

It's Significant to Me!

Making Sense of Agricultural Variability, Statistics, and On-Farm Research

Dr. Jeff Miller – Miller Research LLC

Dr. Bryan Hopkins – BYU-Provo



ONLY \$1.25

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Accessed at <http://abowfullofhappiness.blogspot.com/p/sea-monkey-art.html>

HOLIDAY PICTURES

EXPECTATION VS. REALITY



From
Gathermoms.com

MCDONALDS BIG MAC

ADVERTISEMENTS

ACTUAL BIG MAC

- ROTATED TO MOST ATTRACTIVE ANGLE

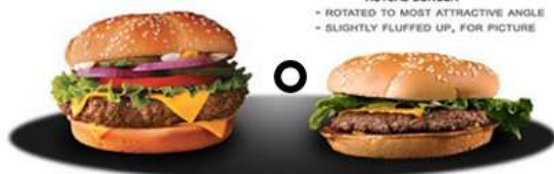


MCDONALDS ANGUS DELUXE TP

ADVERTISEMENTS

ACTUAL BURGER

- ROTATED TO MOST ATTRACTIVE ANGLE
- SLIGHTLY FLUFFED UP, FOR PICTURE



BURGER KING WHOPPER

ADVERTISEMENTS

ACTUAL WHOPPER

- ROTATED TO MOST ATTRACTIVE ANGLE
- WITH CHEESE
- SLIGHTLY FLUFFED UP, FOR PICTURE



TACO BELL CRUNCHY TACO

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ACTUAL TACO



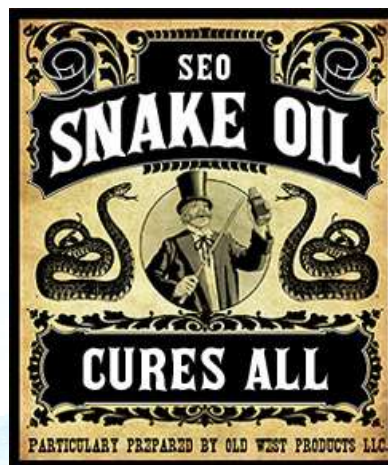
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Choices in Agricultural Products

- Fertilizers
- Pesticides
- Adjuvants
- Equipment modifications
- Water conditioners
- “Snake Oil”



“Real World” Example – Small Plot Research

Treatment	Cwt/acre
Grower standard practice	612
Miller’s Marvelous Masterpiece	626

- MMM provided an increase of 14 cwt/acre.
- Contract price = \$8.00/cwt
- Gross increase = \$112/acre
- MMM only costs \$30/acre
- \$82/acre net gain (2.7x return on investment)

What if I told you the yield difference was “not significant?”



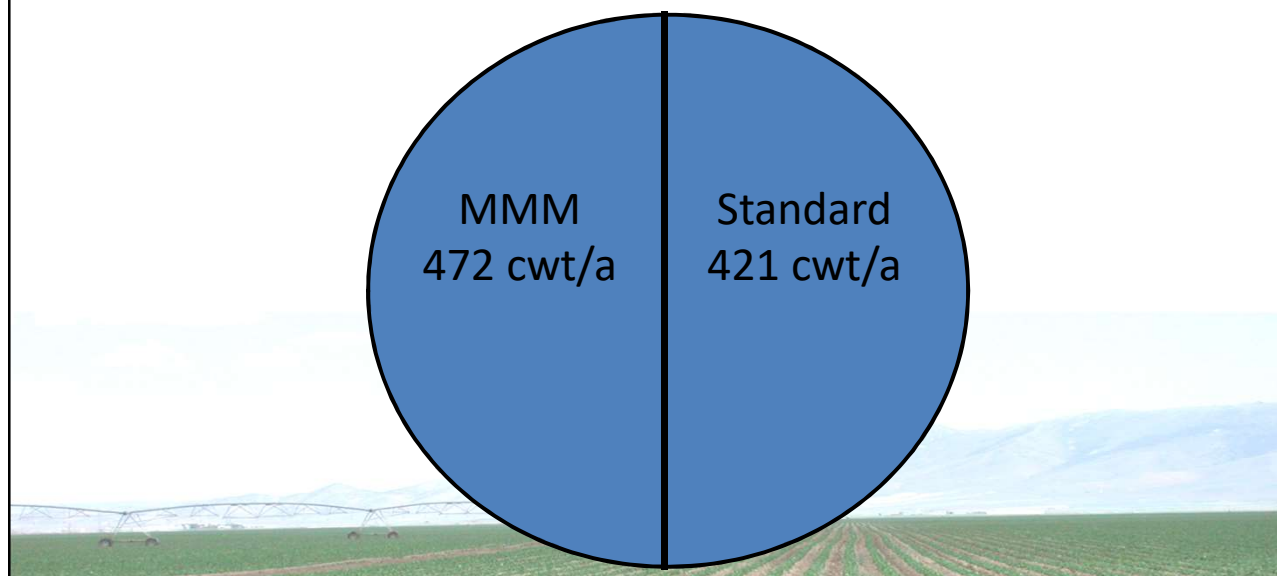
What if I told you the yield difference was “not significant?”

