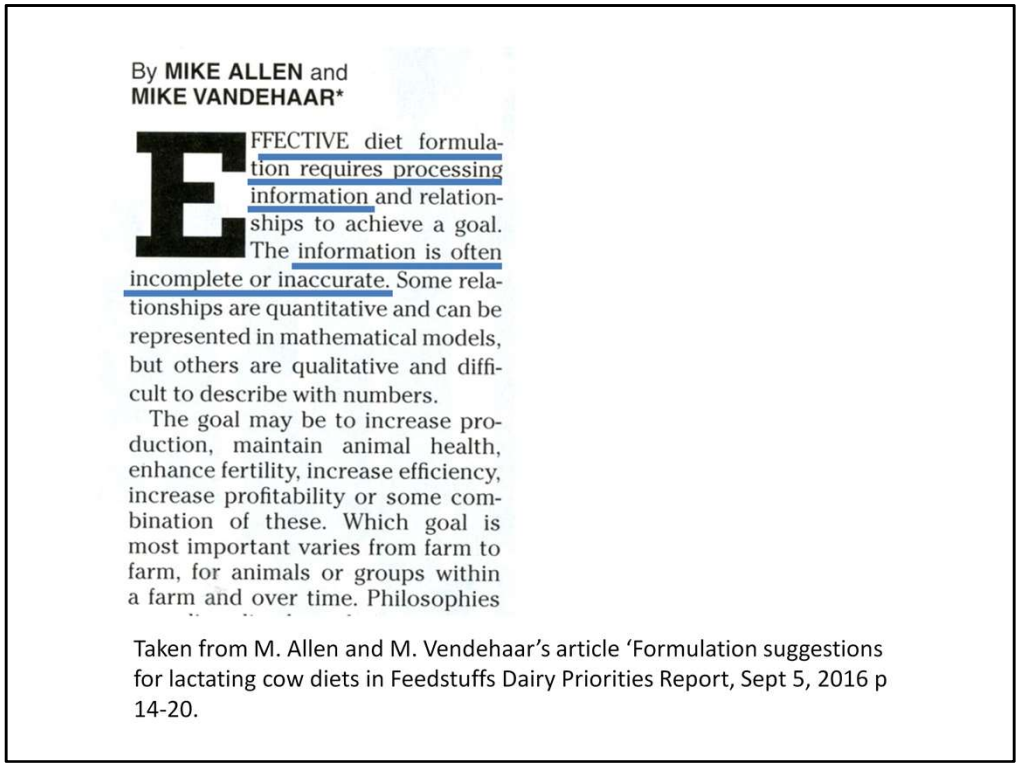
Appropriate and Inappropriate Sources of Information (interpreting data)

Shane Gadberry
sgadberry@uaex.edu
Associate Professor – Beef Cattle
University of Arkansas

Decision-making has a process

Client	Extension Errors
Problem identified	Do we collect enough information to determine the problem is accurately and completely described?
Identify a solution	
Collect data/information	**Do we have the right data to formulate a recommendation?**
Analyze the options and make a decision	
Implement	Do we follow-up to determine if our recommendation was implemented?
Monitor and evaluate	Do we monitor and evaluate the response to our recommendations?
Accept responsibility	

This slide highlights the importance of when clients come to us for information, we need to make sure we do not proceed with a recommendation without having accurate information which includes accurate information about a possible solution but also ask appropriate questions to make sure the problem is completely and accurately described. When possible, try to follow-up regarding adoption and success/failure of the change.



