A Curriculum Study: Accounting Analytics Using Python

Namryoung Lee[1,*]

[1]School of Business, Korea Aerospace University, South Korea

*Correspondence: School of Business, Korea Aerospace University, South Korea

Received: August 13, 2023 Accepted: November 27, 2023 Online Published: February 14, 2024

doi:10.5430/jct.v13n1p255 URL: https://doi.org/10.5430/jct.v13n1p255

Abstract

The purpose of this study is to highlight the necessity of incorporating AI technology into the accounting sector and to provide a curriculum that allows university students to practice using data science in accounting. As the accounting work environment evolves along with technological advancements, employers, including big accounting firms, are looking for people with technical skills in addition to accounting knowledge. Accounting major students should be prepared for a changing business environment by learning technical skills in combination with accounting knowledge. This necessitates a modification in the accounting curriculum to reflect the dynamic accounting environment driven by technological innovation. However, it doesn't appear that the accounting curriculum has changed much to keep up with these modern changes, and there don't appear to be many case studies that expressly combine accounting and data science. As a part of this endeavor, this paper offers a few concrete examples for the integration of accounting and Python. Python via Anaconda is utilized for the cases in this study, and a creative but beginner-friendly programming is applied to each case. As a result, in this study, a few Python-integrated accounting challenges comprising fundamental financial accounting concepts are addressed. These are only a few examples, but they might aid in introducing data science fundamentals, demonstrating how data science is used in accounting, and encouraging further research and development of deep learning.

Keywords: technological innovation, accounting profession, accounting curriculum, python

1. Introduction

"ABCD (Artificial Intelligence (hereafter, AI), Blockchain, Cybersecurity, and Data)" of technologies has had a significant impact on every industry and is incomparably stronger than earlier technological advancements and industrial revolutions in every way. Accounting is one of the industries where convergence with such IT technologies is becoming more and more important. Future accounting trends, according to Forbes (2018), include using the potential of IT technologies like cloud, accelerated automation, and breakthroughs via blockchain.

Meanwhile, among a wide spectrum of technologies, most people will concur that AI is the key technology of the fourth industrial revolution. Given that AI is regarded to have revolutionary potential, the sustainability of businesses may depend on their capacity to add value utilizing AI. Because of its proficiency and consistency in analyzing and interpreting accounting data, AI can provide information faster than humans (Petkov, 2020). 56% of accountants globally say automation has enhanced their revenues during the previous 12 months, according to a Sage (2018) poll. Additionally, it was discovered that 66% of accountants think they would invest in AI to automate tedious and time-consuming processes, and 55% said they will employ AI to enhance business operations.

There is also concern that AI will lead to many people losing their employment. In the field of accounting, this is no exception. Using these new technologies in the accounting profession may be viewed as a danger to accountants' jobs by some (Kotb, Abdel-Kader, Allam, Halabi, & Franklin, 2019). The status of some accountants may be in jeopardy due to AI, despite the fact that technology introduces new skills that can increase productivity, automate, and change how business is conducted (IFAC: International Federation of Accountants, 2019).

On the other hand, the application of AI can lead to the creation of new jobs. Humans, machines, and algorithms will interact more, leading to 97 million new jobs by 2025, according to the World Economic Forum (WEF, May 25, 2022). Rather than being a threat, this could be a chance for the accounting profession (Richins, Stapleton, Stratopoulos, & Wong, 2017). It is obvious that AI is not yet up to human capabilities and is not particularly effective at managing specifics. AI has made repetitious activities in the accounting fields easier to do, but it cannot

take the place of human judgment, which is a human-only skill. The accounting sector has already begun using AI. The Big Four accounting firms have been collaborating with the developers of AI systems to develop systems for auditing (Issa & Vasarhelyi, 2016). The use of AI technology in auditing is already in the development stage (Moffitt et al. 2018). Recently, the Big Four appear to be pursuing AI projects: Deloitte has increasingly concentrated its research and white papers on the subject of artificial intelligence; EY is aiming to automate the auditing process; PwC has also made a considerable investment in the development of AI for auditing; KPMG has developed its own AI tools (KPMG Ignite) (2020, Emerald-Business Intelligence and Analytics).

As the demand for AI grows significantly across industries, employers are looking for people who have even a basic understanding of it, even if they don't specialize in related subjects. Jobseekers should therefore possess the fundamental information processing skills that employers want. The likelihood of survival will be better for accountants who are proficient with AI. Following this trend, countries have started to include IT subjects in accountant exams, or at least demanding IT courses as a prerequisite for taking the accountant exams. The AICPA and NASBA, for example, are collaborating to modernize the CPA license paradigm to reflect the rapidly evolving skills and abilities required of CPAs now and in the future (Tysiac, 2019). According to Rufino, Lim, and Payabyab (2018), employers prefer professional accountants with technological expertise and abilities in addition to their accounting knowledge. Large accounting firms are considering incorporating AI into their accounting work and want to hire people who are experienced with both accounting and AI. In-house training has its limitations, though. Education authorities, institutions, and faculty must make an effort to prepare students for this.