- “A 3% difference may not be significant to you, but it is significant to the grower.”
- “Small plots aren’t the real world.”

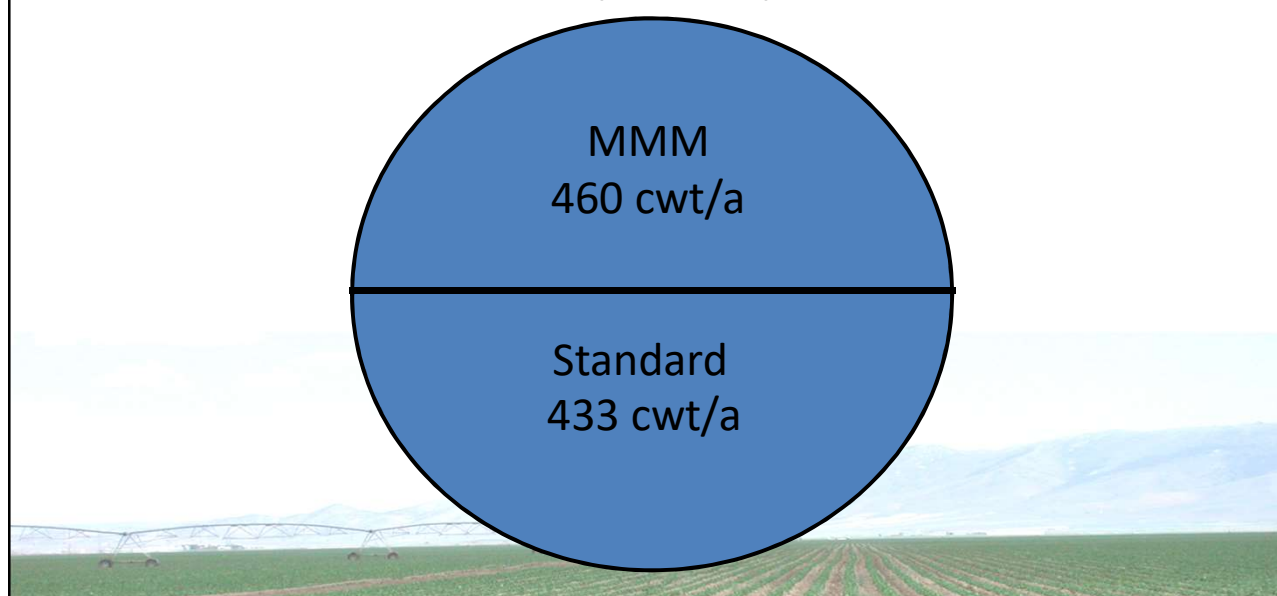
Are these objections valid?



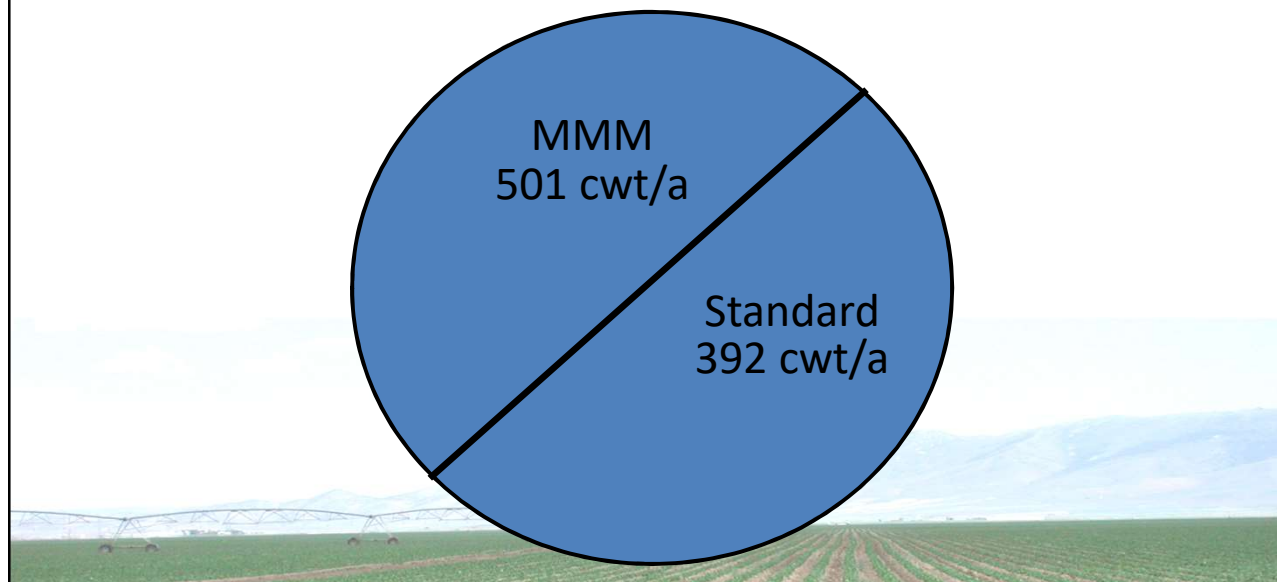
“Real World Example” – Split Pivot Trial #1



