# Statistics are Everywhere!

**Connecting Statistics to Business Careers** 





Leeds School of Business UNIVERSITY OF COLORADO BOULDER





## Agenda

- 1. Introduction
- 2. Helping Students Make Connections
- 3. Discussions In Canvas
- 4. Examples From Students
- 5. Q&A

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Applied Statistics in Business and Economics, 7<sup>th</sup> Edition

Current Courses Taught:



- Quantitative Methods MBA Core Statistics Course (fulltime and evening programs)
- Data and Uncertainty Executive MBA Core Statistics Course
- Managing Business Processes Senior level Undergraduate Course

#### How can we help students connect Statistics to their jobs?



- Examples are helpful but... only go so far.
- Encouraging students to ask questions at their jobs can provide deeper insight across their organizations.
- Discussion prompts allow students to share with each other.
- Online discussions also allow students to ask questions that they might not think of during a class session.
- Discussions also allow me, the instructor, to learn from my students.

### Using Discussions to Explore Connections





#### Join the Discussion: Loyalty Card Program

#### Directions:

Based on the results you've observed with the "Noodles & Company" assignment, answer the following prompts with your group. The following article about Starbucks' rewards program is also an interesting read:

https://www.forbes.com/sites/bryanpearson/2020/12/16/12-holiday-gifts-from-the-starbucks-card/?sh=1aafefb34534 @

- Why do you suppose Noodles did away with their loyalty card program several years ago? (They have since reinstated a loyalty program.)
- Do any of your companies use loyalty cards? How are they implemented? What is the cost for a loyalty program? What are the benefits to the company?

#### Adding value to the discussion:

After you have submitted your post, read your peers' answers and respond to one or more peers using the ABC approach:

- Acknowledge your classmate's post.
- · Build upon the post by providing additional details, ideas, personal perspectives, or links to interesting, relevant articles.
- · Conclude with a question or new idea to stimulate the discussion.





"While it is true in most cases that healthcare organizations cannot provide benefits or rewards to induce patients, there are certain exceptions or "Safe Harbors". One of these Safe Harbors would be by providing benefits that "promote access to care". Basically, if a health organization promotes incentives that help remove barriers to those seeking care ....

This is a relatively new exception and has tricky aspects. Without getting into the nittygritty details of this as there is much more to it, here is an article that provides some examples of what a hospital loyalty program could look like: <u>What hospitals Can Learn</u> <u>From Starbucks</u>"





## Using Discussions to Explore Connections



#### Join the Discussion: OLS Regression

#### Directions:

After completing the assigned readings and watching the videos for the week, add to the discussion thread with a post summarizing your perspective on the following question:

• Using what you learned in the OLS Regression video, can you provide an example of where regression analysis has been or could be used in your industry?

#### Adding value to the discussion:

After you have submitted your post, read your peers' answers and respond to one or more peers using the ABC approach:

- · Acknowledge your classmate's post.
- Build upon the post by providing additional details, ideas, personal perspectives, or links to interesting, relevant articles.
- Conclude with a question or new idea to stimulate the discussion.



"As a warehouse manager I have used ordinary least squares regression to get an estimate of how much our labor costs vary based on the value of shipments we are trying to process. Usually, we input weekly shipping revenue data, and our labor costs by week to see how much we should anticipate spending in hourly labor per dollar shipped.

We have done this analysis a few different times and have found that generally one additional dollar of product shipped results in #.03 in additional hourly labor. R squared when we have performed this analysis has been in the .5-.7 range...."





"... NEVER in my life did I ever think I would be someone to truly enjoy a statistics class, but because your class inspired me, I have now started a stretch assignment project at Lockheed Martin within our People Analytics Team to further my learning on hypothesis testing and regression analysis. My leader was so impressed that I put together an idea for a project that could add a lot of value to our team..."





#### Industry: Town Management

Applying geometric mean to analyze population growth.

- % increase vs average growth rate?
- 2021 population (18813) to 2010 population (10300)
- 85% increase and 5.6% average growth rate





Applying binomial distribution.

"To give everyone background, I do network engineering for a job. However, I have always been curious if I would be able to use the tasks that my engineering group has and line them up with our Service Level Agreements. Then come up with a way to predict with our staffing levels what the probability that we will not meet an SLA is. I think this would be a binomial distribution ...."





Applying Line charts and Visual Tools

Several students worked in construction roles. Lumber prices climbed drastically during the pandemic. There was significant discussion during class and on the discussions about housing prices, materials prices, shortages, etc. Students were excited to use their new charting tools to track prices over time.





### Industry: Engineering and Sales

**Applying Confidence Intervals** 

"As we have gone through the understanding of confidence intervals, I have a keen interest to put these to use in my job. I handle sales in a couple of regions

Something that has bothered me is the guesswork that seems to go into sales targets and quotas for the year. .... Without much understanding of how these targets were determined, to be honest I think it was something like add 5% from last years numbers...

However, with the tools from this class I think I can take a sample size of sales from years past, with a year over year mean and standard deviation, and use this to form a confidence interval for what I would expect the mean sales this year to be..."