As the accounting industrial environment evolves in tandem with AI, accounting education curricula must evolve as well. A new accounting curriculum that incorporates sustainable development challenges into accounting education should be designed (Ebaid, 2022). While the business sector constantly adjusts to new technologies, the accounting curriculum has been chastised for being rigid. Graduates in accounting will suffer as a result of this disproportionate response in academia and in their future professions, which will negatively affect their employability. The newest technology should be heavily considered when developing accounting curricula (Aldhizer, 2015; Qasim & Kharbat, 2020). Qasim and Kharbat (2020) recommend incorporating blockchain, business data analysis, and AI into accounting curricula at three different levels (introductory, intermediate, and senior), adhering to Tyler's (2013) approach. Other studies also point to a discrepancy between the accounting curriculum and the prevalent technologies in the sector (Al-Htaybat, Von Alberti-Alhtaybat, & Alhatabat, 2018; Rezaee, Dorestani, & Aliabadi 2018). To adapt to changes and improve graduates' employability, accounting curriculum should incorporate technology innovations as an important topic (Kotb et al., 2019). Higher education could undergo a fundamental transformation as a result of the use of new technologies like AI, business analytics, and blockchain. Accounting courses will also need to modify how they are created, taught, and assessed (Williams, 2019). ICT software tools should be taught in accounting classes, say Berikol and Killi (2021) to ensure that graduates have ICT skills. New technologies will have an impact on and transform the accounting profession, practice, and education; as a result, education must adapt to these new technologies (Al-Htaybat et al., 2018).

Research on accounting education has stalled and it has been advised that authors produce manuscripts that contribute to the literature on accounting education (Rebele & Pierre, 2015). In this context, accounting curriculum should incorporate data science into accounting lectures through the use of technologies such as Python and R programming, allowing it to be used in classrooms. Businesses mostly employ these computer languages - Python and R - to perform highly specialized and sophisticated statistical analyses. These two programming languages are used to create a variety of algorithms that carry out regression analysis, find data clusters, and carry out other programming operations (Bose & Bhattacharjee, 2022). Although its significance is acknowledged, it appears that there are not many examples of IT introduction and usage in the curriculum for accounting education. The accounting education system needs an overhaul, to be changed to incorporate technologies like Python, R, and SQL among others. The modern dynamic accounting environment, driven by technology innovation, calls for a revision of the accounting curriculum. As part of this endeavor, a teaching case for accounting analytics using Python is introduced in this paper. This study's primary objectives are to demonstrate the value of integrating AI technology into the accounting industry and to develop a curriculum that enables college students to have experience with data science in accounting. Students majoring in accounting should also be ready for a changing business environment by acquiring technical skills in addition to accounting knowledge, as the accounting work environment changes in tandem with technological improvements. Some practical examples of combining accounting with Python, a programming language that is suitable for beginners is provided in this paper. This paper offers several practical and approachable examples of integrating accounting with Python. The remainder of this study is structured as follows: The literature review is covered in Section 2. Teaching examples for accounting analytics using python are provided

in Section 3, and Section 4 includes a summary and conclusions.

2. Literature Review

2.1 Technological Innovation and Accounting Profession

The business world has long acknowledged the enormous influence that technological innovation has had for more than a decade. Piccarozzi, Aquilani, and Gatti (2018) reviewed the topics of Industry 4.0 in management literature and stated that the Fourth Industrial Revolution leads to adopting information technologies in manufacturing and services in a private sector. The accounting industry is not an exception to the effects of numerous technological advancements and solutions. The following processes-audit planning, analytical review procedures, materiality assessment, internal control appraisal, risk assessment, and going-concern decisions-are all aided by digitalization and automation, according to Moudud-Ul-Huq (2014). Many accounting tasks have been automated in many businesses, according to Arntz, Gregory, and Zierahn (2017). While maintaining accounting standards, it necessitates quick adaptation and adjustment of business procedures (Gulin, Hladika, & Valenta, 2019). AI innovation is also transforming the workplace by being utilized to collect and generate accounting data and information (Yoon, 2020). Working with an IT specialist is essential for an accountant. This is due to their key proactive role in running the company's operations. An accountant who is likewise proficient in IT will perform more efficiently (Moudud-Ul-Huq, 2014).

Because big data enhances measurement of the time and better comprehends the information, it can enhance the decision-making process (Liu & Vasarhelyi, 2014). Data management, or how businesses handle data processing to obtain accurate information, is the most significant effect of information technology advancements (Mancini, Lamboglia, & Castellano, 2017).