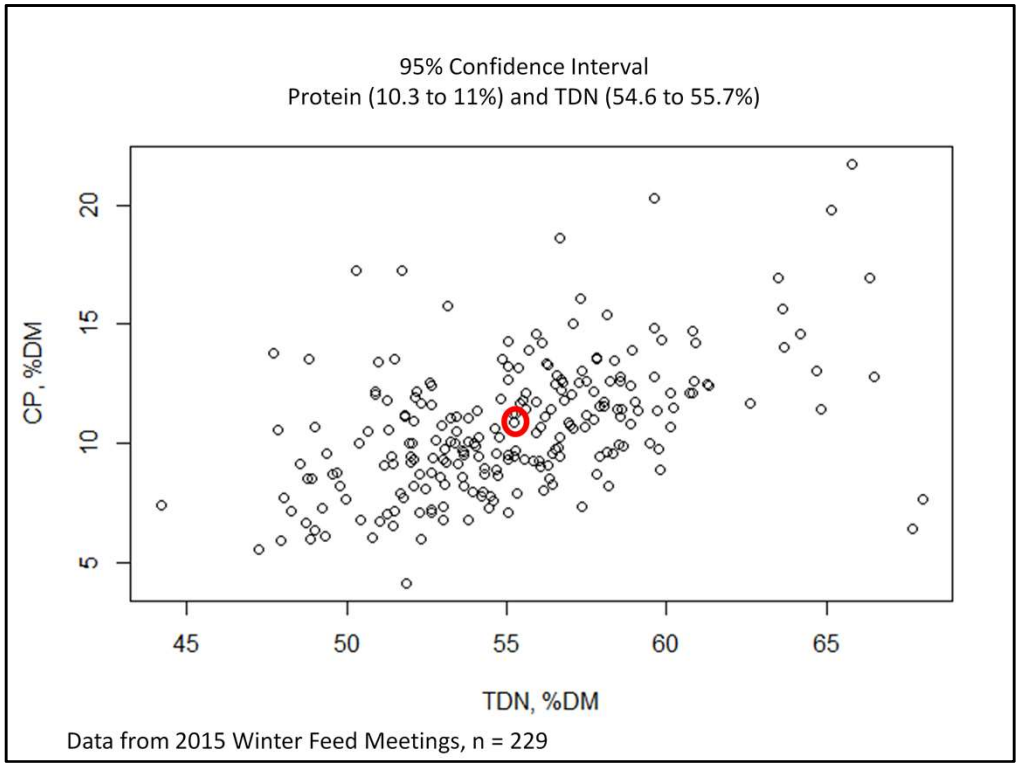
By **MIKE ALLEN** and
MIKE VANDEHAAR*

EFFECTIVE diet formulation requires processing information and relationships to achieve a goal. The information is often incomplete or inaccurate. Some relationships are quantitative and can be represented in mathematical models, but others are qualitative and difficult to describe with numbers.

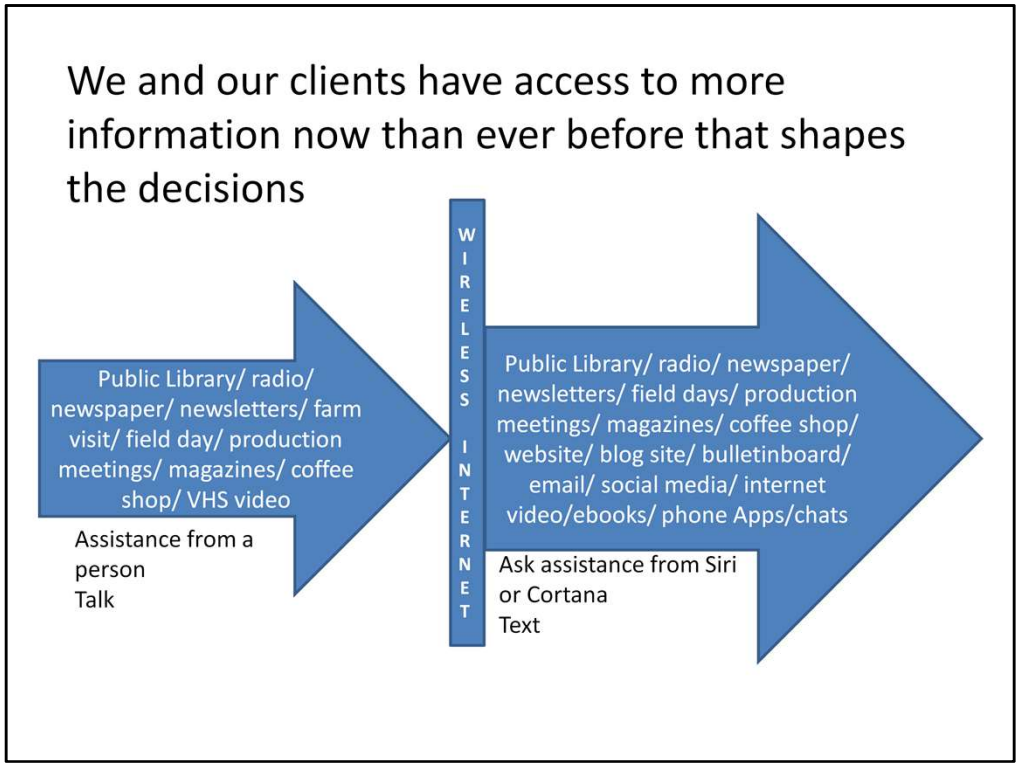
The goal may be to increase production, maintain animal health, enhance fertility, increase efficiency, increase profitability or some combination of these. Which goal is most important varies from farm to farm, for animals or groups within a farm and over time. Philosophies

Taken from M. Allen and M. Vendehaar's article 'Formulation suggestions for lactating cow diets in Feedstuffs Dairy Priorities Report, Sept 5, 2016 p 14-20.

This slide reiterates the point that information can be incomplete or inaccurate

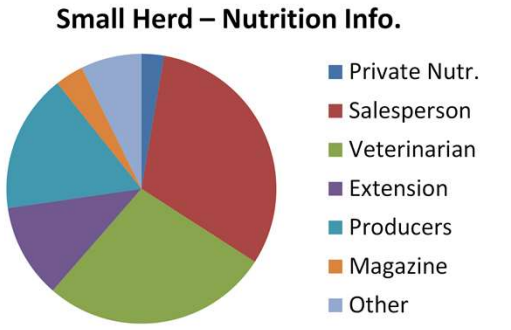


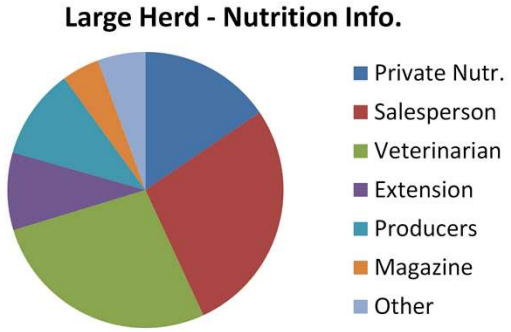
This slide gives an example of inaccurate and incomplete information. The data is taken from forage samples among 8 counties with 6 to 8 ranches per county participating in a winter feed meeting one-on-one consultation exercise in Arkansas. The red circle represents the combined average of CP and TDN among those hay samples and the 95% confidence interval is calculated. How many times are clients asking for assistance with supplemental feed recommendations and the information they give regarding the hay is "it's average quality" or "it's fertilized" . Most of the 229 samples do not represent average quality.



