Applied Business Analytics
BUS 351QR

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Office hours: Monday-Wednesday (9:30-12:30)
Class time: Monday-Wednesday (14:00-15:15)

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Course Description

This course relies on statistical theory and advanced quantitative methods for business analytics. It emphasizes the importance of developing strong quantitative skills by bolstering proficiency in **Microsoft Excel** and **RStudio**.

Prerequisites/Corequisites

STA 282QR or STA 382QR; BIS 255; BUS 321.

Required Textbook and Materials

- **Main textbook**: *Essentials of Statistics for Business & Economics*, 10^{th} *Edition*
  Author(s): Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, Dennis J. Sweeney, Thomas A. Williams.

- **Blackboard**: I will only rely on blackboard to post material pertaining to due dates, exams, grades, problem sets, and study guides.

- **Microsoft Excel** (required): **Excel** is the main statistical software required for data analytics in this course. Excel tutorials are available on my Blackboard and on my Youtube channel.

- **RStudio** (optional): **RStudio** is a programming language and RStudio provides an environment for statistical computing and graphics. First, one needs to install **R** in order to

install RStudio. Both are open-source projects (free of charge). RStudio is not required for the course, it is optional, as mentioned in the textbook. However, I will rely on both RStudio and Excel to demonstrate some key statistical concepts used in class. Nonetheless, students are welcomed to use alternative statistical software for their homework (for example, Python, Tableau, Excel, or STATA). The instructions for downloading RStudio are available on Blackboard.

- **Qualtrics** (required): is an online survey tool useful to design and administer surveys. Students will learn different sampling methods and rely on Qualtrics to collect survey responses for data analysis. Qualtrics is free, but students must register for an account online.

Course Objectives

Upon successful completion of this course, students should be able to:

1. *Manage data:* obtain data from key public and private databases, differentiate between different types of data (for example, qualitative data versus quantitative data), different types of data sets (for example, cross-sectional data versus panel data), and be capable to perform complex data tasks (for example, import, merge, append, and transform data).
2. Develop strong *quantitative skills:* use Excel, Tableau (optional), or **RStudio** (optional) to handle large data sets and for data analysis.
3. Perform *descriptive analytics:* rely on statistical software to describe data, visualize data by making maps, bar graphs, scatter plots, histograms, and other distribution plots.
4. *Understand the fundamentals of probability, estimation, and inference:* we will discuss the properties of random variables, properties of estimators, statistical inference (hypothesis testing), and interval estimation.
5. Understand *sampling theory* and apply the latter to conduct studies and collect data by relying on a survey analytics tool (for example, Qualtrics).
6. Apply the following methods for data analysis: *independent samples T-test*, *Chi-squared test of independence*, and the *F-test for equality of two variances*.
7. Identity the theoretical underpinning of a *simple linear regression model.*
8. *Estimate a multiple regression model* with both quantitative and qualitative variables.
9. Use *advanced statistical methods* (for example, cluster analysis and binary response models) to analyze financial data.

Course Details

It is important to read the relevant chapters in your book, including the videos prior to attending class. Students should be punctual with respect to submitting assignments: I will not adjust

grades or provide makeup exams. Exams are assigned on specific dates: I do not allow makeup exams, except for these students whose cases stem from illness or injury. The class content is designed to be challenging. Consequently, being on time, attending office hours every week, participating in class, and completing the assignments are all important tasks needed to ensure high performance in this course.

This class incorporates an inclusive and equitable environment, which means that students are expected to treat their peers with a high degree of professionalism, kindness, and respect. Additionally, the university's **Title IX** policy encourages access to information and resources to support anyone who has been affected by, knows of, or wants to help prevent an incident or pattern of behavior. Students may contact the Title IX coordinator (**Mary Martinez**) by phone (989-774-3253) to discuss any questions or concerns. Some students may require additional resources to ensure equal access: these students should contact the **accessibility resources center** to discuss ways in which their needs can be met. The accessibility resources center is located in **park library 120**.