Richins et al. (2017) assert that accountants have the opportunity to play a prominent role in problem-driven studies of structured and unstructured data and to assist data scientists in exploratory investigations to produce value through the use of data analytics. Because accountants are already accustomed to working with structured data sets and performing data analytics, Richins et al. (2017) contend that data analytics presents an opportunity for accounting.

Industry seeks to hire people with suitable abilities, and preparing them in a quickly expanding technological environment is a severe concern for academia and graduate employment (Stephanidis, Fitzgerald, & Council, 2013).

Big data and analytics have led the audit profession to include more business analytical procedures into present auditing processes, claim Appelbaum, Kogan, and Vasarhelyi (2017). Analytical proficiency is a crucial necessity for accountants (Kokina, Pachamanova, & Corbett, 2017). Finally, large accounting firms have recently emphasized the use of technology: PwC (2021)'s slogan of ''Tomorrow's audit''; and from Deloitte (2021), ''Time has come for external audits to embrace the use of analytics and technology.''

Humans are concerned that AI will take away their employment (Kotb et al., 2019), however if AI is employed correctly, additional jobs and more work efficiency can be predicted, as the World Economic Forum predicts 97 million new jobs by 2025. Given that accounting is a field with many repetitive tasks, AI may eventually replace human labor in this field. AI, however, has serious limitations when it comes to accounting data interpretation. According to Richins et al. (2017), rather than being a threat, this may present an opportunity for the accounting industry.

2.2 Technological Innovation and Accounting Curriculum

AI, the underlying technology of the Fourth Industrial Revolution is rapidly evolving. The educational curriculum must evolve with the market environment and the types of human resources needed by businesses. Knowledge of information systems is essential to the practice of accounting, and accounting education programs. Numerous existing studies make the case that accounting academics and practitioners must both adjust to these technological advancements. As educators, academics must update their accounting courses if they want to prepare students for the profession's use of big data (Griffin & Wright, 2015). Forensic accounting courses have already been embraced by many schools in Hong Kong and mainland China, according to research by Wang, Lee, and Crumbley (2016). Rezaee and Wang (2019) recommended that forensic accounting, big data/data analysis, and accounting education be included into company curricula based on the survey's findings. Educational institutions must alter their curricula to be able to meet changing market demands (Balios, Kotsilaras, Eriotis, & Vasiliou, 2020).

PriceWaterhouseCoopers (2015) recommended some technical skills in undergraduate accounting programs that can help students prepare for new business environments. Those skills include basic computing courses (Python or Java),

first statistics course (Introduction to programming with R), and second statistics course (Documenting analysis with R, Use of GitHub, and Statistics). Students have the opportunity to take advantage of the growing multidisciplinary field and interest in accounting and analytical employment opportunities through the accounting analytics program (Woodside, Augustine, Chambers, & Mendoza, 2019).

One impetus for innovation in accounting instruction has been the COVID-19 pandemic (Yoon, 2020; Meredith, 2022). The necessity for accounting educators to drive significant change is discussed by Meredith (2022) so that they can explore technology-enhanced accounting education. Losi, Isaacson, & Boyle (2022) also suggest that accounting departments should take faculty members' competence in data analysis knowledge into consideration and concentrate on integrating specific data analysis abilities throughout the accounting curriculum based on this consideration.

However, accounting professors and administrators are confused about what should be addressed in the information systems field (Rebele & St. Pierre, 2015). Despite the fact that industry 4.0 has emerged as a new topic for management academics and the study of business economics, there is still a dearth of literature on the subject (Piccarozzi, Aquilani, & Gatti, 2018). Andiola, Masters, & Norman (2020) investigate ways to incorporate data analytics and emerging technologies into accounting curricula to represent the fast evolving business environment. According to Kennedy and Stratopoulos (2022), it is still a major problem to find professors who can teach accounting courses, such as the accounting curriculum proposed by Andiola et al. in 2020.

For students to be able to adapt to the changing environment, accounting curricula should contain analytical abilities, which are crucial for accountants (McKinney, Yoos, & Snead, 2015). From an interdisciplinary standpoint, it is conceivable to combine accounting and technology courses (Rebele & St. Pierre, 2015). Woodside, Augustine, Chambers, & Mendoza (2020) examined the curriculums of top accounting programs, as well as the course curriculum map, accounting data skills matrix, and professional opportunities. They made a point of highlighting how the tailored accounting analytics program gives students the chance to benefit from the expanding multidisciplinary sector and student interest in accounting and analytical career options. A revolutionized curriculum should concentrate on a systematic approach to data analytics with the use of statistics and the use of real data, according to Richardson and Watson (2020). Richardson and Watson (2020) also argue that data analysis must be integrated into the accounting curriculum in order to innovate it. Even so, it can be challenging to switch from spreadsheets to a language like R (Kennedy & Stratopoulos, 2022).