The challenge today is our clients and ourselves have access to many new sources for information and information is accessible any time and nearly anywhere

We are a resource to the people working on behalf of state and federal government in cooperation with the US Dept of Agriculture to disseminate and demonstrate useful and practical application of research knowledge.





Source: USDA. 2008. Beef 2007-08, Part 1. Reference of Beef Cow-calf Management Practices in the United Staes, 2007-08.

These pie charts illustrate that extension represents a small share of information; yet among these sources, ours should be the most unbiased and is supposed to research based.

- Our information should differ
  - Ethical
  - Evidence based
  - Scrutinized for integrity
  - Interpreted correctly
  - Appropriate for the conditions to which it will be applied

The information we gather needs to be filtered.

Evidence based

Perception ≠ Reality

White & Gold
Blue & Black
Blue & Gold

Remember – perception is not reality. A prime example could be with steroidal growth implants whereby the EU banned the use of and imports of meats from livestock that have been administered growth promoting implants. The basis was the 'precautionary principle'. While there was no scientific evidence to support the ban in association with products that were approved for use at the time of the ban, perception that there were unforeseeable safety concerns provided for the ban. Similarly, when someone tries something new and they are hoping for a benefit, they may 'see benefit' that does not exist . This is the reason why we need research studies to test ideas and confirm their benefit or lack thereof.

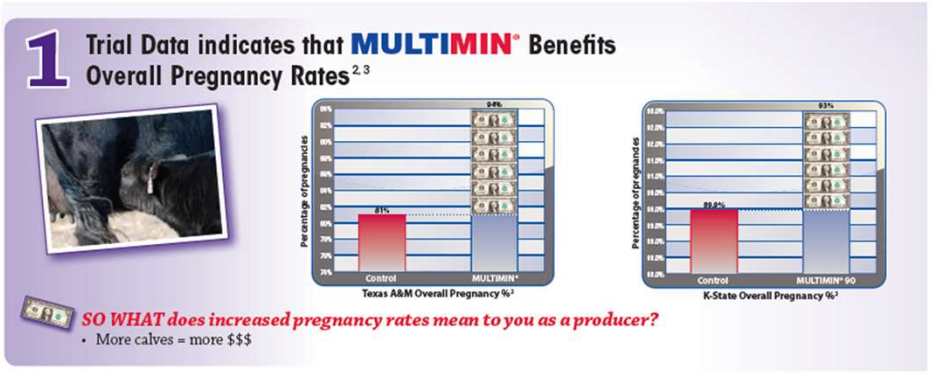
Producer Testimonials

"…..I applied SEA-90 to my fields after our first cutting, at a rate of four pounds in 20 gallons of water per acre, and reduced my fertilizer costs by 50 percent with increased hay production. The first cutting from a field with commercial fertilizer produced 80 round bales, while the same field with SEA-90 and without fertilizer produced 156 round bales. I harvested 387 bales off one 70 acre field. I experienced much better hay production from the SEA-90 fields."
Arkansas

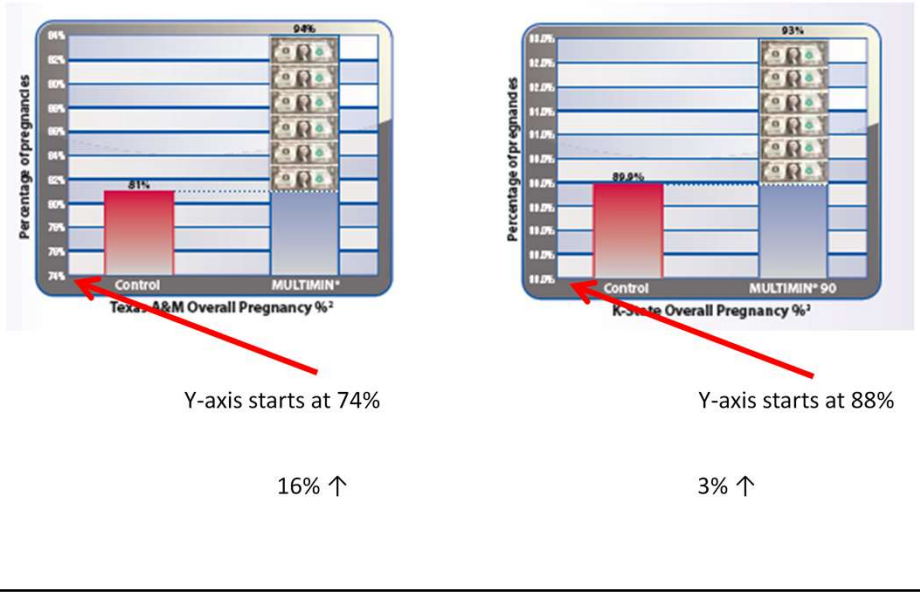
		What is claimed	
		Works	Doesn't Work
What is real	Works	0%	0%
	Doesn't Work	90%	10%

