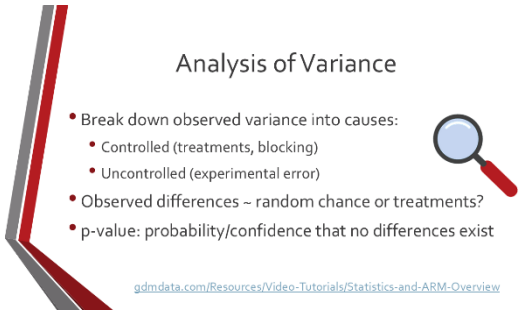
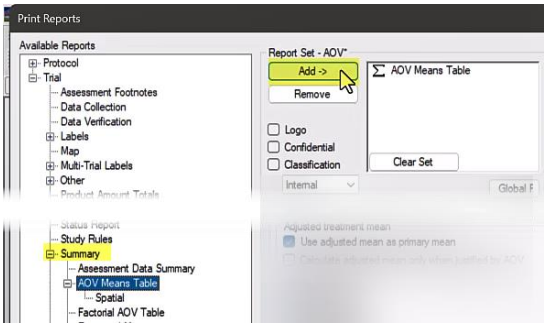
The AOV Report



In this video, we perform analysis of variance in ARM with the AOV Means Table report. Research trials always have variation that comes from a variety of sources. The Analysis of Variance (or AOV) helps us to understand this variation and draw conclusions from the data.

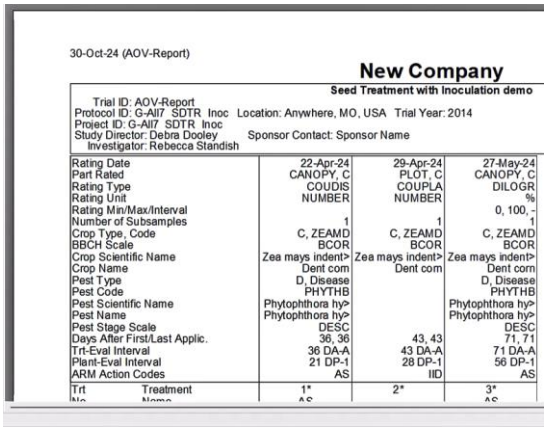
The analysis dissects the variability in the recorded observations. There is 'controlled' variability that comes from the treatment and blocking structures. (The researcher has a hand in determining this, as part of the trial design.) The 'uncontrolled' variability is everything that cannot be controlled, also called the experimental error. The goal is to evaluate whether the observed differences between treatments are due to random chance, or the treatments themselves.

We cover the details of the AOV calculations in part 2 of our statistics overview video. The end result is a p-value, the probability that no differences in treatments exist. We then perform a mean comparison test to understand which treatments differ from each other.



Let's see how this is all put together within ARM.

To perform this analysis on a trial in ARM, first select File, then Print Reports. Under Available Reports, go to the 'Summary" section to select the AOV Means Table. Press Add to place this report in the list of components to generate. Then press Next to run the analysis and generate a report.



30-Oct-24 (AOV-Report)

New Company

Seed Treatment with Inoculation demo

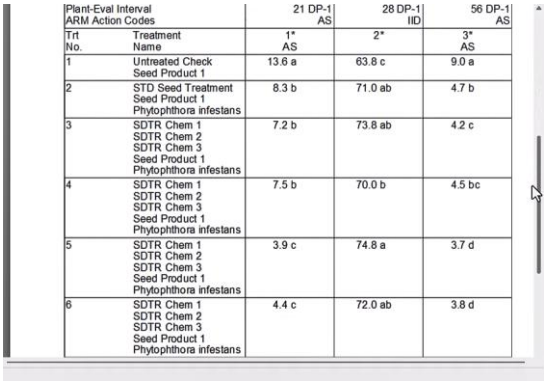
Trial ID: AOV-Report
Protocol ID: G-All7 SDTR Inoc Location: Anywhere, MO, USA Trial Year: 2014
Project ID: G-All7 SDTR Inoc
Study Director: Debra Dooley Sponsor Contact: Sponsor Name
Investigator: Rebecca Standish