The focus on data analytics has led to the creation of various case studies. Some case studies for teaching data analysis were examined by Raschke and Charron in 2021. A teaching example that combines the auditing subjects of inventory and fraud with fundamental data analytics was recently explored by Palier and Lee (2023). They suggested using and comparing Alteryx, a new tool that may be used to discover spreadsheet anomalies, and Excel, a widely used application, in a data analytics case study.

3. Methodology

The methodology utilized in this study is part of a case study. A case study is a comprehensive examination of certain real-world circumstances or the scenarios that are influenced by them. They are used as training aids by professionals and educators alike. This study, in particular, uses a combination of strategies to generate practice examples that demonstrates how accounting ideas can be applied to the fundamentals of Python. These examples are actually composed at a level that students who are not IT majors can use in school classes. The method employed by the study would give students hands-on experience that allows them to develop their comprehension and fluency in the Python programming language. To begin, there are other ways to install Python; however, for the sake of this study, Jupyter Notebook is used, thus ANACONDA installation—which is advantageous since it installs the Python library automatically—is used. Understanding the fundamental principles of Python enables one to craft a case study that effectively integrates programming with accounting ideas. The example is made to use programming that can be integrated with accounting principles, and the fundamental ideas of Python are presented beforehand. The Pandas software is specifically utilized, and it is imperative to comprehend Pandas in order to evaluate data in a tabular format with rows and columns. This is due to Python's popularity as a programming language for data analysis, which makes it easy to apply accounting concepts by building dataframes. Additionally, a number of operators, functions, and other methods that can be combined with accounting are used, along with the Iterable and the Numpy_financial templates. Individual Python inputs and outputs are introduced in the Results section that follows.

4. Results

Python is one of the most widely used computer languages for data analysis. This chapter presents learning examples combining accounting and Python. It focuses in particular on subjects that are primarily covered in the financial accounting principles. Of course, what is presented in this analysis is not necessarily suggested to be followed. There may be other approaches or simpler programming. This is a clear point, though. By enabling easy and varied use of Python, the examples hope to spark interest in Python in non-majors or beginners (such as accounting majors) and encourage future advancement of programming.

Anaconda, a distribution of Python, will be used in this analysis. The description of Anaconda is excluded in this study since the basics of working with Python can be sufficiently learned through other channels. This study includes seven cases. Understanding key financial statements is the first accounting challenge tackled in the case study. There were two approaches taken: utilizing Pandas to create a data frame and doing conditional calculations.

Second, in order to comprehend cash concepts for accounting purposes, the 'groupby' sum in Python is introduced. The third accounting issue is valuing account receivable, and Python's multiplication between columns is introduced to address this. The fourth concept is analyzing inventory cost flow assumptions, and for this, the != (inequality) operator is introduced in python computations between columns. Fifth, the accounting issue of how to compute depreciation is linked to Python's list creation; how to iterate lists using the operator '*'; how to calculate the cumulative sum of an iterable using the itertools.accumulate(iterable) method; and how to perform subtraction between list elements using the zip function. The sixth accounting concept is linked to Python's Practice Numpy-financial for bond present value computation. Finally, in Python calculations between columns and the 'loc' function are introduced to help grasp financial ratio analysis. Examples of how Python can be utilized in these seven accounting concepts are provided below.

Case 1. Understanding Financial Statements and Basic Accounting Equation

The learning objectives of Case 1:

(1) Accounting: Understand the components of two financial statements--Statement of Financial Position and Statement of Income; basic accounting equations.

(2) Python: How to create data frames using Pandas; How to do conditional calculation.

Pandas is a Python library that makes data analysis easier. To utilize the Pandas library, the following must typically be imported:

```
import pandas as pd
from pandas import Series, DataFrame
```

Case1 - Example1.

As of December 31,20xx, the assets and liabilities of ABC Company are listed below:

Cash 120,000; Account Receivables 180,000; Inventory 85,000; Property, Plant, and Equipment 190,000; Account Payables 146,000; Short-term borrowings 130,000.

Using the accounting equation, determine Owner's Equity, as of December 31, 20xx. (Answer: 299,000)

The following Figure1&2 are Python inputs and outputs for creating a data frame:

```
FinPosit = {'account':['cash', 'ar', 'inv', 'ppe','ap','borrowings'],'amount':[120000,180000,85000,190000,146000,130000],
         'identification': ['asset','asset','asset','asset','liability','liability']}
data=DataFrame(FinPosit)
data
```

	account	amount	identification
0	cash	120000	asset
1	ar	180000	asset
2	inv	85000	asset
3	ppe	190000	asset
4	ap	146000	liability
5	borrowings	130000	liability

Figure 1. How to Create Data Frame for Statement of Financial Position Using Pandas

Use '==' to create a conditional expression and perform an operation as shown below. Owners' equity can be calculated.

```
data[data['identification']=='asset']['amount'].sum()-data[data['identification']=='liability']['amount'].sum()
```

```
299000
```

Figure 2. How to Do Conditional Calculation

Case1 - Example2.