Producer testimonials helps sells. And, if you look back at the pie charts – producers go to other producers for information. We ourselves want producer testimonials promoting our programs. However, testimonials can be inaccurate and biased. The testimonial in this slide is not making claims based on a replicated side-by-side comparison of a low rate commercial sea salt product vs commercial fertilizer, their information is confounded by year differences, maturity at harvest differences, could be field differences too. The bottom right graph uses a contingency table to point out that if 90% of the time something is claimed to work but when tested under properly designed conditions it fails 90% of the time does mean that it works, it means that it doesn't work and those making the claim are misinformed.

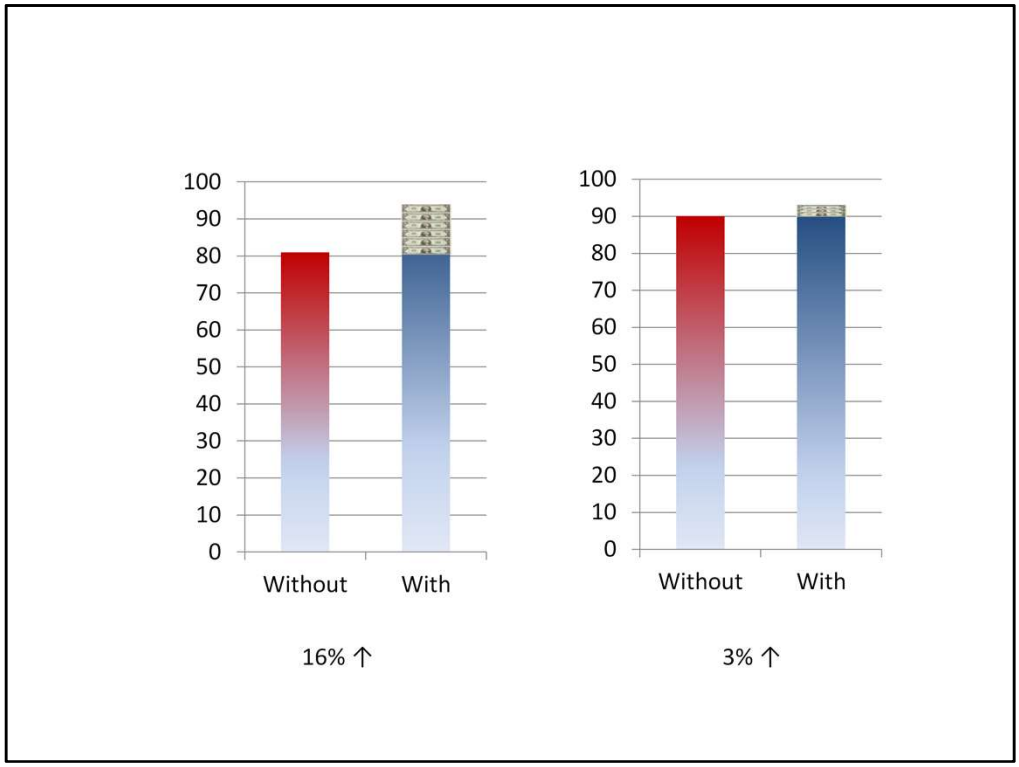
Company Data



The next few slides are going to utilize some company data. The purpose here is not to condemn companies but to illustrate how data can be presented to create a false interpretation of benefit. This example is with Multimin. Multimin is beneficial under certain conditions, but not all conditions. Lets not focus on the product now but how the information is presented. Sorry for the small print blurring. Looking at these to graphs, a selling point could be these are results from two university studies. Visually, the response looks the same.



Now look at the axes and percentage change response. TAMU saw a 16% improvement, whereas the KSU is only a 3% improvement. A change in axes can make small things look big.