#### Industry: Healthcare



Applying regression analysis to an outpatient mental health facility.



Appointments and no-show rates across clinics.

There is no apparent relationship between number of appointments and no-show rate. Regression analysis with scheduled appointments as the independent variable and no-show rate as the dependent variable for the 18 clinics produced a coefficient of determination ( $R^2$ ) of only .06 and the regression coefficient of no-show rate was not significant (p = .349).



"In my previous job as an insurance broker, I would always wonder how they actually factored the insurance premiums that I was selling to clients.

It baffled me how expensive it was to purchase auto insurance and health insurance. Now that I understand regression and can apply it to the insurance world, it has become fascinating!"



#### Industry: Cannabis



".... By early 2019, reverse-engineered terpene profiles were the de facto industry standard for hemp-derived vape cartridges. A recently published paper sheds a lot of light on the relationship between terpenes and the effects of cannabis. It is still undergoing peer review, but their data analysis is directly related to what we are learning in chapters 12 and 13 (simple and multiple regression) ..."





## Industry: Engineering and Sales (again)

"Along with engineering, I also handle sales in Canada and Australia. In doing so, the main goal of mine is to get my product written into specifications, and I would really like to model how successful specifications are for overall sales.

So in this case, my independent variable will be specifications written, and dependent will be overall sales. My intercept will be how many sales are generated with zero specifications, which I should be able to find a fairly accurate number of based on historical data.

So in all: Overall Sales = (Sales Factor due to specification being written \* number of specifications) + sales with 0 specifications"



## Industry: R, Java, Python and genes

"My company asked me to attend a ShortReads course through CU where I have learned to analyze and make conclusions about outputs from high throughput sequencers. I've been challenged to become fluent in Linux and R and familiar with python and java in 6 days...

Essentially, after a lot of trimming, cleanup and mapping, data from a sequencer has finally output a ton of data about the expression levels of mRNA transcripts of different genes that were present in the samples. That's where I finally was able to use statistics! A java program was used to adjust these observations to expected levels based on parameters of collection and storage of and R was used to compare the difference of means and give p-values for differential expression. After a ton of work, I was finally able to conclude which genes are upregulated after different external stimulations! ...I was so excited to finally apply some stats to my research. Have any of you had any similar breakthroughs or exciting AHA moments?"



## Industry: Medical Trials

"I constantly hear our analysts push back on testing data at intermediate points in our clinical trials. They say these intermediate tests "spend alpha". I've always wondered what they meant. Now that I know about Type I and Type II errors it makes so much more sense!"



Alpha-spending is **an approach of distributing (spending)** the type I error (denoted alpha) over the duration of a sequential A/B test. Alpha-spending makes it possible to perform sequential testing while maintaining the overall error probability of the procedure.



I routinely assign a group project that requires students to develop a multiple regression model using a data set of their own choosing.

I encourage students to use data from their work, if at all possible.

This has been one of the most popular, and valuable, elements of my courses over the years.

I learn as much as my students.

### Industry: Bike Reseller







#### Industry: Healthcare - LOS

#### **Question:**

Is the variation in length of hospital stay following mitral valve repair surgery explained by the following variables?



#### **Final Results**

The initial Multi Regression model had one significant variable, transfusion (categorical).

Right tailed T-test to evaluate effect of transfusion on length of stay, **p** = **.0029** 

We reject the null hypothesis because p = .0029 < Alpha=.05.





# LIVEWELL CENTER'S ADVERTISING SPEND

Long-format television advertising:

Channel 9 Colorado and Company – Interview with call-to-action to generate calls

- Calls = revenue?
- What drives our Calls?

### Industry: Fitness



## BACKGROUND

- Gold's Gym Venice Beach is the premier location to spot celebrities and pseudocelebrities in the fitness industry.
- Gold's Gym Venice Beach just recently experienced a growth in membership and would like to identify what is the cause.
- Gold's Gym Venice Beach will focus on the following variables as part of their regression analysis engagement:

Type of Variable	Unit of Measure
Advertising	\$ spent per month
Sales Generated Appointments	# of sales team appointments
Walk-ins	# of walk-ins per month
Social Media – YouTube	# of views per month
Social Media – Facebook	# of likes per month
Time Series	Month over Month

(\$65)

## Industry: Sports Marketing

"Denver Broncos rolled out mobile ticketing in 2018. How satisfied were our fans with the experience?

We will use regression analysis to understand variation in customer satisfaction based on the following variables:

- their satisfaction with stadium wifi,
- *if they were a season ticket holder,*
- their arrival time (minutes before kick-off),
- and their mobile operating platform"



### Advice



"I believe I am the oldest guy in our class. I was a freshman in college when Nirvana released Nevermind. I took four semesters of stats as an undergrad, and I had a very solid handle on everything that we just learned through multiple regression. I didn't use any of this stuff at the beginning of my career, and I brain dumped big chunks of it that would have been useful later in life. My advice to you is to intentionally retain this knowledge. If your current/next job doesn't required you to do stats at this level, make a plan to keep it fresh in your brain."