“Real World Example” – Split Pivot Trial #2

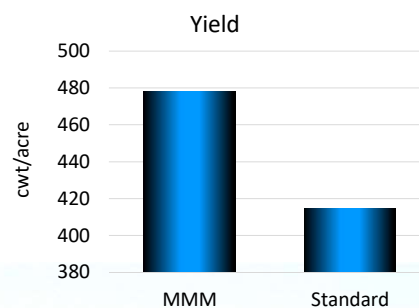


“Real World Example” – Split Pivot Trial #3



Summary of “Real World” Split Pivots (Yield in cwt/acre)

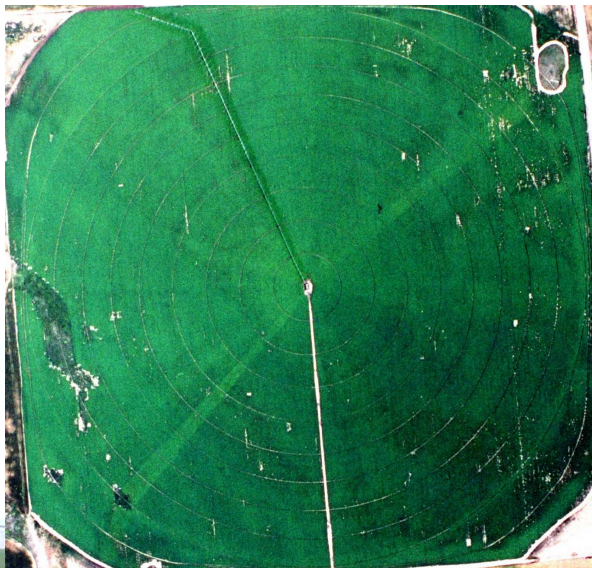
	MMM	Standard
Pivot 1	472	421
Pivot 2	460	433
Pivot 3	501	392
Average	478	415
Benefit	+63 sacks	



Have I convinced you to invest money for Millers Marvelous Masterpiece?
Does it appear legitimate, or is it a “snake oil?”

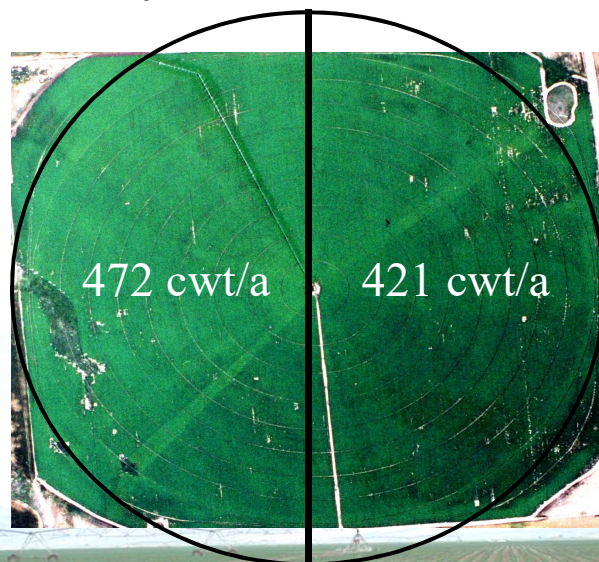


All three “trials” were the same pivot.