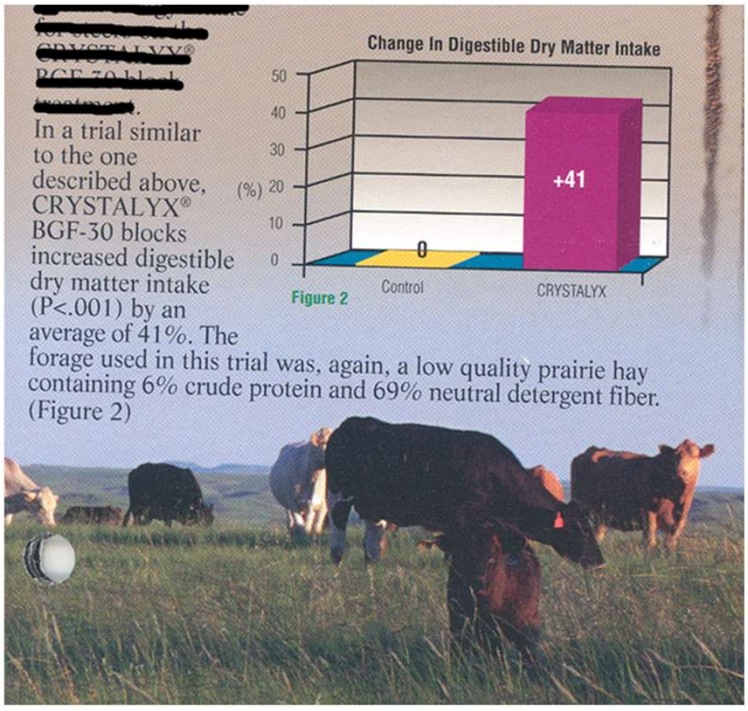


What does it look like when put on the same scale of 0 to 100?

Table 1 Growth of Cattle Consuming a Range Mineral (control) a Range Mineral with Endo-Fighter Formulation (experiment)

	Farm A		Farm B	
Cow Data	Control	Experiment	Control	Experiment
No. cows	29	26	33	34
Starting wt, lb	1114	1077	1351	1276
Ending wt, lb	1090	1102	1397	1381
Wt. change, lb	-24	25	46	105
ADG, lb	-0.24	0.25	0.36	0.81
Avg. daily mineral intake, lb	0.55	0.61	0.26	0.43
Calf Data				
No. calves	22	26	30	34
Starting wt, lb	275	268	342	388
Ending wt, lb	419	470	618	687
Wt. change, lb	144	202	276	299
ADG, lb	1.44	2.02	2.53	2.74
Source: ADM Alliance Nutrition research trial B05301				

Another example is use of on-farm data that is not properly replicated. The calf data shows an ~ 0.5 and 0.25 response with endo-fighter. Although there were a good number of cows within each group for both farms, in this case, cows are not the correct experimental unit but the single response of the group of cows within a pasture. Since there is not a sufficient replication of pastures, we cannot determine if the response is actually due to pasture or if it is associated with external factors such as differences in stocking rates, differences in available forage, differences in sires. We cannot draw accurate conclusions based on the information presented.



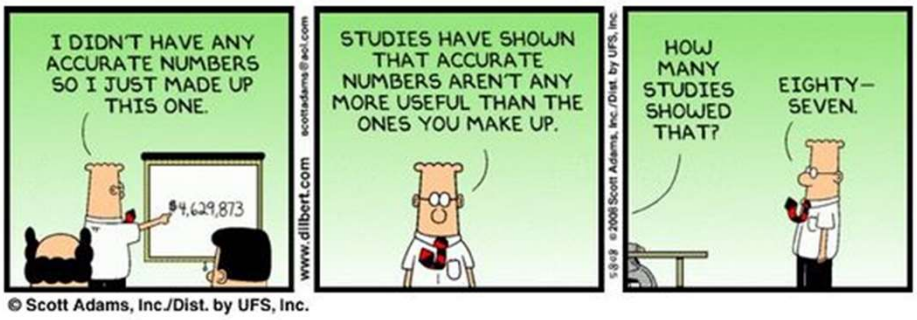
As a final example of data this is the example of something that works, but works under the appropriate conditions. Supplementing protein to low protein hay can help improve digestible dry matter intake. In the trial they indicate the hay was 6% protein. Now, look back to the slide with Arkansas Winter Feed Meeting data. How many of those samples have a protein level that low? It is important the decision is appropriate for the right environment.

Company Data

- Valuable
  - Companies fund a lot of land grant research
    - Perceived bias by clientele
- Approach with caution
  - Often highlight testimonials
  - Modify info graphics to make small changes look big
  - Often do not report “P-values”
  - Like to throw in “University research”
- Look for research citations and follow-up with reading citations or contacting the research PI.

Do we discard company data. Certainly not. Our relationship with companies is important. Sometimes our relationships may cause our clients to perceive bias (agronomist probably deal with this more than livestock). However, it is important for companies to know conditions their products do and do not elicit improvement. Think back to the lifestraw. Approach shiny sales brochure data with caution. Don’t stop with the graphics. Look to see if there are references on flyer/brochure and go to those references; if there isn’t references, try a literature search to set a reference to learn more about the experimental conditions which the product was tested.

What Should I Look for in Data



So what should we look for in data. Numbers aren't supposed to be just "made up" but it does make for humorous cartoons.

What Should I Look for in Data

- Statistical inference
  - Are these two number different?
    - 1.5
    - 1.75
  - By how much? [difference]
    - 0.25
  - What's the **probability** of observing that difference between two samples of a population
    - $\bar{x}$ = 1.5 n = 10 sd = 0.25
    - $\bar{x}$ = 1.75 n = 10 sd = 0.25

In biological systems, responses aren't going to be identical from one experimental unit to the next or one environment to the next. This is the reason understanding variability (variance, standard deviation, standard error) is ever bit as important as understanding the mean response change. Researchers try to control for variability due to external factors like size of animals, breed composition, sires, pasture differences to try to make sure that the difference due to treatment minimizes the probability of "stating something is different when it really isn't" or "stating something is not different when it really is"

What Should I Look for in Data

- Ultimately in Forage and Animal Sciences
  - P-value
  - Or a Least Significant Difference (LSD) associated with a P-value threshold (Forages, test plot yields)

In animal and forage sciences, we rely on probabilities associated with what is called a type I error ('saying something is different when it really isn't) and this is reported as a "P-value". Sometimes a "Least Significant Difference" will be calculated based on a specific p-value thereshold.

