B

Data Analytics and Blockchain Technology

LO	Learning Objective	Page	Assignments
LO1	**Identify and define the four types of data analytics.**	B-2	MC1, EB1, EB2, EB3, EB4, EB5, EB6, EB7, EB8, EB9 EB10
LO2	**Describe the use of data analytics within the accounting profession.**	B-2	MC1, EB1, EB2, EB3, EB4, EB5, EB6, EB7, EB8, EB9 EB10
LO3	**Describe how blockchain technology works.**	B-3	MC2, E11, EB12, EB13, EB14
LO4	**Describe the use of blockchain technology within the accounting profession.**	B-3	MC2, E11, EB12, EB13, EB14

DATA ANALYTICS

Data analytics can broadly be defined as the process of examining sets of data with the goal of discovering useful information from patterns found in the data. Increasingly, this process is aided by computers running programs ranging from basic spreadsheet software, such as **Microsoft Excel** and **Google Sheets**, to specialized software, such as **Tableau**. This technology can reveal trends and insights that would otherwise be lost in the overwhelming amount of data.

Data analytics can be categorized into four mains types, ranging in sophistication from relatively straightforward to very complex. The first category is **descriptive analytics**, which describes what has happened over a given period of time. Simple examples include determining sales trends over a period of time and the relative effectiveness of various social media promotions based on click-through rates. Microsoft Excel and other spreadsheet programs include built-in functions that greatly simplify performing descriptive analytics.

Diagnostic analytics focuses more on why something occurred. This data analytics technique is used to monitor changes in data and often includes a certain amount of hypothesizing: Did the marketing campaign lead to the increase in sales? Did changing the beverage items affect food choices? Did the opening of competing restaurants negatively impact sales growth? Diagnostic analytics is useful because past performance is often a reliable predictor of future outcomes and can greatly aid in planning and forecasting.

Whereas descriptive and diagnostic analytics use data to try to understand what happened and why, **predictive analytics** uses data to try to determine what will happen. The movie, **Moneyball** made the general manager of the **Oakland Athletics**, Billy Beane, famous for using predictive analytics to make personnel decisions in professional baseball. In his evaluation of baseball players, Beane used data to predict player performance so he could assemble the team with the greatest likelihood of winning the World Series. Banks also use predictive analytics to identify and prevent fraudulent transactions by monitoring customer credit card transactions and red flagging those that deviate from a customer behavior profile that was developed from previous transaction and geographic data.

Prescriptive analytics moves beyond what is going to happen to suggesting a course of action for what should happen to optimize outcomes. The forecasts created using predictive analytics can be used to make recommendations for future courses of action. For example, if we own a sports bar and determine there is a high likelihood of our local sports team winning the championship this year, we should expand the bar area and add more big-screen televisions to maximize revenues. **Exhibit B1** summarizes the four types of data analytics.

EXHIBIT B.1

Type of Data Analytics	Purpose	Example
Descriptive	To explain what happened	Sales trends for last year
Diagnostic	To understand why it happened	Did the new advertising campaign cause sales to increase last quarter?
Predictive	To predict what will happen	Predicting fraudulent charges based on past behaviors
Prescriptive	To determine what should happen	Expand business to optimize sales based on predicted championship

Data Analytics in the Accounting Profession

Most accountants are likely already performing descriptive analytics in their regular work. This includes, for example, determining sum totals, averages, and period-to-period changes in such measures as net sales and net income. Other examples include average collection periods and day's sales in inventory by product type. Data analytics has other usefulness and should not be limited to only descriptive analysis. Accountants can provide far more value by employing predictive and prescriptive analytics.

Accountants can obtain data from a variety of company sources, including enterprise resource planning systems, customer relationship management systems, and point-of-sale systems, to aid them in obtaining insight into future outcomes and providing guidance for future actions. The area of credit granting provides an example. Predictive analytics can help compute credit scores to predict the likelihood of future payments. As a result, prescriptive analytics can aid in suggesting terms for granting credit.

Many other opportunities exist for accountants to utilize data analytics. Tax accountants can apply data analysis to unique tax issues to suggest optimal tax strategies. Accountants serving as investment advisors

eLectures
MBC

LO1 Identify and define the four types of data analytics.

1

eLectures
MBC

LO2 Describe the use of data analytics within the accounting profession.

2

can use big data to find patterns in consumer behavior that others can use to build analytic models for identifying investment opportunities.

