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Measuring the Learning Effectiveness of Two Courses in a Program in Accounting Data and Analytics

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Abstract
Driven by rapid technological innovation, information technology (IT) is expected to significantly alter the way that accountants work. However, both accounting researchers and practitioners have observed a shortage of accounting professionals who currently possess the relevant technology skillsets to exploit technological advances. In response, the School of Accountancy of a Singapore-based university launched a second major program in Accounting Data and Analytics in 2018. In this study, we examine the learning effectiveness of two courses – Business Data Management and Data Modelling & Visualization – offered as part of the program. Overall, our results suggest that the courses are effective in enhancing the learning of participants in the areas of business data management, data modelling, and data visualization. These findings are important to students, educators, and employers.

Keywords: Accounting Data and Analytics, Skills and Competencies, Course Evaluation

1. Introduction

Driven by rapid technological innovation, information technology (IT) is expected to significantly alter the way that accountants work (Pan et al., 2016; Nielsen 2018; Hoffman 2018; AICPA, 2019; Seow et al., 2021). In particular, Richins et al. (2017) highlight that IT will allow accountants to play a bigger role in creating value for organizations because data and analytics that are enabled by IT complements accountants' skillsets and knowledge. However, they also highlight that educators must update their curriculums to include relevant technology skillsets in order for accountants to fully capitalize on technological advances. In this regard, both accounting researchers and practitioners have observed a shortage of accounting professionals who currently possess the relevant technology skillsets to exploit technological advances (ACCA, 2016; ISCA and ICAEW, 2017; Daff, 2021).

In recent years, there have been calls for universities to include coverage of technological skills in their accounting curriculums (e.g. Albring and Elder, 2020; Sarkar et al., 2021; Myer 2021). The Association to Advance Collegiate Schools of Business (AACSB) has recommended that accounting degree programs develop skills and knowledge related to the integration of IT in accounting and business. Specifically, AACSB's International Accounting

Accreditation Standard A7 (Information Technology Skills and Knowledge for Accounting Graduates) highlights that these experiences should include the development of skills and knowledge related to data creation, data sharing, data analytics, data mining, data reporting, and storage within and across organizations (AACSB, 2021). Similarly, the International Federation of Accountants (IFAC) recommends that relevant technology skillsets - including those in IT, statistics, and data modelling - be integrated with university programs (Sirois and Savovska, 2017).

In response to these demands and developments, the School of Accountancy of a Singapore-based university (UNIS) developed and launched a second major program in Accounting Data and Analytics (AD&A) in 2018. The AD&A second major program seeks to equip accounting undergraduate students with relevant skillsets in data and analytics that can be readily applied in the accounting industry. In this study, we examine the learning effectiveness of two courses offered as part of the second major in AD&A program: Business Data Management (BDM) and Data Modelling & Visualization (DMV). We choose to examine the learning effectiveness of the BDM and DMV courses because data management (Olsen 1999; Levine and Siegel 2001; Lawson and Street 2021), data modelling (Stout 2015; Goh 2018, 2019), and data visualization (Janvrin et al. 2014; Kokina et al. 2017; Goh 2020, Williams 2020; Goh et al. 2021) are relevant data and analytics skillsets that have important and wide-ranging applications in accounting.

We examine the learning effectiveness of the BDM and DMV courses using a 2 (*both_courses* versus *neither_course*) X 1 between participants experiment conducted with 83 undergraduate students enrolled in the Bachelor of Accountancy program at UNIS who are in at least the third year of their studies. In the *both_courses* condition, participants had completed both the BDM and DMV courses. In the *neither_course* condition, participants had completed neither of these courses. Participants in both conditions accessed the experimental instrument via Qualtrics and were asked to answer ten multiple choice questions (MCQs) related to business data management and ten MCQs related to data modelling and visualization. Overall, our results indicate that participants in the *both_courses* condition performed better (i.e. had more correct answers) on both the questions related to business data management and data modelling and visualization than participants in the *neither_course* condition. This suggests that the courses are effective in enhancing the learning of participants in the areas of business data management and data modelling and visualization.