What Should I Look for in Data

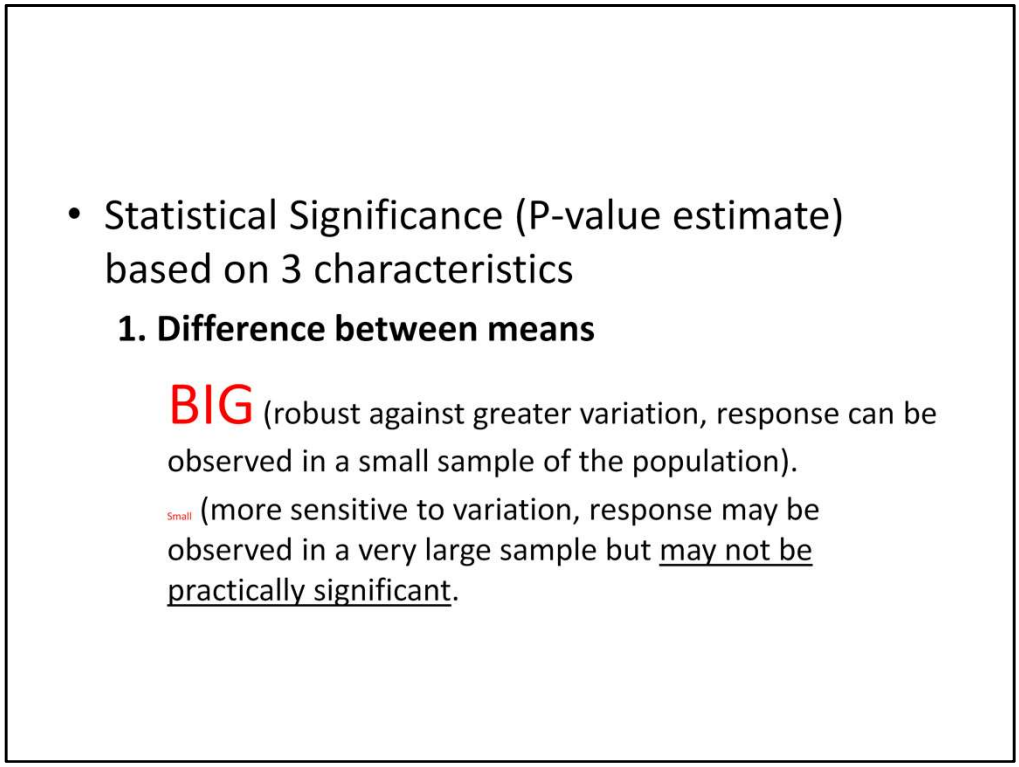
- **P-value** interpretation (most p-values are from 'two-sided tests)
  - P > 0.20
    - Study either poorly designed or effect size not large enough to warrant application – either way stay away.
  - P = 0.11 to 0.20
    - Data is interesting; consider the study characteristics; approach conclusion with caution
  - P = 0.06 to 0.10
    - Some evidence to support observing the response, study limitations may have caused probability to be greater than what might occur with a larger sample size
  - P <= 0.05
    - Good to very good evidence to support observing the response.

You could probably categorize the 'P-value' like above. The more universally accepted p-value is <=0.05 ; so there is no more than a 5% chance of stating the difference is true when it really isn't.

What Should I Look for in Data

- When possible – examine the response for multiple studies
  - Counting p-values (easy but can be misleading)
  - Meta-analysis (better but may not have sufficient studies to support)
  - Regression, meta-regression models (idea for prediction like Nutrient Requirements, fertilization rates, etc)

When possible, try not to draw a conclusion from one study; especially if your conditions differ. The more studies that show similar response size, the more conclusive the evidence becomes. 3 methods of combining results include counting study p-values (what most of us do but can be misleading with studies that are in that P = 0.05 to P = 0.2 range); meta-analysis but sometimes there's not enough studies, and regression to combine studies with is where we start developing things like nutrient requirements for animals.



The size of the difference between the control and alternative treatment is one of three characteristics that influences the p-value

If differences between a control and treatment are BIG – the response is more robust against variation; this is important because research we try to make environments as homozygous as possible with the only difference being the treatment; however, in practical application the environments are very heterogenous.

If differences between a control and treatment are small – it takes a large sample size to compensate for variation but also, small responses may not be practically significant.