Perhaps no area of accounting can benefit more from an understanding of data analytics than auditing. Auditors employ data analytics to shift from the sample-based audit model to one based on continuous modeling of much larger data sets. This allows auditors to identify the riskiest areas of an audit by focusing on outliers and exceptions.

The major accounting firms have fully embraced the power of data analytics. **PricewaterhouseCoopers** (PWC), **Deloitte**, **Ernst & Young** (EY), and **KPMG** all devote significant staffing resources to provide data analytics services to their clients. These firms claim they can help their clients optimize their data assets to aid in faster and better decisions. For example, PWC provides a flowchart starting with the building of a data foundation and applies advanced analytics to improving business performance, ultimately leading to opportunities for innovation.

While computers and software are instrumental in the entire process, the human element is the most critical factor in the success of any data analytics program. One commonality among surveys of top company managers is the value placed on data analytics for the company's future. Another commonality is the need for professionals trained in data analytics to help the company attain its goals.

BUSINESS INSIGHT

Data Analytics in Accounting Benford's Law provides an example of how data analytics has been used to uncover fraud in a national call center. Forensic accountants utilized their knowledge of Benford's Law to form evidence of a problem by observing patterns in the data. According to Benford's Law, in any list of financial transactions, the number one should occur as the first digit 30.1 percent of the time, with each successive number occurring as the first digit in lesser percentages, with the number nine occurring less than 5 percent of the time. Forensic accountants examined issued refunds and noticed an excessively high occurrence of the number four. The forensic accountants learned that the company had a policy that required supervisor approval of refunds that exceeded $50. The accountants were able to identify a small group of operators who had been issuing fraudulent refunds to family, friends, and themselves. These fraudulent $40 refunds totaled several hundred thousand dollars.

LO3 Describe how blockchain technology works.
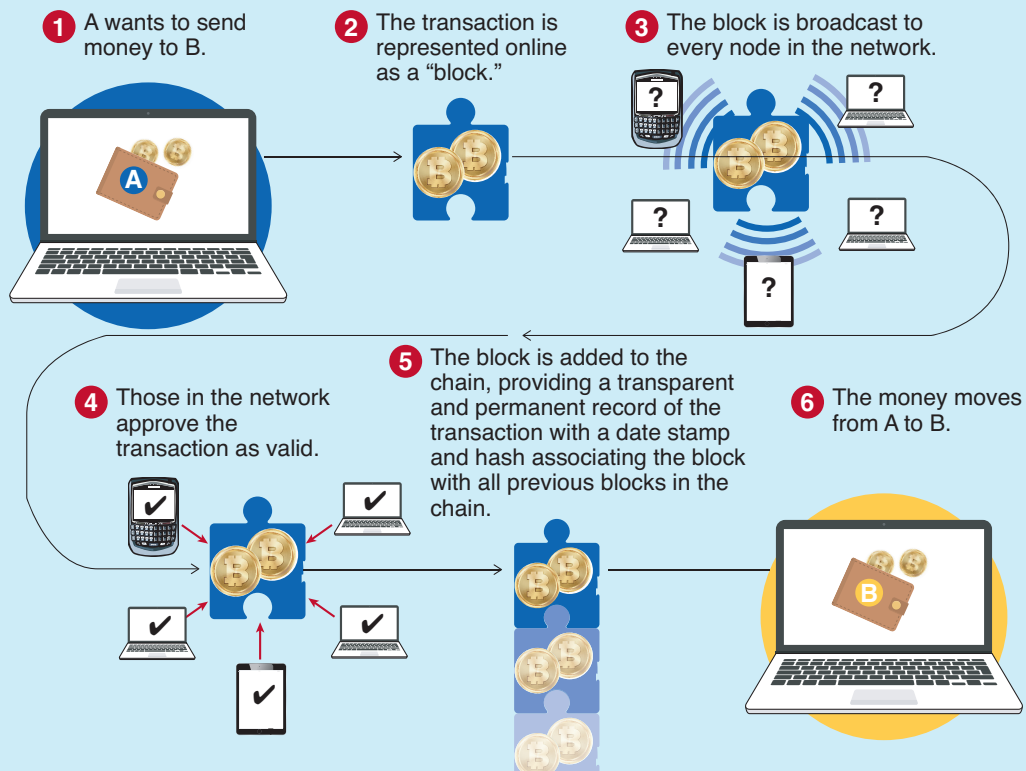
3

BLOCKCHAIN TECHNOLOGY

Blockchain technology differs from the traditional accounting ledger in a fundamental way that has immense implications for the accounting profession. A traditional ledger system is a closed system controlled at a centralized location with individuals at the centralized location responsible for the maintenance and integrity of the ledger. In contrast, a blockchain is an open, decentralized ledger, where the ledger is distributed across multiple computers called **nodes**. The blockchain ledger is managed autonomously by the distributed nodes such that data is authenticated by mass collaboration rather than by a central authority. Each node on the blockchain maintains a complete copy of all past transactions that have been added to the ledger. Thus, by comparing to the other nodes' copies, the ledger is continuously synchronized. Unlike traditional accounting ledgers, none of the nodes have any special rights that differ from those of the other nodes.