The followings are taken from the financial statements of XYZ Company:

Sales 28,000 Advertising Expense 1,500; Prepaid Rent Expense 2,350; Account Payables 300; Rent Expense 3,000; Salary Expense 6,500; Supplies Expense 2,700; Interest Expense 500.

Determine Net Income. (Answer: 13,800)

The following Figures 3 and 4 are Python inputs and outputs for creating a data frame:

```
IncomeState = {'account':['sales','adv','prepaidR','ap','rentexp','salaryexp','suppexp','intexp'],
               'amount':[28000,1500,2350,300,3000,6500,2700,500],
               'identification': ['revenue','expense','asset','liability','expense','expense', 'expense','expense']}
data=DataFrame(IncomeState)
data
```

	account	amount	identification
0	sales	28000	revenue
1	adv	1500	expense
2	prepaidR	2350	asset
3	ap	300	liability
4	rentexp	3000	expense
5	salaryexp	6500	expense
6	suppexp	2700	expense
7	intexp	500	expense

Figure 3. How to Create Data Frame for Income Statement Using Pandas

Using '==', the conditional expression, the amount of net income can be calculated as follows:

```
data[data['identification']=='revenue']['amount'].sum()-data[data['identification']=='expense']['amount'].sum()
```

```
13800
```

Figure 4. How to Use Conditional Expression

Case 2. Cash

Coins, bills, checks, money orders, and cash on hand or on deposit in a bank are all examples of cash.

The learning objectives of Case 2:

(1) Accounting: Understanding what is included in cash for accounting purposes.

(2) Python: How to create data frame using Pandas; Practice how to calculate the 'groupby' sum.

Case 2 - Example.

Identify each of the followings and calculate Cash and Non-Cash amounts.

Currency 1,500; Checks 2,200; Money Orders 3,000; Notes Receivables 1,900; Checking Account 8,000; Account Receivables 2,000 (Answer: 14,700; 3,900)

Similar to above, Figures 5 and 6 are Python inputs and outputs for creating a data frame:

```
cash = {'account':['currency','checks','moneyorders','nr','checkingacc','ar'],
        'amount':[1500,2200,3000,1900,8000,2000],
        'identification': ['cash','cash','cash','noncash','cash','noncash']}
data=DataFrame(cash)
data
```

	account	amount	identification
0	currency	1500	cash
1	checks	2200	cash
2	moneyorders	3000	cash
3	nr	1900	noncash
4	checkingacc	8000	cash
5	ar	2000	noncash

Figure 5. How to Create Data Frame for Cash Using Pandas

The 'groupby' sum can be calculated as follows:

```
data.groupby('identification').sum()
```

identification	amount
cash	14700
noncash	3900

Figure 6. How to Calculate the 'groupby' Sum

Case 3. Valuing Accounts Receivable

Analysis used to estimate the uncollectible accounts; involves stratification of receivables based upon age.

The learning objectives of Case 3:

(1) Accounting: How to value account receivable, the allowance method of accounting for uncollectible receivables based on aging of accounts receivable

(2) Python: How to create data frame using Pandas; multiplication between columns; Add that value to the new column.

Case 3 - Example.

The company prepared the following aging schedule for its accounts receivable. Estimate allowance for uncollectibles. (Answer: 2,050)

Aging Schedule

Aging class	AR bal.	% estimated uncollectible
0-60 days	70,000	1%
61-90 days	15,000	4%
91-180 days	5,000	10%
More than 180 days	1,000	25%

Below, Figures 7 and 8 are Python inputs and outputs for creating a data frame:

```
AR = DataFrame({'aging class':['0-60 days','61-90 days ','91-180 days ','More than 180 day'],
                'ARbal':[70000,15000,5000,1000],'Est':[0.01,0.04,0.10,0.25]})
AR
```

	aging class	ARbal	Est
0	0-60 days	70000	0.01
1	61-90 days	15000	0.04
2	91-180 days	5000	0.10
3	More than 180 day	1000	0.25

Figure 7. How to Create Data Frame for Account Receivables Using Pandas

After multiplying between the columns of the data frame and adding the value to a new column, the sum of them becomes the estimated uncollectibles.

```
AR['allowance']=AR['ARbal']*AR['Est']
AR
```

	aging class	ARbal	Est	allowance
0	0-60 days	70000	0.01	700.0
1	61-90 days	15000	0.04	600.0
2	91-180 days	5000	0.10	500.0
3	More than 180 day	1000	0.25	250.0

```
Allsum=sum(AR['allowance'])
print(Allsum)
```

```
2050.0
```

Figure 8. Multiplication between Columns; Add That Value to the New Column

Case 4. Accounting for Merchandising Businesses Inventories

The unit cost of an item in inventory must be determined using a cost flow assumption. There are three common cost flow assumptions: First-in, First-out Method; Last-in, First-out Method; Average Method. Here, Average Method under a periodic inventory system would be used in an effort to provide a simple example.