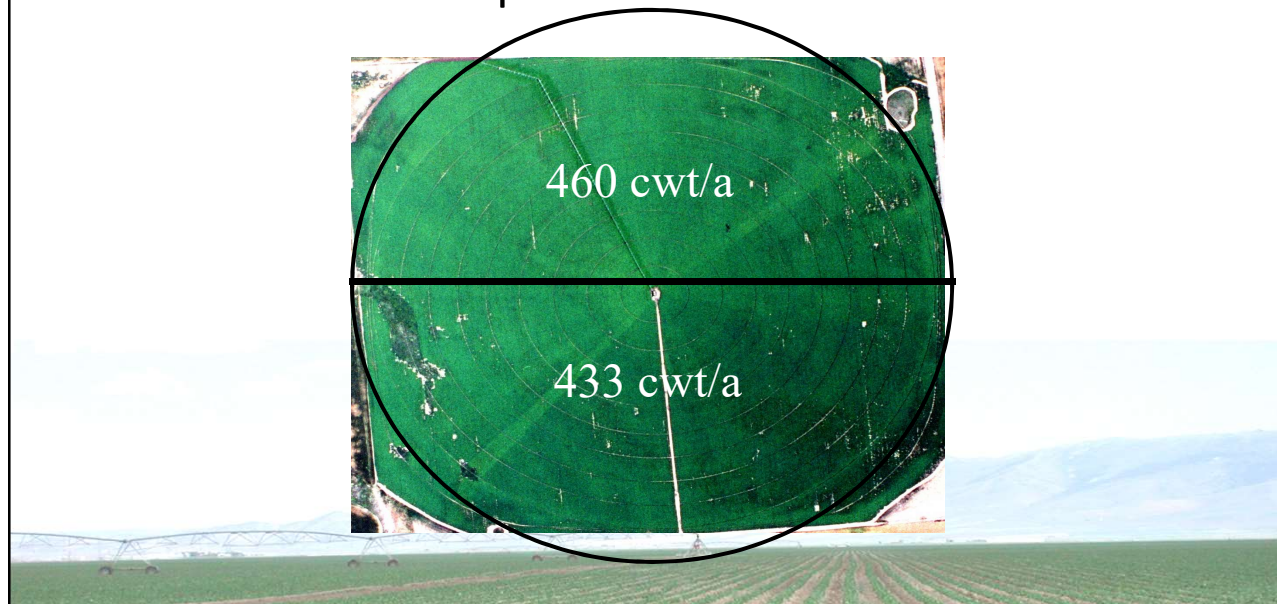


The halves of the field were
“all treated the same.”

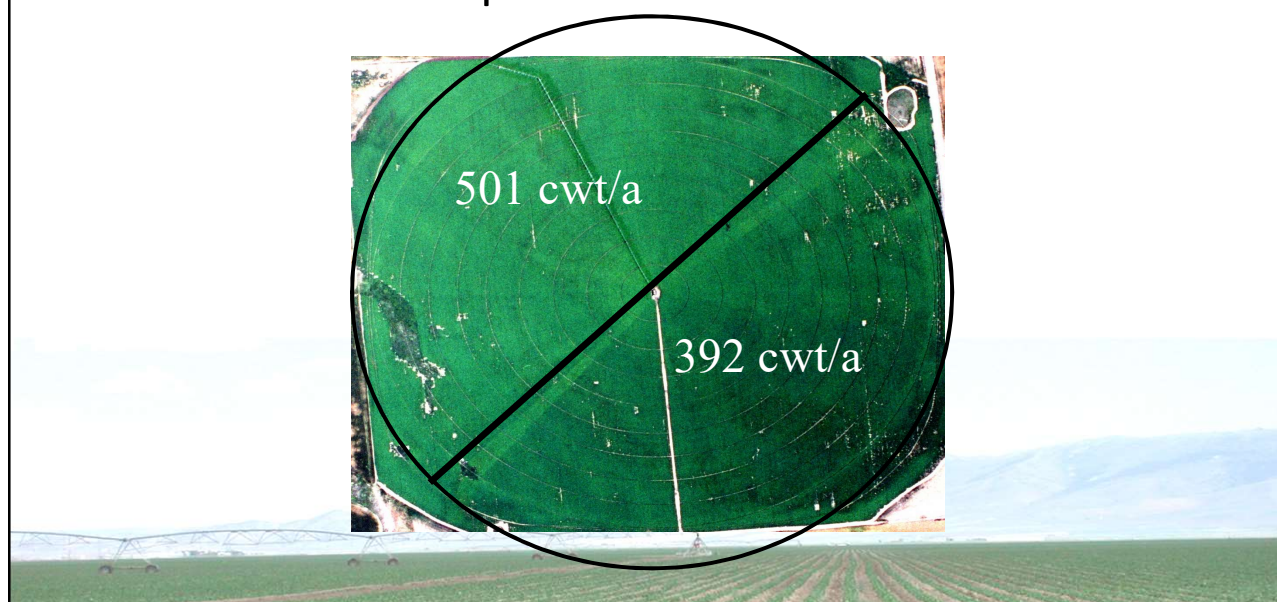
Split Pivot Trial #1



Split Pivot Trial #2



Split Pivot Trial #3



So why was one side better than the other?