Blockchains get their name because new ledge data are periodically bundled into blocks, which are then added to previous blocks to form a chain. Each block can contain a cryptocurrency exchange, as is the case with **Bitcoin**, but other possibilities include sales transactions, equity trades, loan payments, election votes—pretty much any contract transaction. In addition, the block contains a **time stamp** and a **hash #**, which together form a cryptographic signature associated with the previous blocks. This time stamp and hash make the blockchain essentially tamper-proof because the blocks cannot be changed without the change being apparent to all other nodes. While the chain propagates in only a single chronological order, it can be audited in both directions. **Exhibit B-2** is a visual depiction of the blockchain process.

LO4 Describe the use of blockchain technology within the accounting profession.

4

The accounting profession has seen changes arising from a vast array of technological innovations, from computer spreadsheets to general ledger software to enterprise resource systems. Blockchain technology represents another innovation in the way accounting is and will be performed. The invention of double-entry accounting, the bedrock of financial accounting, allowed managers to trust their own financial record-keeping. Unfortunately, the same level of trust does not exist with outsiders, which is why companies rely on independent auditors for an opinion on the integrity of an entity's financial statements. These audits are often very time-consuming and costly.

EXHIBIT B.2

How a Blockchain Works

1 A wants to send money to B.

2 The transaction is represented online as a "block."

3 The block is broadcast to every node in the network.

4 Those in the network approve the transaction as valid.

5 The block is added to the chain, providing a transparent and permanent record of the transaction with a date stamp and hash associating the block with all previous blocks in the chain.

6 The money moves from A to B.

Accountants working in the traditional centralized-ledger environment are likely to spend a large amount of time reconciling accounts and amounts. This involves comparing balances at their company with external documents from outside entities, including banks, brokerages, and business partners, among others. In addition to the time-consuming process of acquiring all the needed sources of information and performing the comparisons, additional time and effort are often needed to reconcile any differences. In a blockchain's distributed ledger system, all node participants can continually confirm all transactions, greatly reducing the effort involved in periodic reconciliations.

Accountants working in the traditional environment are expected to produce internal, ad hoc reports. This often requires considerable effort reconciling internal documents, perhaps from multiple departments or divisions. In a blockchain environment, accountants spend far less time verifying transactional data, freeing up time for more valuable advisory activities.

As a final example of the many ways blockchain technology will change the way accountants work, consider the traditional closing of the books at the end of each period. Instead of needing to acquire the necessary data, verify its accuracy, and make all the necessary adjustments, one could envision a far more automated process with the use of blockchain technology. Financial statements could be updated continuously from data provided by the blockchain, making the period-ending closing process much less time-consuming.

Blockchain technology is widely viewed as the next major step in financial accounting. Instead of keeping separate records documenting each transaction, transactions can be written directly into the decentralized ledger. Thus, each transaction is distributed and cryptographically signed to ensure against later falsification or destruction. This has the potential to allow auditors to automatically verify much of the data in a traditional audit, freeing them to provide value in more important areas, such as the analysis of complex transactions or operational efficiencies.

Some accountants may worry that these evolving technologies will diminish the need for accountants. If history is any indication, the opposite is likely. The accountant's role in the financial process will certainly change, but this change will be evolution, not extinction. Information will still need to be interpreted and categorized before entering the blockchain, and this is where future accountants will provide their value. The Big Four accounting firms realize this and are at the forefront in research on how blockchain technology will be used.

SUMMARY

LO1 **Identify and define the four types of data analytics. (p. B-2)**

- Data analytics can broadly be defined as the process of examining sets of data with the goal of discovering useful information from patterns found in the data.
- Data analytics can be categorized into four types: descriptive, diagnostic, predictive, and prescriptive.

LO2 **Describe the use of data analytics within the accounting profession. (p. B-2)**

- Many accountants are already performing descriptive data analytics.
- Accountants can add much more value by performing predictive and prescriptive data analytics.
- The large accounting firms have devoted large resources to data analytics.
- Being well trained in data analytics is important for future accountants.

