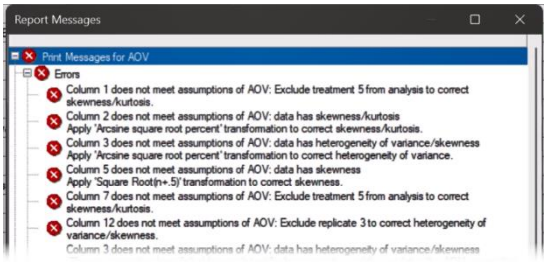
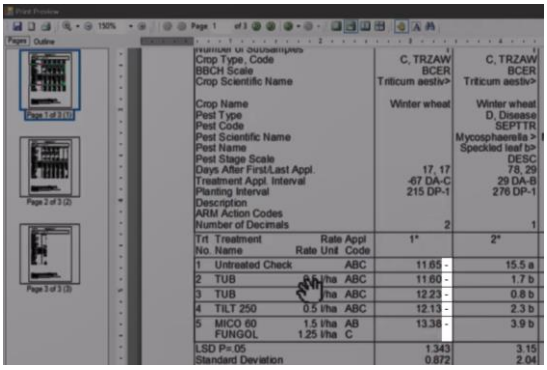
Common Questions: AOV Means Table

The AOV Means Table is the primary report for statistical analysis of a trial in ARM.
In this video, we answer questions that are frequently asked about the AOV report from ARM.

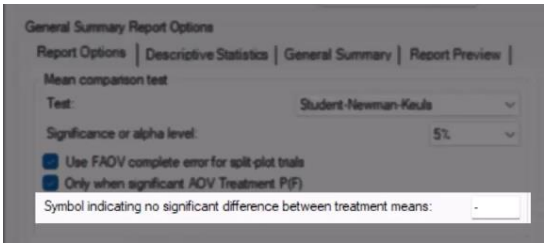


We begin in an example trial with a variety of assessments. Select File > Print Reports and then press Next to generate the report. A window first appears with some details about the analysis that was performed. In this case, the errors that appear are related to the assumptions of AOV. These are from an older tool for data review, where ARM scanned all columns and made recommendations on what actions to take. If you declined those actions, they became errors on this list. These should be just warnings, which we can ignore if we already reviewed the data with Column Diagnostics.



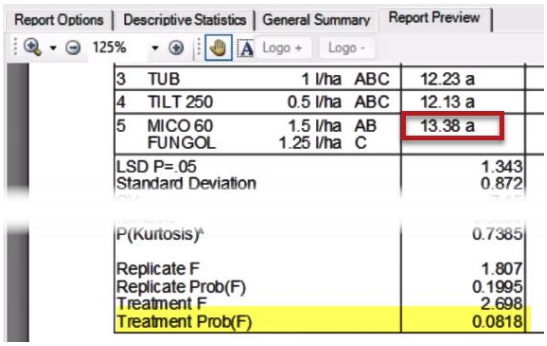
Now select Preview to view the report on-screen. Many of the questions that we receive follow a theme: "Where are my letters?". Significant differences between treatments is typically a desired outcome of a trial, so this does not come as a surprise. However, there are a few things to consider when the analysis does not show significance.

Our first question arises from column 1: Why do I not see any letters at all? Note that there are small dashes in the place where the significance letters typically display.



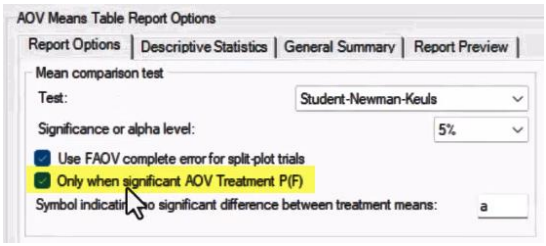
If we go back to the report options, the dashes come from the option "Symbol indicating no significant difference between treatment means". Up to 3 characters can be entered in this box to use in place of significance letters when no separation between treatments exists. Some common alternatives to the dash include: 'NS' for "no significance" or simply an 'A' so that all means have the same letter in common.

Use the Preview tab on this dialog to make it easier to toggle between the options and the report content.

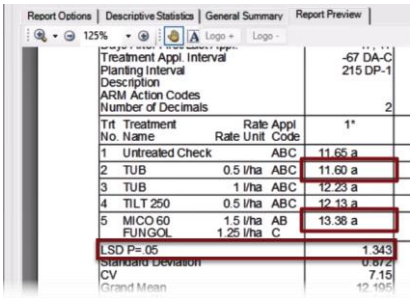


The next question is, why are there no significant differences being reported? After all, treatment 5 appears to have a larger response than the other treatments. To answer this, we need to review the results of the AOV analysis. The Treatment probability of F for this assessment is 0.08, which means we can only be 92% confident that there is at least 1 significant difference among these treatments. But our alpha significance level is set to 5%, establishing that we must be at least 95% confident in order to declare differences to be significant.