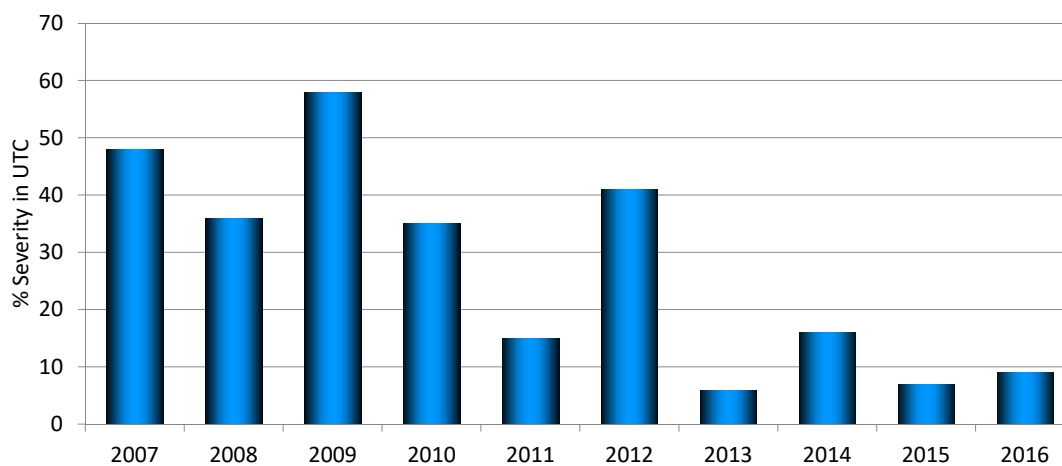
- Soil fertility
- Soil type
- Soil compaction
- Slope
- Field micro-climate
- Moisture holding capacity
- Pests
- Water relations
- Cultural practices
- Field history
- **Natural variation**

Can you ever have a situation where “everything is the same?”



Effect of Year on Rhizoctonia Severity

Russet Burbank; 3-year rotation; non-inoculated



Environment and/or seed has a large effect.

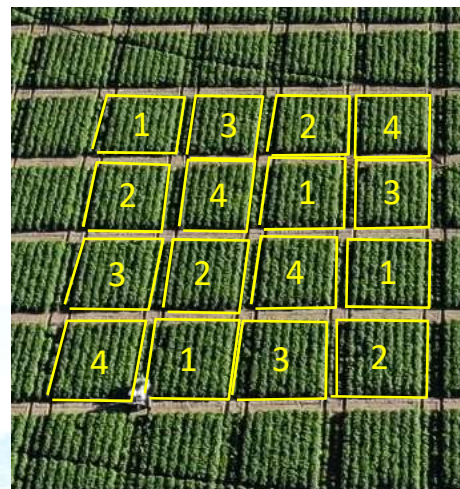
So how can you know if something you do will consistently and repeatedly make a difference?

Or in other words,
Do I spend the money?



Use of Replicated Research Data

- Aim for uniform samples:
 - Small plots
 - Assign treatments randomly
 - Replication
- Eliminate bias
 - Evaluate “blindly”
- Consistency over time
 - 1 year vs multiple years



What do Statistics have to do with this?

- Making sense of numbers so that good decisions can be made.
- Examples
 - Medical studies = release of new drugs
 - Sports
 - Marriott Hotels – Courtyard by Marriott
 - Coca Cola – new formulation in 1985



Adapted from Donnelly, 2007, "The Complete Idiot's Guide to Statistics"

Statistical Differences

- Do the data from my sample support my conclusions?
- No statistical difference \neq no difference
 - = The evidence does not support claiming there is a difference.



“Real World” Example

Treatment	Total Yield
Grower standard practice	612
Miller’s Marvelous Masterpiece	626

- MMM provided an increase of 14 cwt/acre.
- Contract price = \$8.00/cwt
- Gross increase = \$112/acre
- MMM only costs \$30/acre
- \$82 net gain (2.7x return on investment)

“Real World” Example with Statistics

Treatment	Total Yield
Grower standard practice	612
Miller’s Marvelous Masterpiece	626
Mean	619
Standard Deviation	29.80
Least Significant Difference (0.10)	49.58
Treatment Probability (F)	0.5461

“Real World” Example with Statistics

	Standard	MMM
Rep 1	583	623
Rep 2	649	607
Rep 3	605	612
Rep 4	609	662
Mean	612	626