LO3 **Describe how blockchain technology works. (p. B-3)**

- A blockchain represents a decentralized ledger system.
- Each decentralized computer on the blockchain is called a node.
- Unlike a traditional ledger system where authority for maintenance and integrity rests at a centralized location, each node on the blockchain has the same rights as each other node.
- Each block in the blockchain contains information, such as transaction details, along with a time stamp and a hash linking the block to previous blocks in a chronological order.
- Blockchains are essentially tamperproof because alteration to a block by a node would be apparent to every other node on the blockchain.

LO4 **Describe the use of blockchain technology within the accounting profession. (p. B-3)**

- Blockchain technology represents another innovation that will change the way accountants perform their work.
- Blockchain technology will fundamentally change the way audits are performed because all parties to the blockchain will be able to independently verify all transactions.
- Blockchain technology will greatly reduce the time and effort accountants spend on other tasks, such as reconciling source documents, producing ad hoc reports, and performing period-ending book closings.

KEY TERMS

Blockchain technology (p. B-3)	Diagnostic analytics (p. B-2)	Predictive analytics (p. B-2)
Data analytics (p. B-2)	Hash # (p. B-3)	Prescriptive analytics (p. B-2)
Descriptive analytics (p. B-2)	Nodes (p. B-3)	Time stamp (p. B-3)

MULTIPLE CHOICE

LO1, 2 **1.** Which of the following are the four categories of data analytics?
- *a.* Descriptive, diagnostic, predictive, prescriptive
- *b.* Expressive, diagnostic, predictive, prescriptive
- *c.* Descriptive, analytical, predictive, prescriptive
- *d.* Descriptive, diagnostic, prognostic, prescriptive

LO3, 4 **2.** The glue that binds blocks in a blockchain consist of what?
- *a.* Time stamps
- *b.* Sequential numbering
- *c.* Regulatory approval
- *d.* Hashes
- *e.* Both *a.* and *d.*

EXERCISES

A video demonstrating the use of Microsoft Excel's built-in functions for data analysis is available on the textbook's website to assist in solving exercises EB-1 through EB-3.

EB-1. **Using Microsoft Excel for descriptive analytics.**   **LO1, 2**
Go to the book's website and download the file Employee data.xlsx **link**. You will need to have the Analysis Toolpak add-in installed in Excel. It can be found under the Tools tab. If it does not appear, select Excel Add-ins under the Tools tab, and then check Analysis Toolpak. From the Excel ribbon, select Data and then Data Analysis. From the pop-up window, choose Descriptive Statistics; then click OK. Select the salary column as the input range, and check the box for labels in the first row. Choose "New Worksheet" as the output option, click Summary Statistics, and click OK. Report the following:

a.   Mean (average) salary
b.   Median salary
c.   Minimum salary
d.   Maximum salary
e.   Number of salary observations in the database

EB-2. **Using the Microsoft Excel PivotTable function for descriptive analytics.**   **LO1, 2**
Go to the book's website and download the file Employee data.xlsx **link**. Place your cursor anywhere in the table of data. From the Excel ribbon, select Insert and then Pivot Table. The entire table should be selected automatically along with the choice to output the PivotTable to a new worksheet. Select OK. From the PivotTable Fields section, select and drag "Gender" and "Minority" to the "Rows" box below. Select and drag the variable "Education" to the "Columns" box. Select and drag the variable "Salary" to the "Values" box. Change the sum of salary to the average of salary by clicking the "i" icon to the right of the "Sum of Salary," choosing "Average," and then clicking OK. Report the following:

a.   Does additional education appear to be associated with a higher average salary?
b.   Do males (1) or females (0) appear to earn higher average salaries?
c.   Do minorities (1) or nonminorities (0) appear to earn higher average salaries? Does this hold for both genders?
d.   What is the average salary of the entire population? What is the average salary of the entire population of males? What is the average salary of the entire population of females? What is the average salary of the entire population of male minorities? What is the average salary of the entire population female minorities?