The learning objectives of Case 4:

(1) Accounting: Understand inventory cost flow assumptions

(2) Python: How to create data frame using Pandas; Calculations between column; use of != (inequality) operator

Case 4 - Example.

Date	Transaction	Q	P
2020-03-01	BI	5	20,000
2020-03-09	purchase	15	16,000
2020-03-16	sale	10	
2020-03-24	purchase	20	24,000
2020-03-29	sale	12	

Cost of merchandise sold using average cost method, periodic inventory system? (Answer: 20,500)

Figures 9~11 are Python inputs and outputs for creating a data frame:

```
inventory = {'transaction':['bi','purchase','sale','purchase','sale'],
         'q':[5,15,10,20,12],'p':[20000,16000,0,24000,0]}
data = DataFrame(inventory)
data
```

	transaction	q	p
0	bi	5	20000
1	purchase	15	16000
2	sale	10	0
3	purchase	20	24000
4	sale	12	0

Figure 9. How to Create Data Frame for Inventory Using Pandas

The following is how to multiply between columns and add a new column to the data frame:

```
data['pq']=data['q']*data['p']
data
```

	transaction	q	p	pq
0	bi	5	20000	100000
1	purchase	15	16000	240000
2	sale	10	0	0
3	purchase	20	24000	480000
4	sale	12	0	0

Figure 10. How to Multiply between Columns and Add New Column to Data Frame

By dividing between columns, the cost of merchandise sold using average cost method under periodic inventory system can be calculated as follows:

```
data['pq'].sum()/data[data['transaction']!='sale']['q'].sum()
```

```
20500.0
```

Figure 11. How to Divide between Columns

Case 5. Fixed Assets - Depreciation

The Straight-Line Method is employed in this case among the numerous depreciation techniques. The Straight-Line Method provides for the same amount of depreciation expense for each year of the asset's useful life.

Annual depreciation = (Cost – Residual value)/Estimated life

The learning objectives of Case 5:

(1) Accounting: How to compute depreciation, using strait-line method

(2) Python: How to create lists; How to iterate lists using the operator '*'; How to calculate the cumulative sum of an iterable using itertools.accumulate(iterable) method; Use the zip function to perform subtraction between list elements.

Case 5 - Example.

cost=100000; residual value=5000; useful life=4

Determine book value, end of year. (Answer: 76,250; 52,500; 28,750; 5,000)

Figure 12~15 illustrates how lists can be created:

```
cost=100000
rv=5000
ul=4
anndepre=(cost-rv)/ul
print(anndepre)
```

```
23750.0
```

Figure 12. How to Create Lists

Lists can be iterated using the operator '*':

```
cost=[100000]
anncost=cost*4
print(anncost)
anndepre=[23750]
aanndepre=anndepre*4
print(aanndepre)
```

```
[100000, 100000, 100000, 100000]
[23750, 23750, 23750, 23750]
```

Figure 13. How to Iterate Lists Using the Operator '*'

The following is how to calculate the cumulative sum of an iterable using a method from the Python module "itertools" called accumulate, which takes an iterable as an argument.

```
import itertools
accdepre = list(itertools.accumulate(aanndepre))
print(accdepre)
```

```
[23750, 47500, 71250, 95000]
```

Figure 14. How to Calculate the Cumulative Sum of an Iterable

List components can be subtracted from one another using the zip function. Finally, the book value of each end of year can be determined as follows:

```
[x-y for x,y in zip(anncost, accdepre)]
```

```
[76250, 52500, 28750, 5000]
```

Figure 15. How to Use the Zip Function to Perform Subtraction between List Elements

The methodology described in this case can appear a little complicated, but it is meant to be used to practice various methods.

Case 6. Bonds

Bonds are regarded as a challenging topic for students in financial accounting courses since they call for an understanding of present value ideas. Numpy is the most basic module when implementing numerical analysis and statistics-related functions with Python. The issue price of bonds may be easily computed using the Numpy_financial template (https://gist.github.com), as illustrated below, and the notion of bonds can be better understood.