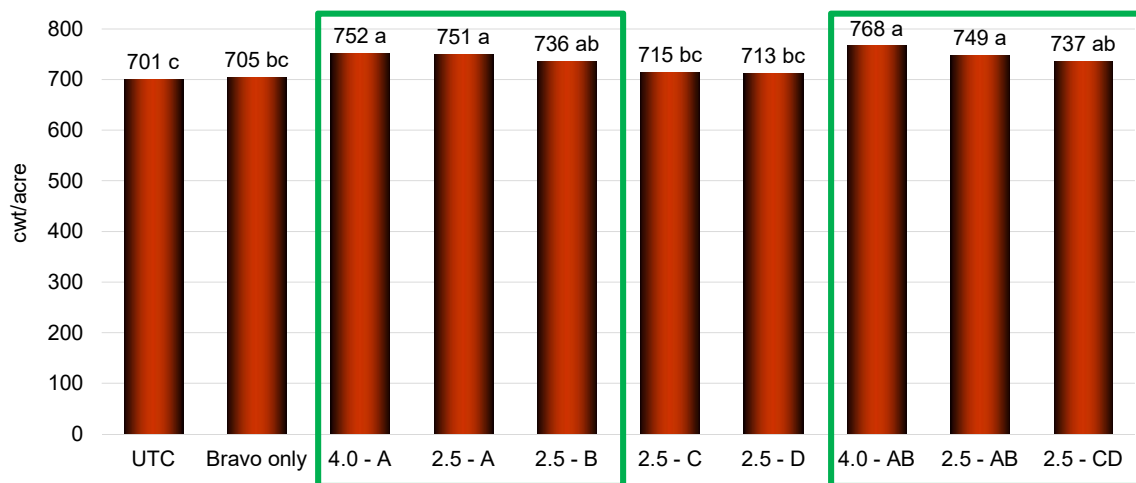
“Real World” Example #2

Treatment	Total Yield
Grower standard practice	612 b
Miller’s Marvelous Masterpiece	626 b
Tried and True Formula #1	674 a
Mean	637
Standard Deviation	32.81
Least Significant Difference (0.10)	45.08
Treatment Probability (F)	0.0783

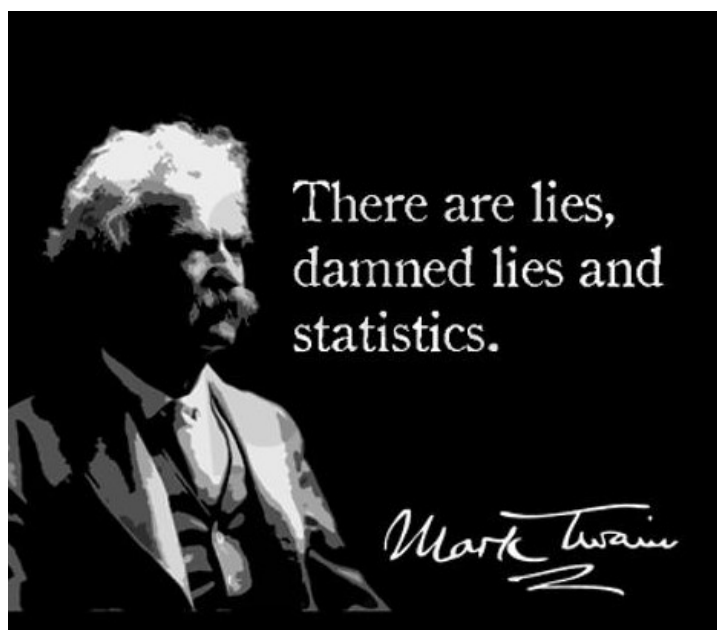
What do those small letters mean?

- Same letter = evidence does not support a difference.
- Different letter = evidence supports a true difference.

Quash Rate and Timing on Total Yield

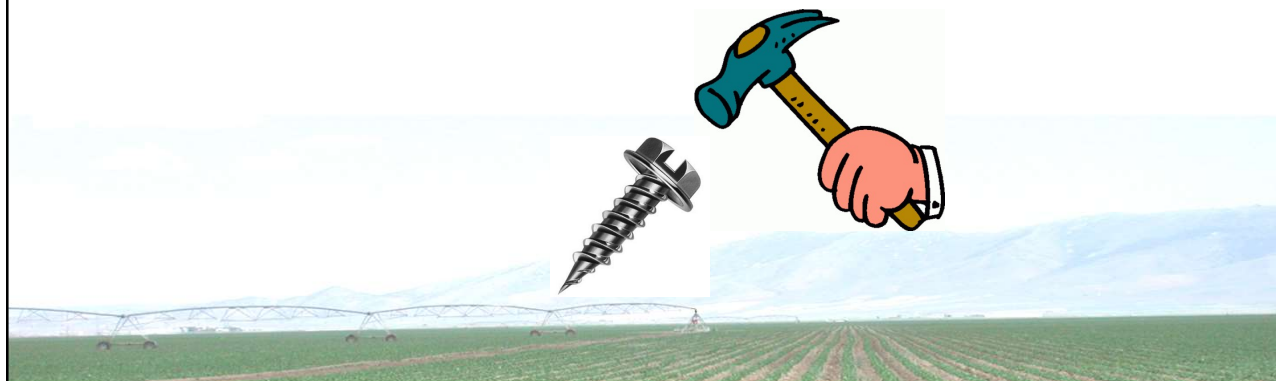


All treatments (except UTC) received Bravo WS each application.