Grade Distribution

Grade	Range (%)
A	94-100
A-	90-93.99
B+	85-89.99
B	80-84.99
B-	77-79.99
C+	73-76.9
C	70-72.99
C-	67-69.99
D+	63-66.99
D	60-62.99
F	0-59.99

Table 1: Grade Distribution (BUS-351QR)

- **Midterm (10%)**: there is a midterm exam and its content emanates directly from the topics of random variables and the fundamentals of probability.
- **Final exam (10%)**: the final exam only includes contents from the simple linear regression model.
- **Labs (40%)**: there are two data labs. Due to the size of the labs: students are encouraged to form groups of 11 as means to facilitate the assignments.
- **Problem sets (40%)**: there are two main problem sets. This is an individual assignment and the content emanates directly from lecture content.

Schedule and weekly learning goals

The following class schedule is tentative and may change if needed. The weekly topics should mainly serve as a reference for the lectures.

Week (1)

- *Syllabus:* I will provide an overview of class expectations, problem sets, labs, and exams in an introductory video on Blackboard. It is strongly recommended to watch the video and read the syllabus prior to attending the first class.
- *Applied business analytics (introduction):* I discuss the main focus of the course, different categories of empirical studies, types of data with emphasis on data visualization, and unethical concerns in data analytics.
  - ***Chapter 1: data and statistics*** (required reading).
  - ***Chapter 2: descriptive statistics (tabular and graphical displays)*** (required reading).

Weeks (2-3)

- *Descriptive statistics:*: I will start by providing a basic introduction to summation notation and functional forms. We will discuss measures of central tendency, variability, and skewness and use the latter concepts to analyze real data. Lastly, this section will emphasize more data visualization techniques (for example, we will examine scatter plots, box plots, maps, and data dashboards).
  - ***Data workshop:*** I will introduce some statistical tools in Excel. Additionally, I will provide a tutorial on data analysis in RStudio.
  - ***Chapter 3: descriptive statistics (numerical measures)*** (required reading).

Week (4)

- *Introduction to probability:* we will discuss laws of probability and the concept of independence.
  - ***Chapter 4: introduction to probability*** (required reading).

Week (5)

- *Random variables:* we will discuss the properties of random variables, the **central limit theorem**, and examine five probability distributions with applications (for example, Normal distribution, Chi-square distribution, F-distribution, T-distribution, and Poisson Distribution).
  - ***Chapter 5: discrete probability distribution*** (required reading).
  - ***Chapter 6: continuous probability distribution*** (required reading).

Weeks (7-8)

- *Estimation theory, sampling distribution, and sampling methods:* we will discuss the characteristics of an **estimator**, the **sampling distribution** of means, and three sampling methods (for example, **random sampling**, **stratified sampling**, and **cluster sampling**).
  - *Data workshop*: here, I will provide a practical example that illustrates the sampling distribution of means by using Excel and **RStudio** (optional for students).
  - ***Chapter 7: sampling and sampling distributions*** (required reading).

Week (9)

- *Interval estimation and hypothesis testing:* I will briefly discuss the topic of confidence intervals and the concept of hypothesis testing with some applications.
  - ***Chapter 8: interval estimation*** (required reading).
  - ***Chapter 9: hypothesis tests*** (required reading).

Week (10-11)

- *Test of independence, inference about population means, and variances:* I will rely on the independent-samples T-test, the Chi-squared test of independence, and the F-test for equality of two variances for data analytics.
  - ***Chapter 10: inference about the difference between two population means (matched samples)***(required reading).
  - ***Chapter 11: inference about a population variance*** (required reading).
  - ***Chapter 12: test of independence***(required reading).

Week (12)

- *Simple linear regression model:* we will derive the **ordinary least squares (OLS)** estimator for a simple linear regression model and discuss the underlying classical assumptions of the OLS estimator.
  - ***Chapter 14: simple linear regression*** (required reading).

Weeks (13-14)

- *Multiple regression model with qualitative variables:* I will discuss the underlying classical assumptions of a multiple linear regression model. Lastly, I will examine the main differences between the **linear probability model**, the **logistic** regression, and the **probit** model.
  - ***Chapter 15: multiple regression*** (required reading).

Academic Integrity

Refer to the University's **academic policies and guidelines** for information pertaining to academic integrity and honesty policy. Students are responsible to adhere to the honor code in all academic endeavors.