The learning objectives of Case 6:

(1) Accounting: How to compute present value of bonds.

(2) Python: Practice Numpy-financial

Case 6 - Example.
principal = 100000; market interest rate = 0.12; due in 3 years; interest = 0.10 * principal
Present value of bonds? (Answer: 95,196)

The issuance price of the bond can be easily calculated using the Numpy_financial template, as shown in Figure 16.

```
import numpy_financial as npf
import numpy as np

principal = 100000
market_interestrate = 0.12
period = 3
interest = 0.10 * principal

PVbond = (npf.pv(market_interestrate, period, interest, principal)) * -1
print("The price of bond is : $" + str(PVbond))
```

```
The price of bond is : $95196.33746355685
```

Figure 16. Practice Numpy-financial

Case 7. Financial Statements Analysis

Financial statement analysis examines the relationships between financial statement amounts and takes into account both the historical trends in the figures as well as their relationships with one another. Financial Statement Analysis fits into the decision-making cycle. All interested parties, including investors, creditors, and management, can employ financial statement analysis.

The learning objectives of Case 7:

(1) Accounting: Understand some ratio analyses such as current ratio, quick ratio, dent ratio, debt-to-equity ratio, asset-to-equity ratio.

(2) Python: How to create data frame using Pandas; Calculations between column; Add that value to new row using 'loc' function.

Case 7 - Example.

Based on the following information,

Calculate (a) owner's equity amount; (b) Ratios - Current ratio, Quick ratio, Debt-to-equity ratio, Debt ratio, Assets-to-equity ratio

Cash and cash equivalents	75,000
Temporary investments	65,000
Accounts receivable, net	60,000
Inventories	100,000
Total current assets	300,000
Property, plant, and equipment	400,000
Total assets	700,000
Accounts payable	80,000
short-term debt	120,000
Bonds payable	150,000
Total liabilities	350,000

(Answer: Owner's equity 350,000; current ratio 1.5; quick ratio 1.0; debt ratio 0.5; Debt-to-equity ratio 1.0; assets-to equity ratio 2.0)

Figures 17 and 18 are Python inputs and outputs for creating a data frame:

```
fs = {'acc':['cash','ti','ar','inventory','tca','ppe','ta','ap','std','bp','tl'],
'amount':[75000,65000,60000,100000,300000,400000,700000,80000,120000,150000,350000],
      'class':['qa','qa','qa','nqca','tca','nca','ta','cl','cl','ncl','tl']}
data = DataFrame(fs)
data
```

	acc	amount	class
0	cash	75000	qa
1	ti	65000	qa
2	ar	60000	qa
3	inventory	100000	nqca
4	tca	300000	tca
5	ppe	400000	nca
6	ta	700000	ta
7	ap	80000	cl
8	std	120000	cl
9	bp	150000	ncl
10	tl	350000	tl

Figure 17. How to Create Data Frame for Ratio Analysis Using Pandas

The values to be calculated and added to the new rows using the 'loc' function are as follows:

```
data.loc[12]=['cr',data[data['class']=='tca']['amount'].sum()/data[data['class']=='cl']['amount'].sum(), 'na']
data.loc[13]=['qr',data[data['class']=='qa']['amount'].sum()/data[data['class']=='cl']['amount'].sum(), 'na']
data.loc[14]=['dr',data[data['class']=='tl']['amount'].sum()/data[data['class']=='ta']['amount'].sum(), 'na']
data.loc[15]=['dte',data[data['class']=='tl']['amount'].sum()/data[data['class']=='oe']['amount'].sum(), 'na']
data.loc[16]=['ate',data[data['class']=='ta']['amount'].sum()/data[data['class']=='oe']['amount'].sum(), 'na']
```

```
data
```

	acc	amount	class
0	cash	75000.0	qa
1	ti	65000.0	qa
2	ar	60000.0	qa
3	inventory	100000.0	nqca
4	tca	300000.0	tca
5	ppe	400000.0	nca
6	ta	700000.0	ta
7	ap	80000.0	cl
8	std	120000.0	cl
9	bp	150000.0	ncl
10	tl	350000.0	tl
11	oe	350000.0	oe
12	cr	1.5	na
13	qr	1.0	na
14	dr	0.5	na
15	dte	1.0	na
16	ate	2.0	na

Figure 18. Calculations between Columns; Add That Value to New Row Using 'loc' Function

4. Discussion and Conclusions

All industries are evolving with technological innovation. For accounting, future trends would involve utilizing the possibilities of IT technologies such as cloud, accelerated automation, and breakthroughs via blockchain (Forbes, 2018). On the one hand, it is hoped that the advancement of AI will speed up and streamline work processes; but, on the other hand, it is anticipated that AI will eventually replace human labor in all industries, particularly in the accounting sector, which is thought to have many repetitive activities. AI has simplified repetitious accounting tasks,

but it still cannot take the place of human judgment. And fortunately, AI can deliver information more quickly than humans because of their consistency and capacity to comprehend and evaluate accounting data (Petkov, 2020). As a result, accountants with IT expertise can work more efficiently. Employers prefer professional accountants with technology expertise and competencies in addition to accounting knowledge, according to Rufino et al. (2018). Large accounting firms, of course, do the same. For those in the accounting sector who have IT skills, there may be several opportunities to find new career paths.