Our findings are important to students, educators, and employers. With the increasing use of data technology in the accounting profession, the demand for accounting graduates equipped with relevant data and analytics skillsets is growing rapidly (Tschakert et al. 2016; Richins et al. 2017; Nielsen 2018; Dow et al. 2021; Kokina et al. 2021). While accounting programs in universities around the world, including in Singapore, have increased their offerings of technology-related courses (Seow et al. 2021; Dzuranin et al. 2019; Richardson and Shan 2019), the effectiveness of these courses in imparting relevant technology skillsets to students is often unclear. To the extent that our results suggest that the courses in BDM and DMV are effective in introducing students to relevant technology skillsets, they would provide important insights to students, educators, and employers.

In particular, a key goal that universities and other educational institutions have when introducing data and analytics related skillsets to their accounting curriculum relates to ensuring students possess up-to-date skillsets being demanded by the accounting profession (Al-Htaybat et al. 2018; Richardson and Shan 2019; Qasim 2020). Stakeholders of the accounting profession, including academics (Sledgianowski et al. 2017), professional bodies (AICPA, 2019; AACSB, 2021; ISCA & ICAEW, 2017), and employers (PwC 2015; Spraakman et al. 2015; Meyer 2021), have highlighted the critical importance for accountants to possess data and analytics skillsets. To the extent that our results suggest that the BDM and DMV courses offered by UNIS are effective in helping students learn data and analytics skillsets, they would provide assurance to both students and employers that students participating in such courses are effectively learning relevant data and analytics skillsets. Further, it is important that universities and educational institutions consider the needs of employers when designing educational programs (Mari et al. 2019). Accordingly, insights from our study would also be relevant to universities and other educational institutions as they make plans to adjust their accounting curriculum to improve the employability of their students.

The rest of our paper proceeds as follows. Section 2 discusses relevant background to the study and develops our hypotheses. Section 3 introduces our method and section 4 presents our results. Finally, section 5 concludes the paper.

2. Background and Hypotheses Development

2.1. Second Major in Accounting Data and Analytics

The second major in AD&A program was launched in 2018 and requires students to complete eight courses in addition to the requirements of the Bachelor of Accountancy program at UNIS. The courses offered by the AD&A second major relate to three key pillars: (i) data technology, (ii) accounting application, and (iii) accounting analytics capstone. First, as part of the data technology pillar, students have to complete four compulsory courses relating to data technology. These courses are designed to provide students with basic data and analytics skillsets that are required in the performance of data and analytics related tasks in the accounting setting. These four courses include accounting information systems, business data management, data modelling & visualization, and statistical programming. Second, as part of the second pillar, students have to complete three elective courses relating to accounting applications. These courses are designed to enable students to apply the basic data and analytics skillsets acquired under the first pillar in specific accounting contexts and functions. Electives offered under the second pillar include forecasting & forensic analytics, analytics for value investing, audit analytics, and auditing information systems. Third, as part of the accounting analytics capstone pillar, students have to complete a capstone course. This course is designed to require students to apply their data and analytics knowledge obtained from the first two pillars to solve real-word accounting problems. The capstone course applies a unique award-winning experiential learning pedagogy that seeks to shift the focus from teaching to learning (Seow et al. 2021). The curriculum structure for the AD&A second major is presented in Figure 1.

Figure 1. Curriculum Structure for the Second Major in Accounting Data and Analytics.

Data Technology (Compulsory) Four Courses	**Accounting Application** (Electives) Any Three Courses
• Accounting Information Systems • Business Data Management • Data Modelling and Visualization • Statistical Programming	• Forecasting and Forensic Analytics • Analytics for Value Investing • Analytics for Financial Instruments • Audit Analytics • Auditing Information Systems
COMPULSORY: Accounting Analytics Capstone (Experiential-learning format)	

2.2. Evaluating the BDM and DMV courses

The Kirkpatrick's model has been used in examining the effectiveness of training programs, including those offered in universities (Kirkpatrick and Kirkpatrick 2006; Praslova 2010). The model consists of four levels relating to reaction (level 1), learning (level 2), behavioral change (level 3), and organizational performance (level 4). The Kirkpatrick's model is relevant to our setting because it provides a structure for program evaluation that can be adapted to suit the specific situation and intentions of the program being examined in order to ensure adequate and appropriate appraisal (Paull et al. 2016).