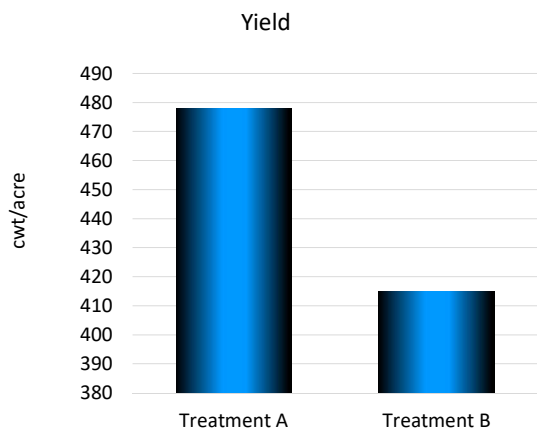


Statistics can be misused!

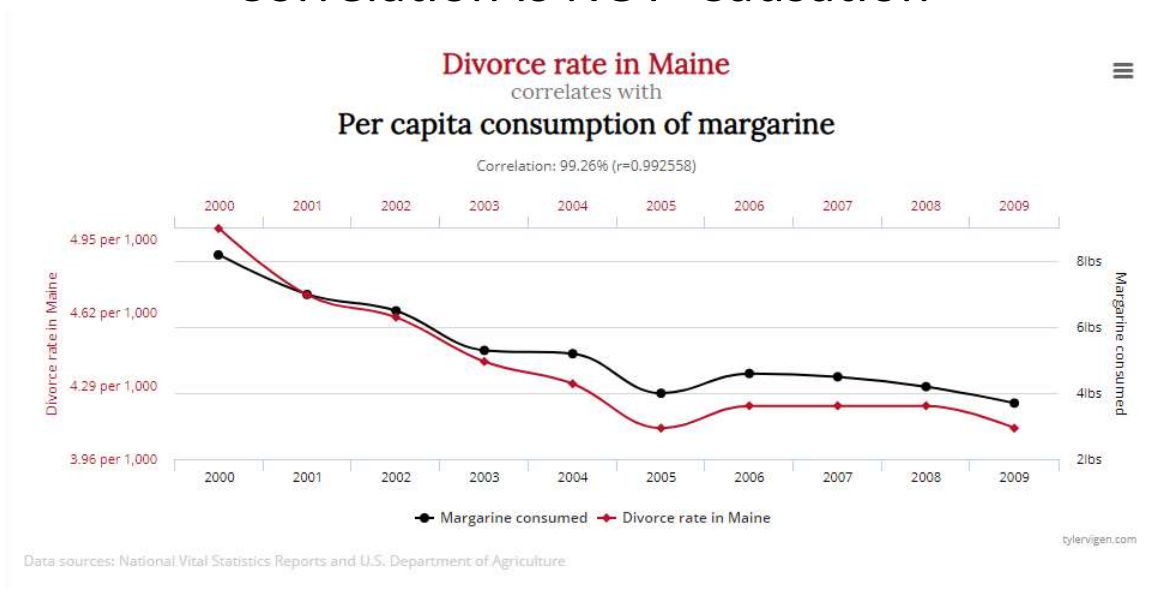
- Biased sampling – Not representative of population
- Reporting of only positive results