EB-3. **Using Microsoft Excel for diagnostic analytics.**   **LO1, 2**
Go to the book's website and download the file Employee data.xlsx **link**. You will need to have the Analysis Toolpak add-in installed in Excel. It can be found under the Tools tab. If it does not appear, you will need to select Excel Add-ins under the Tools tab and then check Analysis Toolpak. From the Excel ribbon, select Data and then Data Analysis. From the pop-up window, choose "Regression," and then click OK. Select values in the "Salary" column as the Input Y Range and values in the columns for "Gender" through "Education" for the Input X Range. Choose "New Worksheet" as the output option; then click OK. Report the following:

a.   A measure on how well the independent variables gender, minority, and education are able to explain the variation in average salary is the adjusted R Squared. What percentage of the variation in average salaries is described by these variables?
b.   The t Stat is a measure of how an individual independent variable explains variation in the dependent variable average salary. An absolute value greater than 2 is generally considered a significant value in explaining variation. What do the t Stats tell us about the ability of the variables gender, minority, and education to explain average salary?

A video demonstrating the use of Tableau Public for data analysis is available on the textbook's website, to assist in solving exercises EB-4 through EB-6. In addition, a series of tutorial videos is available on the Tableau website **https://public.tableau.com/en-us/s/resources**.

Go to the Tableau website, **https://public.tableau.com/en-us/s/**, and download the app in order to complete exercises EB-4 through EB-6.

LO1, 2   **EB-4.   Using Tableau to create summary statistics.**
Go to the book's website and download the file Employee data Tableau.xlsx **link**. Connect Tableau Public to this Excel file. Go to the worksheet and drag the measures "Education," "Jobcat," and "Jobtime" up to Dimensions. Compare the average salaries by gender and minority status by dragging "Gender" to Rows and "Minority" to Columns and then "Salary" to the canvas. Change salary from a sum to an average.

a.   How do average salaries compare by gender and minority status?

Next, explore how education level affects this relation by dragging "Education" to Columns. It may be easier to make this comparison by switching the order of "Minority" and "Education" on the Columns bar.

b.   Does education level affect how average salaries compare by gender and minority status?

Next, change salary from average to maximum.

c.   Does education level affect how maximum salaries compare by gender and minority status?

LO1, 2   **EB-5.   Using Tableau to calculate a visualization.**
Starting with the results from EB-4, change salary back to average. Select the side-by-side bar chart (ninth selection) from the "show me" selections.

Based on this visualization of the data, what can you say about relative salaries for males and females and for Caucasians and minorities?

LO1, 2   **EB-6.   Using Tableau to forecast future values.**
Go to the book's website and download the file Employee data Tableau.xlsx **link**. Connect Tableau Public to this Excel file. Go to the worksheet and drag the measures "Education," "Jobcat," and "Jobtime" up to Dimensions. Forecast average salaries for males and females based on Jobtime by first dragging "Gender" to Rows and "Jobtime" and "Salary" to Columns. Drag "Salary" to the canvas. Change salary from a sum to an average. From Analytics, select Forecast.

At 100 months of job time, how do the forecasts of average salary for males compare with females?

LO1, 2   **EB-7.   Public accounting firms and data analytics.**
Go to PWC.com and select "Services" and then "Data and Analytics." Choose a topic and write about how PWC is using data analytics to help its clients.

LO1, 2   **EB-8.   Public accounting firms and data analytics.**
Go to KPMG.com and select "Insights" and then "Data and Analytics." Choose a topic and write about how KPMG is using data analytics to help its clients.

LO1, 2   **EB-9.   Public accounting firms and data analytics.**
Go to Deloitte.com and select "Services" and then "Analytics." Choose a topic and write about how Deloitte is using data analytics to help its clients.

LO1, 2   **EB-10.   Public accounting firms and data analytics.**
Go to EY.com and click on the three horizonal lines in the upper right corner. Next, choose "What we do" and then select "Our services" from the menu on the right side. Finally, click "Analytics and big data" from the popular quick links. Choose a topic and write about how Ernst & Young is using data analytics to help its clients.

LO3, 4   **EB-11.   Public accounting firms and blockchain technology.**
Go to PWC.com and search for "blockchain." Choose a topic and write about how PWC is using blockchain to help its clients.

EB-12. **Public accounting firms and blockchain technology.**   **LO3, 4**
Go to KPMG.com and search for "blockchain." Choose a topic and write about how KPMG is using blockchain to help its clients.

EB-13. **Public accounting firms and blockchain technology.**   **LO3, 4**
Go to Deloitte.com and search for "blockchain." Select "Blockchain—Perspectives, insights, and analysis." Choose a topic and write about how Deloitte is using blockchain to help its clients.

EB-14. **Public accounting firms and blockchain technology.**   **LO3, 4**
Go to EY.com and search for "blockchain." Choose a topic and write about how Ernst & Young is using blockchain to help its clients.