# Advanced Accounting Analytics
## ACCT 70291

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Office hours: Fridays, 10:30 a.m.-12:00 p.m. in person at Mendoza 371 and by appointment (Get feedback on assignments and midterms!)

https://notredame.zoom.us/j/95836355412

**Teaching Assistant:** Patrick Pierret
Patrick.G.Pierret.2@nd.edu

Office hours: 11:00-1:00 p.m. Mondays Mendoza 266 and by appointment

**Class schedule** Mondays and Wednesdays, 3:00-4:45 p.m. Mendoza 159

**Course site** Please access Sakai using your NetID. You will want to focus on the "Modules" tool for course materials and assignments.

### Course overview

Advanced Accountancy Analytics is an applied analytics course in the MSA graduate program which applies the latest analytical methodologies to a variety of accounting engagements including internal audit, mergers & acquisitions, modeling, valuation, financial reporting, risk assurance, federal and international tax planning, and financial advisory. Because of the broad scope of the applications in the class, no extensive knowledge is assumed in any single substantive area. In other words, irrespective of which track you have chosen, you will be able to experience the excitement of applying analytical methodology to mock client engagements, as it is the goal of the course to enhance your analytical skills in a cross-disciplinary environment. Moreover, you will obtain practical experience applying analytical methodologies in the context of data storytelling, spreadsheet decision modeling, and predictive analytics.

### Required Materials (Rent or Purchase)

George Mount, *Advancing into Analytics: From Excel to Python and R* (O'Reilly 2021), ISBN 978-1-492-09434-0 ($48.49 on Amazon and, if you're interested, also available on Google Play at a publisher's discount)

J. Christopher Westland, *Audit Analytics: Data Science for the Accounting Profession*, (Springer, 2020), ISBN 978-3030490904 ($69.99 on Amazon to purchase, $21 to rent)

### Required Materials (On Reserve in Mahaffey Business Library)

Bertsimas & Freund, *Data, Models, and Decisions* (Dynamic Ideas, 2004) ~ In addition to the library copy, I have an extra copy in my office that you may sign out for two hours at a time.

Mark J. Nigrini, *Forensic Analytics* (Wiley, 2nd Edition 2020) ISBN 978-1119585763

Camm et al., *Business Analytics* (Cengage, 3rd Edition, 2019) ~ In addition to the library copy, I have several extra copies in my office that you may sign out. ISBN 978-1337-40642-0

**Recommended (useful and inexpensive) resources include:**

Wickham & Grolemund, *R for Data Science* (O'Reilly 2017) ISBN 978-1-491-91039-9 (good for visualization with R)

Tilman M. Davies, *The Book of R,* No Starch Press 2016, ISBN 987-1-59327-651-5 (for coding)

Eric Matthes, *Python Crash Course,* 2nd ed. 2019, ISBN 978-1-59327-928-8

**Prerequisites**

ACCT 70081 and ACCT 70181, or instructor's permission.

**Grading Criteria**

Final grades will be set to an average GPA from 3.3 - 3.6, consistent with Accountancy Department requirements. In the spirit of fairness, no extra credit will be awarded on an individual basis.

**Course Work**

| | |
|---|---|
| Participation | 10% |
| Labs: | 20% |
| Case Studies: | 30% |
| Midterms: | 20% |
| Final Exam: | 20% |

**Participation:**

Participation is understood to mean attendance, participation in class labs, as well as active listening and asking questions of guests (senior managers, partners, and market leaders) who join us to introduce engagements in which you will be involved as an associate at a Big Four.

**Attendance**

Attendance in all class sessions is expected, whether in-person or via Zoom (see link on p. 1) in case of illness, a "red card," or on scheduled synchronous learning days. Where conflicts arise, students are expected to provide adequate advance notice and make up any missed work. Please inform me in the event of any unforeseen circumstances, so that I might better support you.

**Labs:**

Computer-based labs – including "mock engagements" on practice-specific topics such as Fraud, ETR, Earnings Management, Capital Allocation, and Contingent Liabilities, as well as in-class technology "challenges" – will be conducted (in your project groups) to enhance your knowledge and skills, and so that you may experience how analytical solutions bring value to client engagements. With the exception of Excel, no prior experience is assumed for any of the computer-based tools we will employ in the class. Completed labs and case studies will be submitted on the course Sakai web site.

**University of Notre Dame Academic Code of Honor**

The University of Notre Dame Graduate Academic Code of Honor is observed in this class.