We focus on level 2 (i.e. the learning aspect) of the Kirkpatrick's model which evaluates specific aspects of the skills and competencies that students have gained from a program. In particular, we examine the extent to which two courses offered as part of the AD&A second major have achieved their intended learning outcomes by measuring the knowledge that students gain from the courses in BDM and DMV (versus students who have not taken the courses).

The BDM course offered at UNIS covers the fundamentals of relational database theory. It also covers important data management concepts such as data modeling, database design, implementation, data access, and practical

data-related issues in current business information systems. Upon successful completion of this course, students are expected to be able to understand the role of databases in integrating various business functions in an organization, query a database using Structured Query Language, and gain familiarity with some commercial database tools (e.g. MS VISIO, MySQL).

The DMV course offered at UNIS introduces a variety of quantitative techniques used in the development, implementation, and utilization of analytical data models that accountants regularly use in decision making. These techniques include regression analysis, time-series analysis, optimization, text analytics, and simulation. In addition, the DMV course introduces students to key principles and techniques for data visualization. At the end of the course, students are expected be able to create visuals including dashboards and interactive visualizations for decision making in the accounting context.[1] To the extent that both the BMD and DMV courses are effective at improving students' learning and achieve their learning objectives, it would lead to the following hypotheses.

H1: *Students who have taken the BDM course will have greater knowledge about business data management than students who have not taken the course.*

H2: *Students who have taken the DMV course will have greater knowledge about data modelling and visualization than students who have not taken the course.*

3. Method

To examine our hypotheses, we conducted an experiment with 83 participants recruited from undergraduate students enrolled in the Bachelor of Accountancy program at UNIS who are in at least their third year of study.[2] Overall, 8 (9.6 percent) participants were between the ages of 18 and 21, 70 (84.3 percent) participants were between the ages of 22 and 25, and 5 (6 percent) participants were above 25 years of age. In addition, 37 (44.6 percent) participants were in their third year of study while 46 (55.4 percent) of participants were in either their fourth or fifth year of study. Further, 36 (43.4 percent) participants were male. A total of 81 (97.6 percent) participants reported that they had completed at least one internship and 28 (33.7 percent) of participants reported that they had completed at least one internship that had exposed them to data and analytics. Finally, 41 (49.4 percent) participants reported that they had completed both the BDM and DMV courses and 42 (50.6 percent) participants reported that they had completed neither course.[3]

We used a 2 (*both_courses* versus *neither_course*) X 1 between-participants experimental design to test our hypotheses. The experiment was administered via Qualtrics. Participants were first asked to state their year of study and if they had completed the BDM and DMV courses. Participants were allowed to proceed with the experiment only if they reported that they (i) were in at least their third year of study and (ii) had completed both BDM and DMV or had completed neither course. Participants who reported that they had completed both BDM and DMV were assigned to the *both_courses* condition while participants who reported that they had completed neither course were assigned to the *neither_course* condition. Across both conditions, participants were then asked to provide demographic information. Following that, they were presented with twenty MCQs. The first ten questions relate to content covered in the BDM course while the final ten questions relate to content covered in the DMV course.[4] Participants were given cash vouchers worth twenty-five Singapore dollars for participating in the study.

[1] Synopses extracted from the course outlines of the BDM and DMV courses are presented in Appendix A.
[2] We obtained approval to conduct the experiment from our institution's Institutional Review Board.
[3] The age, year of study, gender, and number of internships (including those that exposed them to data analytics) reported by participants who had completed both course and participants who had completed neither course do not differ significantly (all $\chi 2<5.13$, all $p>0.27$).
[4] The questions were set by instructors who had taught the BDM and DMV courses at UNIS. We pre-tested the experimental instrument with two faculty members who had taught in the second major program and with five students who were enrolled in the second major program. Overall, they highlighted that the instrument was adequate in testing participants' knowledge of business data management and data modelling and visualization, suggesting that the external validity of our questions is high. The twenty questions used in the instrument are presented in Appendix B.

