Open Discussion Topic:
"Potential Pitfalls in the Use of Coefficient of Variation as a Measure of Trial Validity"

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Coefficient of Variation: What we recall.

- The first thing we probably recall about Coefficient of Variation (%CV)
- “If a trial CV is above X do not use the results”
- “If a trial CV is above Y be cautious about the results”
  - Texas A&M AgriLife Crop Testing Program (hybrid & variety trial results): cautions readers if CV > 15%
  - National Sunflower Association: will not publish hybrid trial results if CV > 20%

Coefficient of Variation: What it Is. I

- A measure of spread that describes the amount of variability relative to the mean.
- Because the coefficient of variation is unitless, you can use it instead of the standard deviation to compare the spread of data sets that have different units or different means.

Coefficient of Variation: What it Is. II

- In probability theory and statistics, the **coefficient of variation**, also known as **relative standard deviation**, is a standardized measure of dispersion of a probability distribution or frequency distribution.
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- Often expressed as a percentage, and is defined as the ratio of the standard deviation to the mean.

- The standard deviation is heavily influenced by outliers just like the mean (it uses the mean in its calculation) and leads to high CV.
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- So knowing nothing else about the data, the CV helps us see that even a lower standard deviation doesn't mean less variable data.

Case Study

- An original data set that had a high or “bad” CV
- What factor(s) caused it?
- Of course a “better” data set would fix the problem and then the trial results would be accepted
  - *Or would it?*

Case 1—Original Field Data

Grain Sorghum Hybrid Trial, Hockley Co., Texas (2010)

Company	Hybrid	Block A	Block B	Block C	Block D	Average	StDev
NC+	6B50	1,605	2,010	1,780	1,525	1,730	215
NC+	7C22	2,650	2,820	2,820	2,530	2,705	142
Pioneer	87G57	1,820	1,960	2,135	1,605	1,880	224
Pioneer	85G46	2,500	2,605	2,745	2,330	2,545	175
Pioneer	85G85	2,065	2,190	2,305	2,080	2,160	112
Richardson	9200Y	1,600	2,015	1,770	1,695	1,770	178
Richardson	Sprint II	1,420	1,770	1,765	1,405	1,590	205
Frontier	303C	2,100	2,340	2,265	1,955	2,165	172
Sorgh Partners	KS 585	2,400	2,640	2,550	2,310	2,475	148
Sorgh Partners	KS310	1,080	1,405	1,360	1,115	**1,240**	166
Dekalb	DK-44	2,730	3,010	2,925	2,695	**2,840**	152
Dekalb	37-07	2,135	2,400	2,255	2,010	2,200	167
	Blk Avg	2,009	2,264	2,223	1,938	2,108	171
			P-Hybrid	<0.0001			
			PLSD	105	(0.05)		
			%CV	**23.3**			

Case 2—What if the Data were "Better"

Less variability within an individual treatment's replications

Company	Hybrid	Block A	Block B	Block C	Block D	Average	StDev
NC+	6B50	1,705	1,910	1,680	1,625	1,730	125
NC+	7C22	2,750	2,720	2,720	2,630	2,705	52
Pioneer	87G57	1,920	1,860	2,035	1,705	1,880	137
Pioneer	85G46	2,600	2,505	2,645	2,430	2,545	96
Pioneer	85G85	2,165	2,090	2,205	2,180	2,160	49
Richardson	9200Y	1,700	1,915	1,670	1,795	1,770	110
Richardson	Sprint II	1,520	1,670	1,665	1,505	1,590	90
Frontier	303C	2,200	2,240	2,165	2,055	2,165	79
Sorgh Partners	KS 585	2,500	2,540	2,450	2,410	2,475	57
Sorgh Partners	KS310	1,180	1,305	1,260	1,215	**1,240**	54
Dekalb	DK-44	2,830	2,910	2,825	2,795	**2,840**	49
Dekalb	37-07	2,235	2,300	2,155	2,110	2,200	84
	Blk Avg	2,009	2,264	2,223	1,938	2,108	171
			P-Hybrid	<0.0001			
			PLSD	105	(0.05)		
			%CV	**22.4**			

Case 3—What if the Data were "Perfect"?