Violation of the Code of Honor consists of misrepresenting, in any way, anyone else's work as your own, verbal or written misrepresentations to the instructor, use of unauthorized external materials during quizzes and/or tests, or unauthorized collaborative effort on the examinations. All members of the class have an equal and shared responsibility to enforce the code of ethics among their peers.

**University of Notre Dame Health and Safety Protocols**

In this class, as elsewhere on campus, students must comply with all University health and safety protocols, including:

Face masks that completely cover the nose and mouth will be worn by students and instructors;
Physical distancing will be maintained in instructional spaces;
Please choose and remain in your chosen seats throughout the semester – you may want to seat near your project group teammates – which the university has asked faculty to document for purposes of any needed contact tracing; and
Protocols for staged entry to and exit from classrooms and instructional spaces will be followed.

We are part of a community of learning in which compassionate care for one another is part of our spiritual and social charter. Consequently, compliance with these protocols is an expectation for everyone enrolled in this course. If a student does not wish to comply with the University's health and safety protocols, the student should participate in class remotely. Persistent deviation from expected health and safety guidelines within the classroom may be considered by the university a violation of the University's "Standards of Conduct," as articulated in *du Lac: A Guide for Student Life*, and will be referred accordingly.

**Faith Life**

The Basilica of the Sacred Heart is open for public Masses and operating consistent with diocesan guidelines.
Most daily Masses will take place in residence halls and academic buildings, though adjusted as needed for physical distancing requirements.
Sunday Masses in residence halls will conform to required guidelines, resulting in either multiple Masses in the hall chapel or a consistent alternative location and time each week.
As your semester brings reading and homework assignments, cases, presentations, studying for the CPA, job searches, etc., please remember that your spiritual and physical health is your priority and ours!

**Course Outline:**
**For Week of:**

March 14 Welcome and Introduction to R Programming

RStudio is an integrated development environment or IDE. You'll download R from https://cran.r-project.org and install RStudio from http://www.rstudio.com/download. You'll also download a few R packages – packages are collections of functions, data, and documentation – that extend the capabilities of base R.

Reading:

Wickham & Grolemund, *R for Data Science* (O'Reilly 2017), Preface, pp. IX-XX

Groups are due by the end of class today.

March 16 Unit 1 Decision Making Under Uncertainty: Investments, Mergers & Acquisitions, and Capital Allocation

Readings

Bertsimas & Freund, *Data, Models, and Decisions*, THE RAND JOURNAL OF ECONOMICS (Autumn, 1999), Chapter 1, 2-32

Camm et al., *Business Analytics* (Cengage, 3rd Edition, 2019) Chapter 5, pp. 166-207, An Introduction to Modeling Uncertainty and Chapter 11, pp. 500-514, Monte Carlo Simulations

In these labs and case study, we will practice modeling and simulating a valuation problem where we face real-world challenges regarding the underlying assumptions about the valuation model. We will find that, with uncertain inputs but known probability distributions, we can simulate alternate outcomes and develop well-supported recommendations.

Unit 1 Lab I ~ Monte Carlo Simulation with Excel, with R , and with R Shiny

Case Study #1 Passed Out ~ M&A/Valuation Engagement: Simulation Due March 21

March 21 Unit 1 Lab 2 ~ Capital Allocation and Optimization exercise using Excel Solver

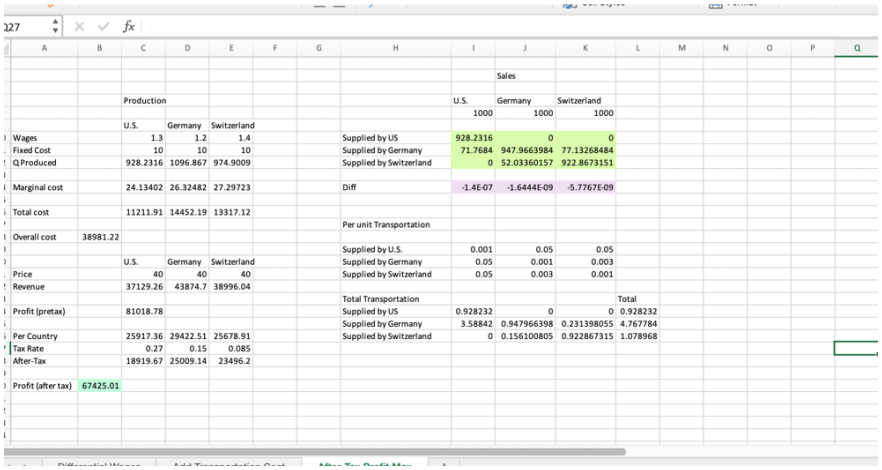
Readings

Morton, *Entry Decisions in the Generic Pharmaceutical Industry*, THE RAND JOURNAL OF ECONOMICS (Autumn, 1999)