4. Results

H1 states that participants who have taken the BDM course will have greater knowledge about data management than participants who have not taken the course. H2 states that participants who have taken the DMV course will have greater knowledge about data modelling and visualization than participants who have not taken the course. As an overall measure of participants' knowledge of data management and data modelling and visualization, we computed the number of MCQs relating to data management (*BDM_correct*) and data modelling and visualization (*DMV_correct*) that participants answered correctly. We also computed the sum of the total number of MCQs relating to both data management and data modelling and visualization that participants answered correctly (*all_correct*).

Panel A of Table 1 presents the number of participants who answered each of the twenty questions relating to business data management and data modelling & visualization correctly (incorrectly). Panel B of Table 1 provides descriptive statistics for *BDM_correct*, *DMV_correct*, and *all_correct* while panel C presents simple main effects tests. Overall, we find that the proportion of correct answers is higher in the *both_courses* condition than in the *neither_course* condition for eight of the ten BDM questions (all χ^2>5.49, all p<0.01, one-tailed) and eight of the ten DMV questions (all χ^2>2.03, all p<0.08, one-tailed). In addition, the proportion of correct answers is no different in the *both_courses* condition and the *neither_course* condition for the remaining two BDM questions (all χ^2<0.33, all p>0.28, one-tailed) and two DMV questions (all χ^2<0.60, all p>0.22, one-tailed).

Further, *DM_correct* (t=7.27, p<0.01, one-tailed), *DMV_correct* (t=5.51, p<0.01, one-tailed), and *all_correct* (t=7.87, p<0.01, one-tailed) are significantly greater in the *both_courses* condition than in the *neither_course* condition. Overall, these results suggest that participants who have taken the BDM and DMV courses have greater knowledge of the two subject areas than the students who have not taken the courses, and are consistent with both H1 and H2.

Table 1: Participants' MCQ Responses.
Panel A: Number of Correct Responses (Number of Incorrect Responses)

Question	**Condition**			
	Both_courses	***Neither_course***	χ^2	**P-value***
BDM Q1	23 (18)	24 (18)	0.01	0.46
BDM Q2	34 (7)	20 (22)	11.38	0.00
BDM Q3	30 (11)	16 (26)	10.33	0.00
BDM Q4	26 (15)	13 (29)	8.78	0.00
BDM Q5	21 (20)	11 (31)	5.49	0.01
BDM Q6	30 (11)	12 (30)	16.51	0.00
BDM Q7	16 (25)	19 (23)	0.33	0.28
BDM Q8	30 (11)	9 (33)	22.30	0.00
BDM Q9	32 (9)	13 (29)	18.54	0.00
BDM Q10	26 (15)	6 (36)	21.14	0.00
DMV Q1	38 (3)	23 (19)	15.32	0.00
DMV Q2	23 (18)	17 (25)	2.03	0.08
DMV Q3	38 (3)	31 (11)	5.27	0.01

DMV Q4	39 (2)	26 (16)	13.48	0.00
DMV Q5	31 (10)	16 (26)	11.89	0.00
DMV Q6	23 (18)	20 (22)	0.60	0.22
DMV Q7	33 (8)	17 (25)	13.87	0.00
DMV Q8	16 (25)	9 (33)	3.05	0.04
DMV Q9	32 (9)	25 (17)	3.31	0.03
DMV Q10	14 (27)	13 (29)	0.10	0.38

Panel B: Total Questions Correct: Mean (Standard Deviation) [Number of Participants]

Condition	**BDM Questions**	**DMV Questions**	**All Questions**
Both_courses	6.54 (2.00) [41]	7.00 (1.69) [41]	13.54 (3.17) [41]
Neither_course	3.40 (1.93) [42]	4.69 (2.10) [42]	8.10 (3.13) [42]

Panel C: Simple Main Effects

Effect	**t**	**p-value***
Both_courses versus *Neither_course* for BDM questions	7.27	0.00
Both_courses versus *Neither_course* for DMV questions	5.51	0.00
Both_courses versus *Neither_course* for all questions	7.87	0.00

Table 1 presents results for participants' response to MCQs. Panel A presents the number of questions that participants answered correctly and incorrectly. One-tailed tests are indicated with a *. Panel B presents descriptive statistics for the *both_courses* and *neither_course* conditions while panel C presents simple main effects tests.