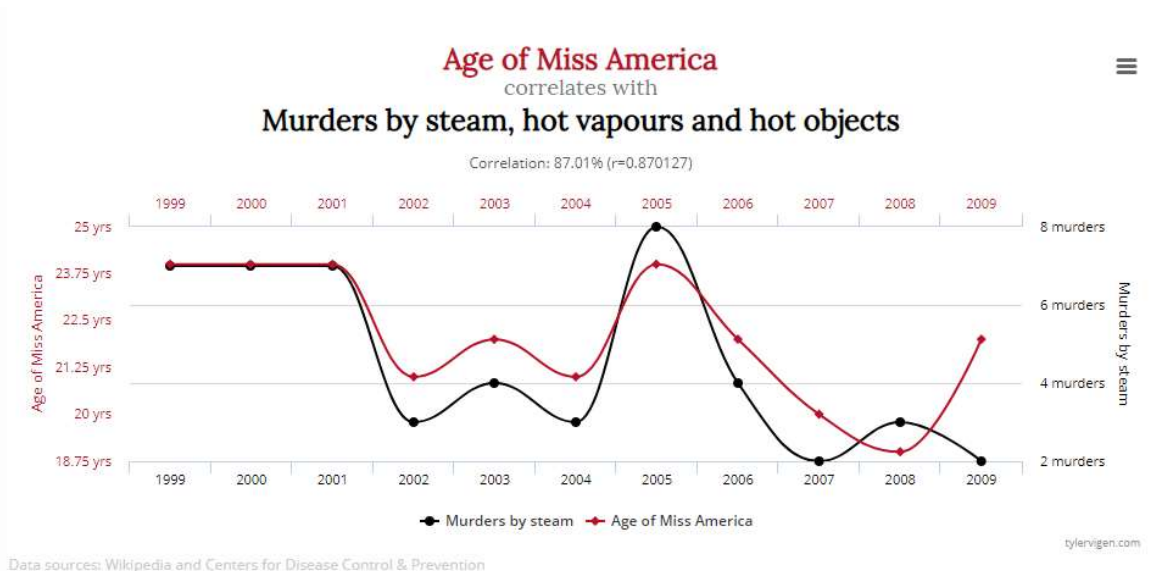
Deceptive Graphing



Correlation is NOT Causation



Correlation is NOT Causation



The Psychology of Sunk Cost

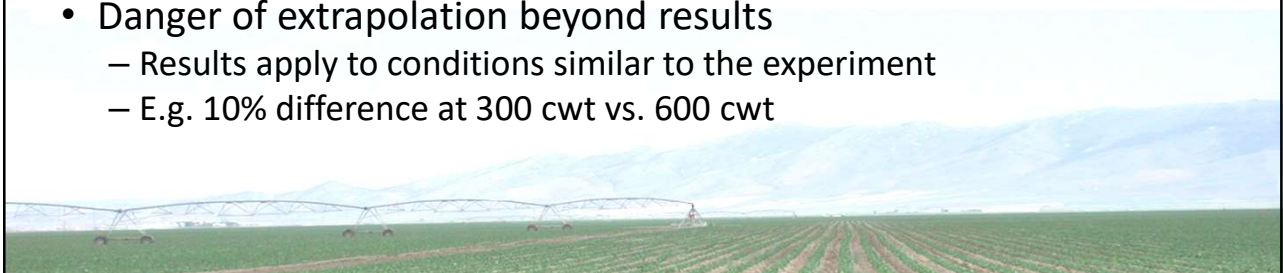
Arkes and Blumer, 1985, Organizational Behavior and Human Decision Processes 35:124-120

- The tendency to maintain an endeavor once an investment of time, money, or effort has been made.
 - Desire not to appear wasteful
 - Overly optimistic bias on probability of success
 - “Too much invested to quit (or stop)” (e.g. sitting through a bad movie)
- Just because somebody is doing something, it doesn’t mean it works.



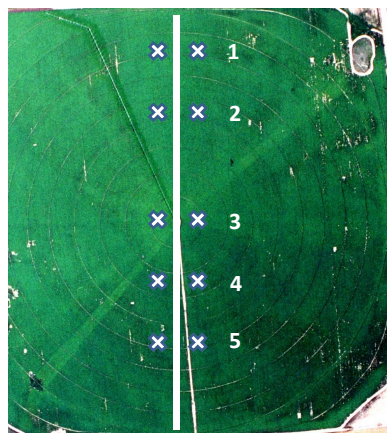
Moving Scientific Results to the “Real World”

- Danger of testimonials
 - Was there an adequate control or check?
 - Was there another reason (e.g. conflict of interest) that could influence the testimonial?
- What is the “real world”?
- Danger of extrapolation beyond results
 - Results apply to conditions similar to the experiment
 - E.g. 10% difference at 300 cwt vs. 600 cwt



Can you do this with a split field?

- More difficult
- Paired samples
- Potential problems
 - Plugged planter nozzle
 - Maintenance app skip
 - Poor sample selection
 - (e.g. Site 3)
- May be easier to apply the treatment.



Disclaimer

- Some disease management practices will not have a measureable ROI.
 - Disease pressure is not uniform from year to year
 - Late blight protection
- Some practices should be viewed as an insurance policy.



So do I spend the money?

- Look at reputable data – does it support the claims?
- Be wary of testimonials – are they only sharing the good ones?
- “It has been tested by the _____” – but what were the results?
- Photographs do not count as data!
- If no data are available, do your own testing.
 - Consult with a researcher to ensure your test is set up properly.
- If it's too good to be true...



Everyone else needs data!