In this lab, we will examine the global pharmaceutical industry and apply analytical and financial tools in a competitive analysis engagement for our client, a multinational pharmaceutical. In Data Visualization, we examined the global pharmaceutical industry and analyzed market entry potential for our client. Here, we follow up with a nonlinear optimization of capital allocation, manufacturing, distribution, and structuring of corporate entities.

**Course Outline:**
**For Week of:**

March 21 cont.



| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Sales | | | | | | | |
| | | | Production | | | | | | U.S. | Germany | Switzerland | | | | | | |
| | | | | | | | | | 1000 | 1000 | 1000 | | | | | | |
| | | | U.S. | Germany | Switzerland | | | Supplied by US | 928.2316 | 0 | 0 | | | | | | |
| | Wages | | 1.3 | 1.2 | 1.4 | | | Supplied by Germany | 71.7684 | 947.9663984 | 77.13268484 | | | | | | |
| | Fixed Cost | | 10 | 10 | 10 | | | Supplied by Switzerland | 0 | 52.03360157 | 922.8673151 | | | | | | |
| | Q Produced | | 928.2316 | 1096.867 | 974.9009 | | | | | | | | | | | | |
| | Marginal cost | | 24.13402 | 26.32482 | 27.29723 | | | Diff | -1.4E-07 | -1.6444E-09 | -5.7767E-09 | | | | | | |
| | Total cost | | 11211.91 | 14452.19 | 13317.12 | | | | | | | | | | | | |
| | | | | | | | | Per unit Transportation | | | | | | | | | |
| | Overall cost | 38981.22 | | | | | | | | | | | | | | | |
| | | | | | | | | Supplied by U.S. | 0.001 | 0.05 | 0.05 | | | | | | |
| | | | U.S. | Germany | Switzerland | | | Supplied by Germany | 0.05 | 0.001 | 0.003 | | | | | | |
| | Price | | 40 | 40 | 40 | | | Supplied by Switzerland | 0.05 | 0.003 | 0.001 | | | | | | |
| | Revenue | | 37129.26 | 43874.7 | 38996.04 | | | | | | | | | | | | |
| | | | | | | | | Total Transportation | | | | Total | | | | | |
| | Profit (pretax) | | 81018.78 | | | | | Supplied by US | 0.928232 | 0 | 0 | 0.928232 | | | | | |
| | | | | | | | | Supplied by Germany | 3.58842 | 0.947966398 | 0.231398055 | 4.767784 | | | | | |
| | Per Country | | 25917.36 | 29422.51 | 25678.91 | | | Supplied by Switzerland | 0 | 0.156100805 | 0.922867315 | 1.078968 | | | | | |
| | Tax Rate | | 0.27 | 0.15 | 0.085 | | | | | | | | | | | | |
| | After-Tax | | 18919.67 | 25009.14 | 23496.2 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | Profit (after tax) | 67425.01 | | | | | | | | | | | | | | | |

March 23 Unit 2 Lab 1 ~ R Programming (Analytics)

Variables and Programming Basics
Analytics for a Financial Center Client
Twitter Analysis with R
R Twitter Analysis Lab Passed Out ~ Time Series Analysis with RTweet Due March 27

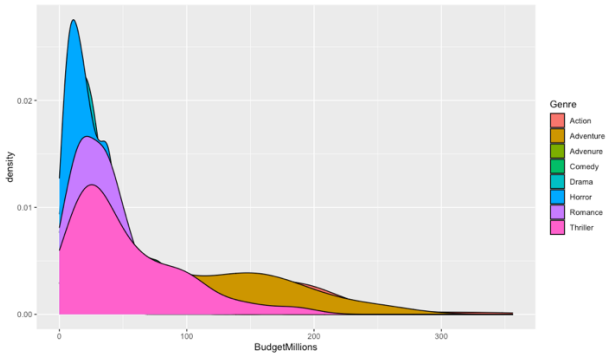
We will perform basic analytics using SORT, IF, ELSE, FOR loops, WHILE loops, etc. to perform basic analytical tasks.

Reading

Ch. 1 – Ch. 2 of Wickham & Grolemund, R for Data Science
Review material on Data Frames, Sorting, Lists, Selecting, For and While loops.