Statistical Significance (P-value estimate) based on 3 characteristics

2. Sample size

small (typical of most research studies –try to account/balance for as many sources of variation as possible; however, small sample sizes can cause large P-values)

LARGE (less typical of research studies, may result in statistical signficance ≠ practical signficiance; necessary for most reproduction work)

The number of experimental units is the second of 3 characteristics that greatly influences the pvalue

In research we need small sample sizes because land and animals are expensive to replicate. For our clientele, it is important if we can see a response with small sample sizes because not all farms are large. For some responses, like reproduction, small samples are difficult to demonstrate a statistically significant response (low pvalue) and require larger sample sizes than other responses. Yet, if the response requires an extremely large sample size to cause it to be 'statistically significant' , it may not be practically significant to the ranch with a small number of livestock.

Statistical Significance (P-value estimate) based on 3 characteristics

3. Variation (standard deviation) among samples

small (needed to detect differences when sample size is small and/or mean difference in treatments is small)

LARGE (generally undesirable because only large difference is mean is needed or its an indication that sample size is inadequate)

Variation among samples is the third characteristic that affects the pvalue. In research, experimental designs and number of replicates are chosen in an effort to minimize variation.

What Should I Look for in Data

- Tabular Example

Indication of mean difference (1.75 – 1.5 = 0.25) which corresponds to a 17% increase (1.75 – 1.5)/1.5

	Treatment[a]		
	Control	Treated	SEM
Response	1.5[b]	1.75[c]	0.09

[a]n/trt = 10
[bc] Means within row differ (P ≤ 0.05)

Sometimes/ but not always researchers put sample size/treatment in tables [otherwise in methods]

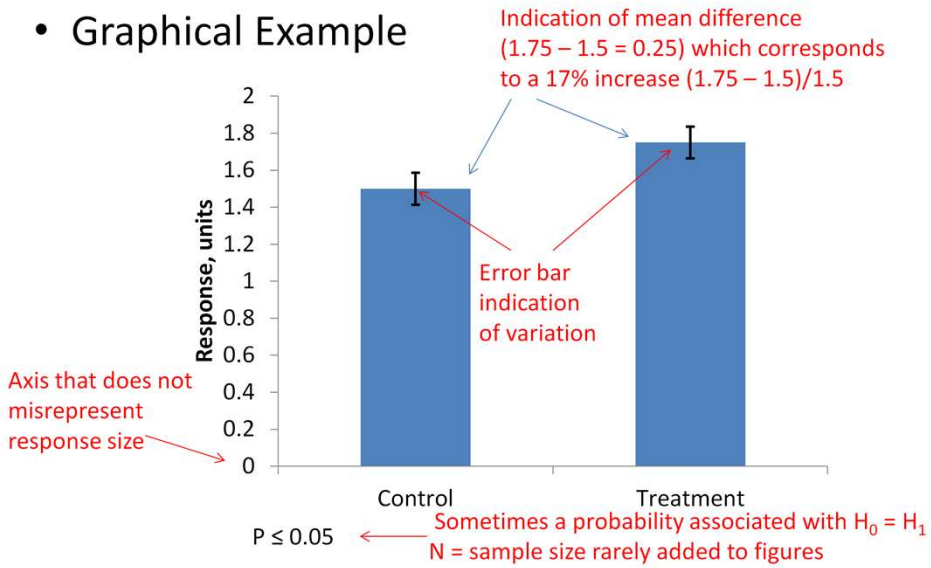
Indication of variation

Probability associated with $H_0 = H_1$

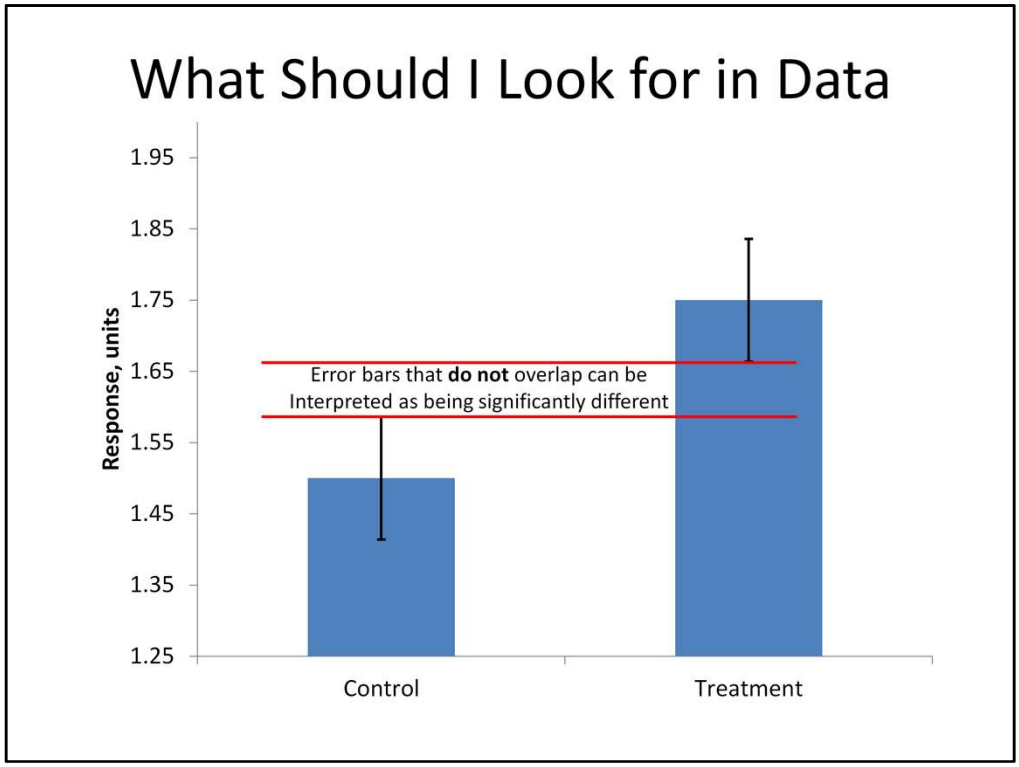
So practical examination of tabular data – look for the difference between treatments, look for the pvalue, you may want to calculate the % change. The change from 1.5 to 1.75 is a 17% increase which is pretty big.