The discrepancy in the technological adoption between auditors and management professionals is another problem that begs the question of whether the auditing community is open to embracing novel approaches such as Big Data Analytics (Alles, 2015). Also, while there is a growing awareness of the need for education and learning reform to keep up with the rapid breakthroughs in technology since the COVID-19 epidemic, there is still a considerable lag in keeping up with these developments. Educational institutions as well as accounting and auditing professionals must work to adapt to technology advancements and incorporate changes in the accounting and auditing sector.

According to PriceWaterhouseCoopers (2015), technical skills that can assist students in getting ready for a new business environment should be taught in undergraduate accounting programs. To appropriately prepare students for the evolving AI-driven accounting environment, accounting education curricula must be updated. The evolution of the accounting curriculum, however, appears to be still far behind the development of the sector. When developing accounting courses, the most recent technologies should be heavily examined (Qasim & Kharbat, 2020; Richardson & Watson, 2020) and ICT software tools should be taught in accounting classes (Berikol & Killi, 2021). The COVID-19 epidemic has fueled innovation in technology-enhanced accounting education (Meredith, 2022). Start here

However, finding academics who can teach accounting courses that incorporate analytical skills is still a big concern. Accounting departments should focus on integrating specific data analysis skills into the accounting curriculum and take faculty members' proficiency in data analysis expertise into account (Kennedy & Stratopoulos, 2022; Losi et al., 2022). Furthermore, there aren't many studies that offer examples of cases that can be used in actual lectures, despite the fact that its importance is recognized.

To undertake highly specialized and complex statistical analyses, accounting education needs to be altered to include technologies like R, Python, SQL, and other technologies. Regression analysis, data clustering, and other programming operations can all be done using a number of algorithms created using the two computer languages R and Python (Bose & Bhattacharjee, 2022). This paper introduces a teaching case for Python-based accounting analytics as a part of this initiative. Previous research has explored the relationship between technological innovation and the accounting profession or curriculum. This study, however, offers a practical demonstration of how accounting concepts can be applied to the fundamentals of Python through the use of direct examples. Research offering such an immediate, hands-on experience has been scarce.

There were seven cases in this study. Accounting topics included understanding financial statements, basic accounting equation concepts, definition of cash in accounting, valuing account receivable, understanding inventory cost flow assumptions, how to depreciate fixed assets, how to compute present value of bond, and financial statements analysis. ANACONDA and Jupyter Notebook were utilized in this study to connect these accounting problems to Python. Along with a number of operators, functions, and other methods that can be used with accounting, the Iterable and the Numpy_financial template were also used. These tools come with several accounting problems, such as: how to use Pandas to create a data frame; how to do conditional calculations; how to introduce the 'groupby' sum in Python; how to multiply data between columns; how to use the operator '*'; how to compute the cumulative sum of an iterable; how to use the zip function; and how to use the 'loc' function. These are only a few examples of how accounting and Python have been combined. However, it will be crucial to spark non-major students' attention in order to give them a taste of programming and encourage in-depth learning.

Many outstanding case studies that combine accounting and data science to engage students in a more understandable manner are expected to be available for use in teaching. Through practical experience, the topics in this study will serve as components for updated accounting curricula for students, helping them to gain more fluency and understanding of the Python programming language. These hands-on experiences have the potential to equip students with valuable skills that will be invaluable in their future IT employment. It is intended that this research will act as inspiration for the creation of a curriculum that can readily connect each subject with data science in a more diverse field, helping to improve the number of students who are better equipped. This study has certain limitations in spite of its contributions. Other technologies that can be coupled with accounting include R, Python, SQL, and many more. This study, which is a case study, generates practical examples that show how accounting

concepts can be applied to the foundations of Python using a variety of ways. In this study, however, just Python is used. Still another limitation is a lack of sound methods. Little research has been done on the use of digitalization in accounting and how it affects the accounting industry. Future studies can combine different technologies outside Python with accounting, to create a curriculum that offers a range of practical experiences. Furthermore, research employing techniques like surveys and in-depth interviews could offer insights into how to better adjust to the automated and digital world.

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Acknowledgments

Not applicable.

Authors contributions

Not applicable.

Funding

Not applicable.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Sciedu Press.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.