March 28 Unit 2 Lab 2 ~ Basic R Programming (Visualization)

R for an Entertainment Industry Client



**Course Outline:**
**For Week of:**

March 30 Regression Analytics with R: Earnings Management

Unit 3 Lab 1 ~ Regression in R: An Engagement for an Insurance Industry Client

Remember the visualization techniques we used in Data Visualization to look for evidence of fraud? We will employ basic data analysis and regression techniques using the R programming language to model earnings management engagements in an Audit practice, and look for potential fraud with this new tool.

We will employ basic data analysis and regression techniques using R to model an earnings management engagement in an Audit practice. You will examine three companies engaged in the manufacture of pet products to try to discover which one is most likely engaged in earnings management!

Case II Earnings Management Regression Challenge Passed Out ~ Due April 6
"Financial Reporting: Going to the Dogs"

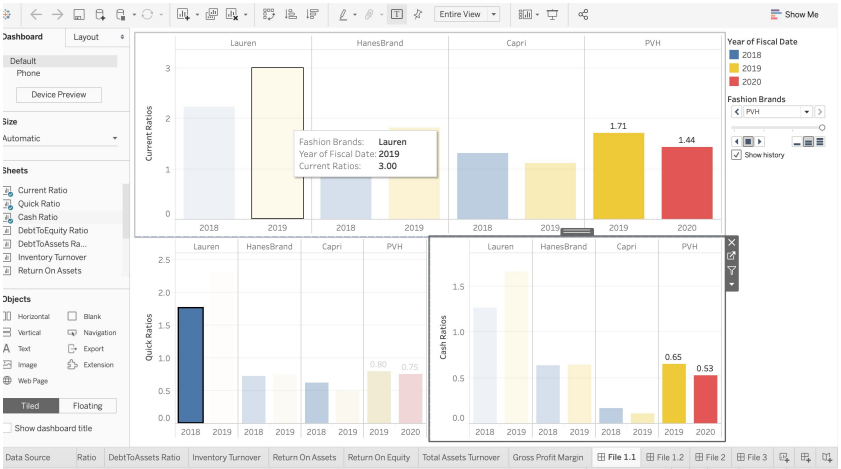
Readings

Regression Models: The Modified Jones Model
Benford's Law (A Mock Audit Case Involving Potential Fraud) Reading: Hill, "The First Digit Phenomenon"

Midterm Financial Accounting Applications with R Programming

Application: Finance Engagement ~ "Fashion Finance"

As you know, ratio analysis (liquidity, solvency, activity, profitability) is a tool used to evaluate relationships among different financial statement items to assess the financial health of a business.




R Challenge Passed Out ~ Fashion Finance Due April 13

**Course Outline:**
**For Week of:**

April 4 Introduction to Python

Unit 4 Lab I Python Fundamentals:

Variables and Data Types ~ Operators ~ Location Functions
Loops ~ Conditional Structures

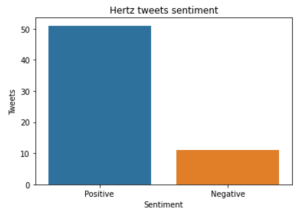
April 6 Visualization with Python ~ Word Clouds and Network Analytics: An Audit Engagement in the Wine Country

```
In [20]: # Create a word cloud image
         wc = WordCloud(background_color="white", max_words=1000, mask=transformed_wine_mask,
                        stopwords=stopwords, contour_width=3, contour_color='firebrick')

         # Generate a wordcloud
         wc.generate(text)

         # store to file
         wc.to_file("wine.png")

         # show
         plt.figure(figsize=[20,10])
         plt.imshow(wc, interpolation='bilinear')
         plt.axis("off")
         plt.show()
```


April 11 Sentiment Analysis with Python

Scrape Twitter for your client to analyze customer sentiment.

```
In [29]: ax = sns.countplot(x = df['Sentiment'])
         ax.set(ylabel='Tweets', title='Hertz tweets sentiment')
         plt.show()
```




```
In [30]: pos_df = df[df['Sentiment'] == 'Positive']
         count_pos = sum(pos_df['nretweets'] + pos_df['nlikes'] + 1)

         neg_df = df[df['Sentiment'] == 'Negative']
         count_neg = sum(neg_df['nretweets'] + neg_df['nlikes'] + 1)
```