Rating Date	22-Apr-24	29-Apr-24	27-May-24
Part Rated	CANOPY, C	PLOT, C	CANOPY, C
Rating Type	COUDIS	COUPLA	DILOGR
Rating Unit	NUMBER	NUMBER	%
Rating Min/Max/Interval			0, 100, -
Number of Subsamples	1	1	1
Crop Type, Code	C, ZEAMD	C, ZEAMD	C, ZEAMD
BBCH Scale	BCOR	BCOR	BCOR
Crop Scientific Name	Zea mays indent>	Zea mays indent>	Zea mays indent>
Crop Name	Dent corn	Dent corn	Dent corn
Pest Type	D, Disease		D, Disease
Pest Code	PHYTHB		PHYTHB
Pest Scientific Name	Phytophthora hy>		Phytophthora hy>
Pest Name	Phytophthora hy>		Phytophthora hy>
Pest Stage Scale	DESC		DESC
Days After First/Last Applic.	36, 36	43, 43	71, 71
Trt-Eval Interval	36 DA-A	43 DA-A	71 DA-A
Plant-Eval Interval	21 DP-1	28 DP-1	56 DP-1
ARM Action Codes	AS	IID	AS
Trt Treatment	1*	2*	3*

Use Print Preview to view the report on the screen. Your company name will appear at the top, along with general header information from the trial.

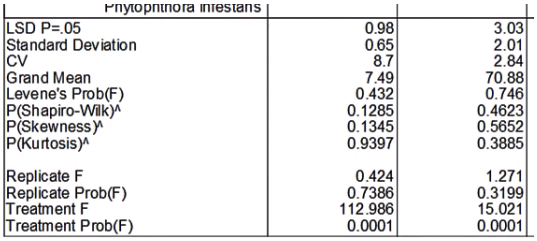
Every rating from the trial is a column in the report table. First we have the header description of each assessment. The Part Rated, Rating Type, and Rating Unit define how the assessment was performed. Details about the crop and pest come next, followed by calculated timing intervals. Add a separate table to the report that describes the codes used in this header by using the "List validation comments" report option.

The AOV Report



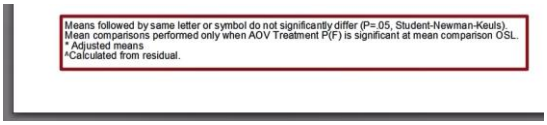
Plant-Eval Interval ARM Action Codes		21 DP-1 AS	28 DP-1 IID	56 DP-1 AS
Trt No.	Treatment Name	1* AS	2*	3* AS
1	Untreated Check Seed Product 1	13.6 a	63.8 c	9.0 a
2	STD Seed Treatment Seed Product 1 Phytophthora infestans	8.3 b	71.0 ab	4.7 b
3	SDTR Chem 1 SDTR Chem 2 SDTR Chem 3 Seed Product 1 Phytophthora infestans	7.2 b	73.8 ab	4.2 c
4	SDTR Chem 1 SDTR Chem 2 SDTR Chem 3 Seed Product 1 Phytophthora infestans	7.5 b	70.0 b	4.5 bc
5	SDTR Chem 1 SDTR Chem 2 SDTR Chem 3 Seed Product 1 Phytophthora infestans	3.9 c	74.8 a	3.7 d
6	SDTR Chem 1 SDTR Chem 2 SDTR Chem 3 Seed Product 1 Phytophthora infestans	4.4 c	72.0 ab	3.8 d

Next in the report are the treatments. The key details from the Treatment editor are included here, with the treatment means for each assessment to the right. Next to the treatment means is the letter result from the means comparison test. Remember that means that do not share a letter in common are considered significantly different.

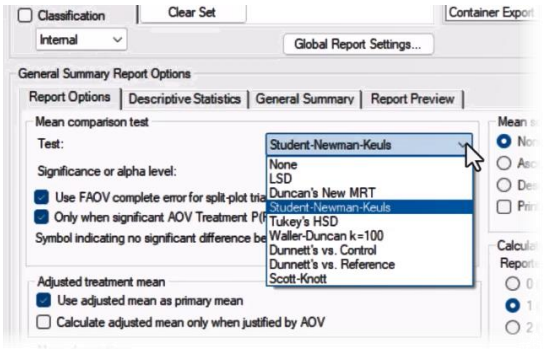


Phytophthora infestans		
LSD P=.05	0.98	3.03
Standard Deviation	0.65	2.01
CV	8.7	2.84
Grand Mean	7.49	70.88
Levene's Prob(F)	0.432	0.746
P(Shapiro-Wilk)^	0.1285	0.4623
P(Skewness)^	0.1345	0.5652
P(Kurtosis)^	0.9397	0.3885
Replicate F	0.424	1.271
Replicate Prob(F)	0.7386	0.3199
Treatment F	112.986	15.021
Treatment Prob(F)	0.0001	0.0001