What Should I Look for in Data

- Graphical Example



For graphs, error should be illustrated with bars (see next slide)



If the bars do not overlap, the associated pvalue will be low to very low.

Statistical Significance
vs
Practical Significance

- Differences can be statistically significant when we have a large study group but the treatment difference
  - may not be practically large enough for smaller operations
    - < 10% response change
    - 10% or more response change
  - external factors may contribute to the lack of practical significance.
    - Cost > return
    - Labor

Remember, statistical significance does not necessary translate to practical significance when additional environmental factors are considered such as cost exceeding return, cost of added labor. For example, creep feeding can show a statistically significant improvement in calf weaning weight; However, the value of gain may be less than the cost of gain.

What is Acceptable/Unacceptable as an Educator

Source	Type	Reason
Producer, salesperson testimonials	Mostly unacceptable	Unproven results Market motive
Public bulletin boards, chat rooms	Unacceptable	Anyone's opinion counts
Print media	Somewhat acceptable	Source reliability Applicable to environment
Factsheets. Extension publications	Mostly acceptable	Applicable to environment/situation May contain on old or unproven data
Product factsheets	Somewhat acceptable	Look for references, interpret comparisons accurately, investigate results
Research updates/bulletins, thesis, dissertation	Mostly acceptable	May represent 'preliminary results' May provide data that doesn't get published ('grey literature')
Published research	Mostly acceptable	Peer-reviewed; journals are prone to **publication bias** (tend not to publish things that didn't work)
State level research/extension faculty	Acceptable	Because I am one?

This is my interpretation of what may be acceptable and unacceptable. There are definitely sources to avoid , but there is no single perfect source. Even peer reviewed research journals are imperfect from the standpoint of 'publication bias' . Sometimes results are published when there weren't statistical differences. Look at the grey literature (experiment station bulletins, departmental reports, theses, dissertations). Here we find a lot of studies that never make it publication to various reasons but are relevant. Overall, Factsheets are supposed to serve as a review of literature and generally accepted communication of methods or results. Check the dates of factsheets to make sure the information is up to date (within 5 years) and applicable to the environment. A factsheet on protein supplementation or calving seasons from Wyoming may not be useful in the southeast.

Lastly, don't less access to technology breakdown the communication between you and your state level research and extension faculty. Communicating with the specialists of your state is extremely important as a new agent. A phone call, email, or text to your state specialist can save a lot on response time.

Searching for Research (use more than 1 resource)

- Google Scholar
  - Article links, citations, hard to find stuff sometimes shows up here
- Academic Article Search Engines via institutional library
  - Web of Science, CAB Abstracts, Agricola Dissertation & Theses
- Literature Citations

So if you cant reach your specialist, don't have a specialist, or there is no clear answer in the factsheet, conduct a literature search. Google scholar is open access and there is a growing number of links to the scientific articles. Use the citations feature to look for similar articles. When accessible, utilize the university connections to subscription databases (examples provided). As an example, a county agent called and a producer had purchased bred heifers that he feared had previously been implanted after weaning and thought the heifers had unusually large teats for their maturity and stage of pregnancy. The question was does implants affect mammary appearance/teat size and if the females were implanted but are bred, will there be any sustained concerns with rebreeding? You won't find that answer in an implanting beef cattle factsheet!

On-Farm Demonstrations/Verifications

- Confirm research in a heterogeneous environment
- Local response
- "Discovery"
- Improve adoption

"Experiment Station vs Real World"

When possible, work with a producer to conduct an on-farm demonstration or verification of a problem solution. These help confirm research in a heterogeneous environment, provide local application, may lead to future questions and also serve as 'real world application of research'. Sometimes producers perceive that the experiment station does not portray real world either because of the effort to reduce variation in research or because of the practical significance the producer identifies with such as labor, cost, or year-round calving. I'll never forget the time a older gentleman that stocker cattled stated at a field day that the results of growing cattle on novel fescue was impressive but at his age it couldn't see taking the risk. Yet 15 years later he is still running cattle. The picture above is from a fence-line weaning demonstration in Arkansas. If you look at all the fenceline weaning research, Fenceline weaned calves do not outperform calves that were placed in a lot on hay and supplement in all cases; once again, environmental conditions play a role. Yet, their diet in a dry lot is likely far more costly.