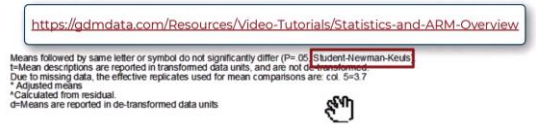
Common Questions: AOV Means Table



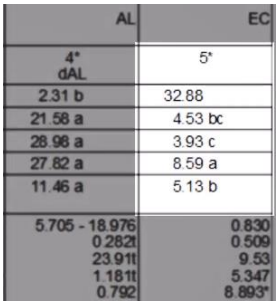
If AOV does not find "any" significance, then should we even bother running a mean comparison test? This is a known as a 'protected' mean comparison test, in an effort to avoid false positives. We can change this behavior by turning off the report option "only when significant AOV Treatment P(F)". Now ARM will perform the mean comparison test, regardless of the AOV results.



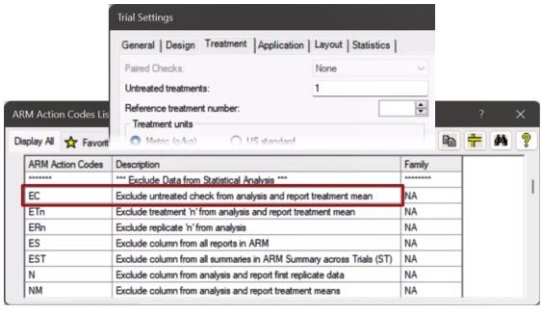
However, this data is set up for one more example, as we still do not see significance! Use the LSD value of 1.34 on the report to manually compare a pair of treatments. Treatment 2 is at 11.6, while treatment 5 is 13.4, with a difference of 1.8. Because this difference is larger than the LSD statistic, we would conclude that there is significance. So why does ARM disagree?



We can find the answer in the footnotes at the bottom of the report. The first footnote lists the alpha level and mean comparison test that was performed, which is Student-Newman-Keuls in this case and not LSD. As discussed in the Statistics Overview video, this SNK test is more conservative than the LSD, reducing the rate of false positives (or Type I error).



Let's move to column 5 for the next question. Here we are missing significance letters only for treatment 1, but the rest of the analysis is present. This is due to the "EC" entered in the ARM Action Codes field for the column, short for "Exclude Check".



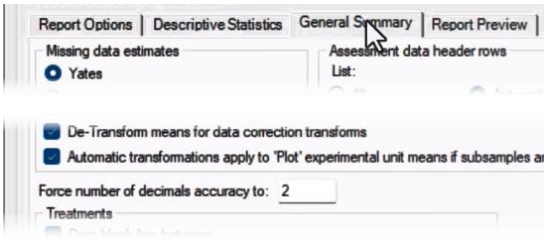
Action Codes are commands given to ARM for the analysis of that specific assessment. In this case, the treatment defined in Settings as the Untreated Check is left out of the analysis entirely, and only the mean is reported for reference.

Also, the action code "ETn" excludes a specified treatment number, where n is replaced by the number. For example, ET3 would hide all of the data for treatment 3 from the analysis of that column. This is not commonly recommended, because it results in lower statistical power, but is used when something goes wrong with a treatment or the check should not be compared with the other products.

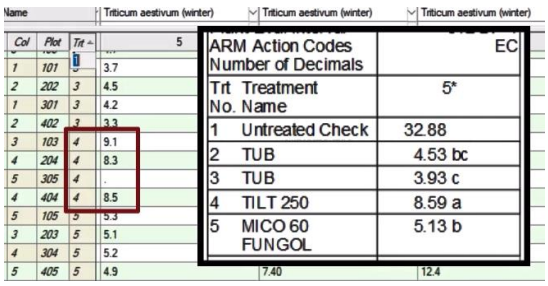
Common Questions: AOV Means Table

Days After First/Last Appl. Treatment Appl. Interval Planting Interval Description ARM Action Codes				17, 17 -67 DA-C 215 DP-1	78, 29 29 DA-B 276 DP-1
Number of Decimals				2	1
Trt No.	Treatment Name	Rate	Rate Unit	Appl Code	1*	2*
1	Untreated Check			ABC	11.65 a	15.5 a
2	TUB	0.5	l/ha	ABC	11.60 a	1.7 b
3	TUB	1	l/ha	ABC	12.23 a	0.8 b
4	TILT 250	0.5	l/ha	ABC	12.13 a	2.3 b
5	MICO 60 FUNGOL	1.5 1.25	l/ha l/ha	AB C	13.38 a	3.9 b
LSD P=.05					1.343	3.15

The assessment header contains the answer to another common question: can I control how many digits are reported? The Number of Decimals field allows you to specify how many decimal places to report for the treatment means, on a per-column basis.