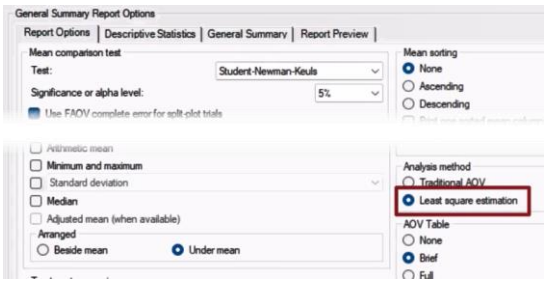
Next on the table are the descriptive statistics, summarizing the entire column. The LSD, Standard Deviation, and CV are commonly included, and we also have the tests for AOV assumptions here. The last section is a brief version of the AOV table that includes just the F statistic and p value for the replicate and treatment sources.



The final component of the AOV report is the list of footnotes at the bottom of the page. These provide important documentation of the analysis options used in the report. The first footnote details the alpha significance level and mean comparison test that was performed. We will use these footnotes to diagnose frequently asked questions about the AOV report in the next video.



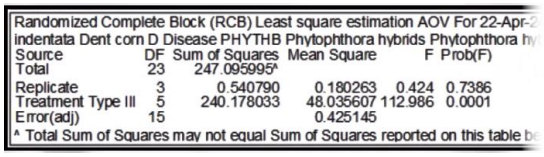
Now let's return to the Print Reports dialog for a look at the report options, which are in the middle of this dialog. Choose the Mean comparison test you wish to use. The top four are the most common and appear in order of most liberal to most conservative.



Choose the significance or alpha level here. Typically this is 5%, but you may need to adjust based on your penalty of failure. More details on these choices can be found in part 3 of our statistics overview video.

Another important choice is the analysis method. GDM recommends 'least square estimation', as it is more sophisticated compared to the Traditional AOV and handles missing data better. An adjusted mean is calculated using a linear regression model to minimize the sum of squared residuals, which is used on the report and in the mean comparisons.

The AOV Report

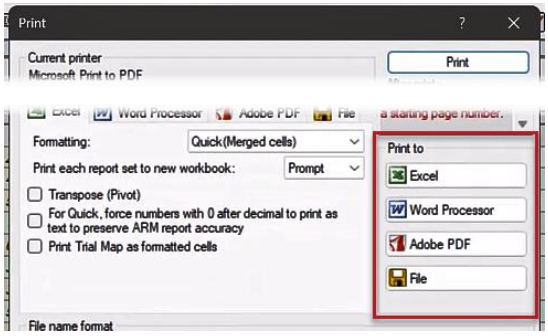


Randomized Complete Block (RCB) Least square estimation AOV For 22-Apr-2
indentata Dent corn D Disease PHYTHB Phytophthora hybrids Phytophthora hy

Source	DF	Sum of Squares	Mean Square	F	Prob(F)
Total	23	247.095995^			
Replicate	3	0.540790	0.180263	0.424	0.7386
Treatment Type III	5	240.178033	48.035607	112.986	0.0001
Error(adj)	15		0.425145		

^ Total Sum of Squares may not equal Sum of Squares reported on this table b

Finally, select how to display the AOV results. We saw the Brief version earlier with just the F and p values. The "full" option prints on a separate page and includes a full AOV table for each assessment, listing the calculations for all sources of variation, including degrees of freedom, sum of squares, mean square, F statistic, and p-value.



A final tip: the Print dialog has options to save the report to a file instead of the printer. The PDF option always matches the preview, although offers fewer additional formatting options after-the-fact. The spreadsheet does not retain the spacing or formatting from the preview, but can be useful to perform additional calculations or graphs from the information in the report.