No variability within an individual treatment's replications

Company	Hybrid	Block A	Block B	Block C	Block D	Average	StDev
NC+	6B50	1,730	1,730	1,730	1,730	1,730	0
NC+	7C22	2,705	2,705	2,705	2,705	2,705	0
Pioneer	87G57	1,880	1,880	1,880	1,880	1,880	0
Pioneer	85G46	2,545	2,545	2,545	2,545	2,545	0
Pioneer	85G85	2,160	2,160	2,160	2,160	2,160	0
Richardson	9200Y	1,770	1,770	1,770	1,770	1,770	0
Richardson	Sprint II	1,590	1,590	1,590	1,590	1,590	0
Frontier	303C	2,165	2,165	2,165	2,165	2,165	0
Sorgh Partners	KS 585	2,475	2,475	2,475	2,475	2,475	0
Sorgh Partners	KS310	1,240	1,240	1,240	1,240	**1,240**	0
Dekalb	DK-44	2,840	2,840	2,840	2,840	**2,840**	0
Dekalb	37-07	2,200	2,200	2,200	2,200	2,200	0
	Blk Avg	2,108	2,108	2,108	2,108	2,108	0
			P-Hybrid	<0.0001			
			PLSD	105	(0.05)		
			%CV	**?????**			

Case 3—What if the Data were "Perfect"?

No variability within an individual treatment's replications

Company	Hybrid	Block A	Block B	Block C	Block D	Average	StDev
NC+	6B50	1,730	1,730	1,730	1,730	1,730	0
NC+	7C22	2,705	2,705	2,705	2,705	2,705	0
Pioneer	87G57	1,880	1,880	1,880	1,880	1,880	0
Pioneer	85G46	2,545	2,545	2,545	2,545	2,545	0
Pioneer	85G85	2,160	2,160	2,160	2,160	2,160	0
Richardson	9200Y	1,770	1,770	1,770	1,770	1,770	0
Richardson	Sprint II	1,590	1,590	1,590	1,590	1,590	0
Frontier	303C	2,165	2,165	2,165	2,165	2,165	0
Sorgh Partners	KS 585	2,475	2,475	2,475	2,475	2,475	0
Sorgh Partners	KS310	1,240	1,240	1,240	1,240	**1,240**	0
Dekalb	DK-44	2,840	2,840	2,840	2,840	**2,840**	0
Dekalb	37-07	2,200	2,200	2,200	2,200	2,200	0
	Blk Avg	2,108	2,108	2,108	2,108	2,108	0
			P-Hybrid	<0.0001			
			PLSD	105	(0.05)		
			%CV	**22.2**			