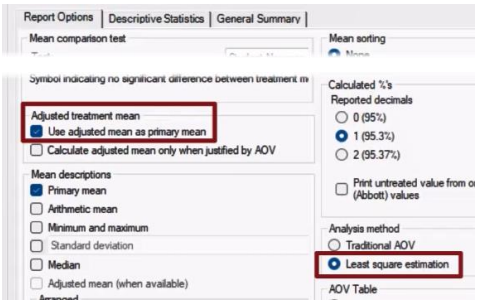


For columns without a Number of Decimals value, ARM uses the report option "Force number of decimals accuracy" found on the General Summary section. If this option is left blank, then ARM reports one more decimal than was contained in the most accurate data point per column.

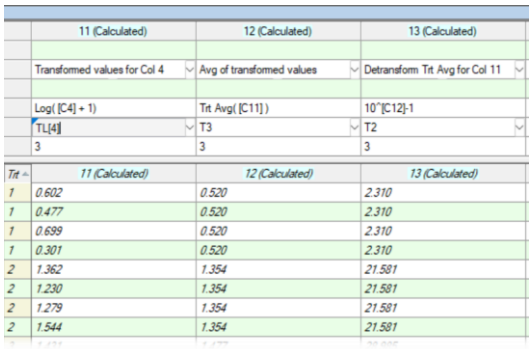


The last question is about the calculation of the means. There are a couple of situations where the mean on the report might not match the hand-calculated average of the assessment values.

The first example is for missing data, like plot 305 here in column 5. The average of the other three values for treatment 4 is 8.63, but ARM reports 8.59 instead.

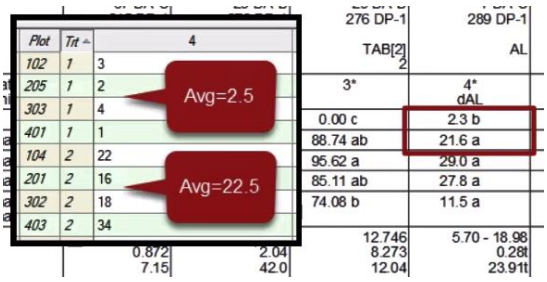


The reason for this difference is that the analysis uses an Adjusted Mean, as part of the Least Squares analysis. Only using 3 values for this treatment but not the others would result in unbalanced data, so we need to adjust the mean in order to fairly analyze this data.

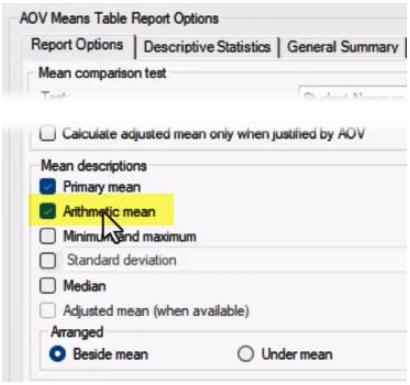


The second situation occurs when there is an automatic data transformation applied, like the logarithm transformation in column 4. During the analysis, the plot values are transformed, and then the AOV is performed on the calculated values. But the "logarithm of percent" is not a simple unit to draw conclusions from!
So ARM "de-transforms" the means using the inverse of the original formula.

Common Questions: AOV Means Table



This creates a weighted mean, which can differ slightly from an average calculated from the raw values, like we see here.



Although this is statistically accurate, if the audience for your report is not statistical in nature, you may also want to display the 'arithmetic' mean from the raw values. This can be added to the report with the Mean Description option, either 'beside' or 'under' the Primary mean.

	29 DA-B 276 DP-1 TAB[2] 2		7 DA-C 289 DP-1 AL	
	3*	A.Mean	4* dAL	A.Mean
0.00 c	0.00		2.3 b	2.5
88.74 ab	88.74		21.6 a	22.5
95.62 a	95.62		29.0 a	33.0
85.11 ab	85.11		27.8 a	29.0
74.08 b	74.08		11.5 a	17.5
12.746			5.70 - 18.98	
8.273			0.28t	
12.04			23.91t	
68.709			1.18t	
1.29			0.792	

Note that when using 'beside', the statistical values are grouped on the left, while the raw means are displayed separately to the right.