5. Conclusion

UNIS launched the second major in AD&A program in 2018 to equip accounting undergraduate students with technology skillsets that can be applied in the accounting context. This program was launched in response to calls from both the industry (PwC 2015; ISCA and ICAEW 2017; AICPA, 2019; AACSB, 2021; ISCA & ICAEW, 2017) and academia (Dzuranin et al. 2019; Richardson and Shan 2019; Dow et al. 2021) for accounting education programs to incorporate technology skillsets, including those relating to data and analytics, in their curriculums. In evaluating the second major in AD&A program, one important aspect relates to the learning effectiveness of the courses offered (Kirkpatrick and Kirkpatrick 2006; Praslova 2010). In this study, we focus on evaluating the learning effectiveness of students in two courses offered in the AD&A second major program: BDM and DMV.

We conducted an experiment to evaluate the learning effectiveness of the BDM and DMV courses offered to accounting undergraduates at UNIS as part of the second major in AD&A. Overall, we find that participants who had completed both the BDM and DMV courses performed better when answering twenty MCQs related to business data management as well as data modelling and visualization compared to participants who had completed neither of these courses. These results suggest that the BDM and DMV courses are effective in enhancing students' learning of data and analytics skillsets related to business data management as well as data modelling & visualization. These findings are particularly important for students, employers, and educators. In particular they are informative to students and employers because they provide insights into the learning effectiveness of two courses related to data and analytics skillsets in two important areas (i.e. business data management and data modelling and visualization) that are in demand in the accounting sector. They are also informative to educators because they provide insights that are relevant in the planning and implementation of an accounting curriculum that will increase the employability of students.

Our study is subject to limitations. In particular, because we only examine the learning effectiveness of the BDM and DMV courses offered as part of the second major in AD&A at UNIS, our finding may not generalize to other contexts. For example, it is possible that the learning effectiveness observed in this study may not generalize to courses relating to other technology skillsets (for example, other skillsets covered in the second major program include programming, fraud analytics, etc) or to courses covering the same technology skillsets but which adopt a different pedagogical approach than that employed by UNIS (for example, while UNIS employs seminar-style classes of approximately 45 students, courses offered by other institutions may adopt alternative pedagogical approaches such as lectures, which typically involve a larger number of students and less two-way interaction between the instructor and students).

There is scope for future research to extend our findings. First, future studies could examine if our findings relating to the learning effectiveness of the BDM and DMV courses extend to courses relating to different technological areas or to when alternative pedagogical approaches are employed. Second, the Kirkpatrick model (Kirkpatrick and Kirkpatrick 2006), which can be used to evaluate educational programs, consists of four levels relating to reaction (level 1), learning (level 2), behavioral change (level 3), and organizational performance (level 4). In this study, we focus on level 2 by examining the learning effectiveness of the BDM and DMV courses. Future research could extend our findings by evaluating the program via the other three levels identified in the Kirkpatrick model.

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Appendix A
Course Synopses Extracted From Course Outlines

Business Data Management
This course will cover fundamentals of relational database theory, important data management concepts such as data modeling, database design, implementation, data access, and practical data-related issues in current business information systems. Upon successful completion of this course, students will be able to understand the role of databases in integrating various business functions in an organization, query a database using Structured Query Language and gain familiarity with some commercial database tools (MS VISIO, MySQL).

Data Modelling and Visualization
Accountants regularly work with large amounts of financial and non-financial data. Data modelling is an important means through which accountants can analyse such data for trends, patterns, relationships, and other useful information for decision making. This course will introduce a variety of quantitative techniques used in the development, implementation, and utilization of analytical data models that accountants regularly use in decision making. It will cover techniques including regression analysis, trend analysis, optimization, text analytics, and simulation. Visualization provides an important means through which accountants can communicate insights obtained via data modelling to their intended recipients. Well-designed visualizations can improve the memory, comprehension, and decision making of intended recipients of this information. This course will introduce students to key principles and techniques for data visualization. Students will create visuals including dashboards and interactive visualizations for decision making in the accounting context.