Case 4—Higher Absolute Yields

Same differences between reps & treatments, but ~2X yields

Company	Hybrid	Block A	Block B	Block C	Block D	Average	StDev
NC+	6B50	3,605	4,010	3,780	3,525	3,730	215
NC+	7C22	4,650	4,820	4,820	4,530	4,705	142
Pioneer	87G57	3,820	3,960	4,135	3,605	3,880	224
Pioneer	85G46	4,500	4,605	4,745	4,330	4,545	175
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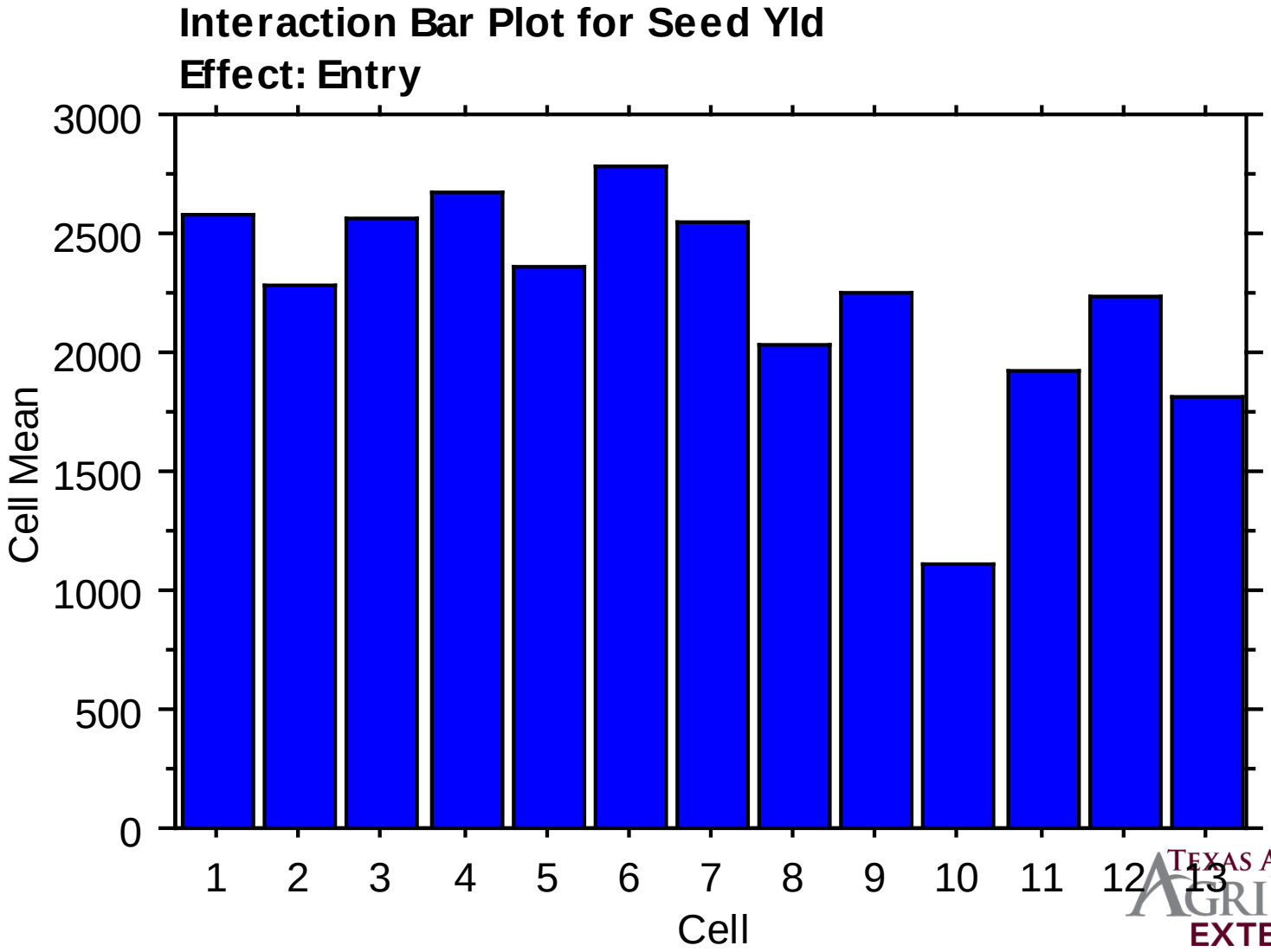
Dekalb	37-07	4,135	4,400	4,255	4,010	4,200	167
	Blk Avg	4,009	4,264	4,223	3,938	4,108	171
			P-Hybrid	<0.0001			
			PLSD	105	(0.05)		
			%CV	**12.0**			

One Low Yielding Sunflower Hybrid

Mean 2,240 lbs./A, Sd = 464, CV = 20.7%



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One Low Yielding Sunflower Hybrid

Mean 2,240 lbs./A, Sd = 464, CV = 20.7%

- If the low (or high) yielding hybrid is removed from the data set:

- Mean 2,336 lbs./A, Sd = 337, CV = 14.4%

- **What to do?** Clearly one entry is skewing your assessment of the validity/reliability of the trial's data

How to Handle These Situations?

- Are there other measures or “tests” that can inform us about CVs?
- Levene’s F test for CVs?
- The standard deviation is heavily influenced by outliers just like the mean (it uses the mean in its calculation), which leads to high CV.

- Bottom Line: If %CV is “high” don’t automatically dismiss it (throw it out), **but examine the data**. Find out why the CV may be high.