April 13 Analyze Stock Data with Python

**Course Outline:**
**For Week of:**

April 18 Unit 4 Lab 2 Application ~ Financial Accounting with Python

Python Libraries

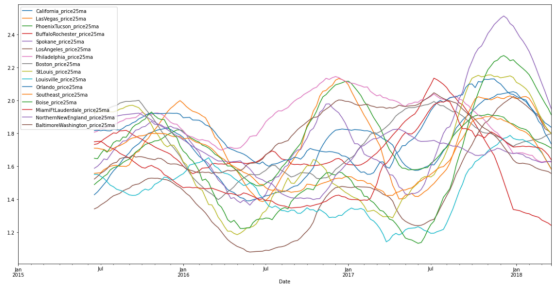
Working with Tabular Data ~ The Pandas Package and Visualization with Python
The Pandas package is arguably the most important workhorse in Data Analytics.

Matplotlib ~ a comprehensive library for creating static, animated, and interactive visualizations in Python.

Application: "The California Fruit Growers Association" Engagement

The California Fresh Fruit Association (CFFA) is an active and engaged advocate in legislative processes and regulatory proceedings in Sacramento and Washington, D.C. The CFFA has engaged you to investigate the consistency of avocado pricing nationwide.

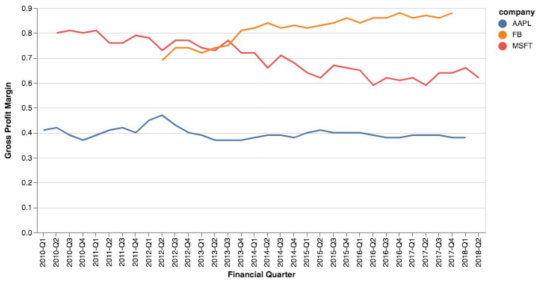
```
In [9]: 1 graph_df.plot(figsize=(20,10), legend=True)
Out[9]: <AxesSubplot:xlabel='Date'>
```



April 20 Unit 4 Lab 3 Application ~ Financial Accounting with Python, cont.

Working with Tabular Data ~ The Altair Package for Visualization with Python
Using key financial statement ratios, we compare Apple, Microsoft, and Facebook.

```
# Put the five layers into a chart and bind the data
alt.layer(gpm_chart, selectors, points, rules, text,
          data=gpm.loc[:,['margin', 'fin_quarter_viz', 'company']], width=600, height=300)
Out[73]:
```



**Course Outline:**
**For Week of:**

April 25 Unit 4 Lab 4 Application ~ Forensic Accounting with Python

Working with Tabular Data ~ The Seaborn Package for Visualization with Python

Application ~ "The Blue Paint" Engagement

The Chicago Police Department (CPD) is the second-largest municipal police department in the United States, behind the NYC Police Department. The Chicago police squad features a distinctive blue paint color. You have been engaged by CPD to investigate an anonymous tip that something 'irregular' is happening with their purchases of blue paint. Your initial meeting with the purchase manager reveals that CPD has five vendors that deliver blue paint (Material ID: BLUEPAINT). Each vendor has a long-running contract with the city with a standard delivery volume of 100 liters per shipment. The delivery tolerance acceptable for good receipt of shipment of blue paint is +/- 5 percent.

You have requested a copy of the data from the City of Chicago SAP system. You focus on the goods receipt events of your purchasing processes. Analyze the data to (a) understand the irregularity and (b) identify the inventory employee who should be contacted about irregularities in blue paint purchases.

April 27 Unit 4 Lab 5 Forensic Accounting with Python, cont.

Application ~ "The Caribbean Cruises" Engagement

You have been engaged by British Petroleum to investigate potential fraud in connection with purchases of Brent Crude. Brent Crude refers to oil sourced from the North Sea of Northwest Europe (between Scotland and Norway). This sweet (i.e., < 0.5% sulfur) light (low density at room temperature) crude oil was first extracted from the Brent oil field in the North Sea in 1976. BP corporate has received an anonymous tip that an employee in the purchasing group for industrial oils has been on a Caribbean cruise for the third time in the last two years. Since spending beyond means is a red flag, you begin an investigation.

You have requested a copy of the data from the BP SAP system. You focus on the purchase orders. Analyze the data to understand the irregularity. Can you establish sufficient evidence to (a) explain the fraud, (b) identify a person of interest, and (c) assess the financial damage?

**Final Exam Distribution**

May 2 The final exam is due May 2nd at 5:00 p.m.

Enjoy practicing your R and Python programming skills with financial accounting, forensic accounting, investment, investment, and/or market entry engagements.