Appendix B
Multiple Choice Questions

Business Data Management

1) Which of the following is not a valid SQL type?

a. NUMERIC
b. FLOAT
c. **DECIMAL**[5]
d. CHARACTER

2) Which operator is used to find a value within a list of values?

a. FIND
b. BETWEEN
c. AT
d. IN

3) Which of the following is true about the HAVING clause?

a. A: Similar function as WHERE clause but it is used for groups rather than rows
b. B: Similar function as WHERE clause but it is used for columns rather than rows
c. C: Similar function as WHERE clause but it is used for columns rather than groups
d. D: It works exactly as a WHERE clause

4) Which command can be used to change a table's definition in SQL?

a. CHANGE
b. UPDATE
c. MOD
d. ALTER

5) When using an SQL SELECT statement querying a single table, the asterisk (*) means that:

a. All records meeting the LIKE wildcard definition are to be returned
b. All records with NULL values are to be returned
c. All records meeting the full criteria are to be returned
d. None of the above is correct

6) Which of the following is the correct order of a SQL statement?
a. SELECT, GROUP BY, WHERE, HAVING
b. SELECT, WHERE, GROUP BY, HAVING
c. SELECT, HAVING, WHERE, GROUP BY
d. SELECT, WHERE, HAVING, GROUP BY

7) The SQL statement: SELE ROUND (724.109, -1) AS RoundValue;
What is the value of RoundValue?

a. 0
b. 720.000
c. 724.000
d. NULL

[5] Correct answers are indicated in bold font.

8) Which statement is used to retrieve all data from staff table whose name starts with 'p'?

a. SELECT ALL FROM staff WHERE COLUMN IN 'name' and col_name LIKE 'p%'
b. SELECT ALL FROM staff WHERE COLUMN IN = 'name' and col_name LIKE 'p*'
c. SELECT ALL FROM staff WHERE name LIKE 'p%'
d. SELECT ALL FROM staff WHERE name LIKE 'p*'

9) Which of the following query finds the name of students who have borrowed at least one book?

a. SELECT DISTINCT s.sname FROM students s, borrowed b WHERE s.sid = b.sid
b. SELECT sname FROM students, borrowed WHERE 'sid students' = 'sid borrowed'
c. SELECT UNIQUE name FROM students, borrowed WHERE sid IS EQUAL in students, borrowed
d. SELECT s.name FROM students, borrowed WHERE 'sid students' = 'sid borrowed'

10) Evaluate the following statement:

```
SELECT a.emp_name, a.sal, a.dept_id, b.maxsal FROM employees a,
(SELECT dept_id, MAX(sal) maxsal FROM employees GROUP BY dept_id) b
WHERE a.dept_id = b.dept_id AND a.sal < b.maxsal;
```

Which of the following statement is true?

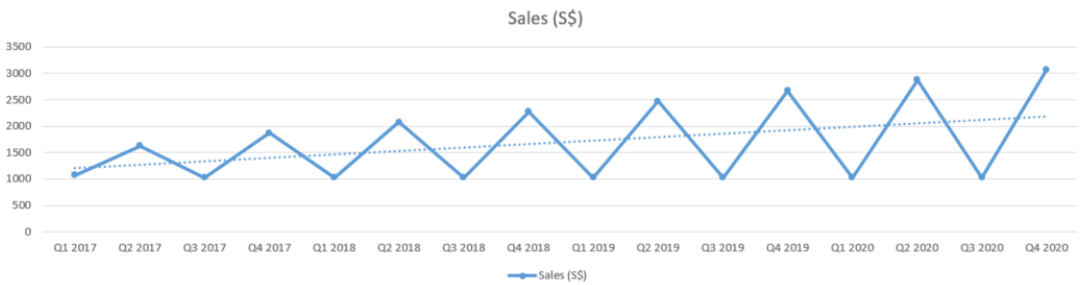
a. The statement produces a NULL match
b. The statement will throw an error at Line 3
c. The statement produces the employee name, salary, department ID, and maximum salary earned in the employee department for all departments that pay less salary than the maximum salary paid in the company.
d. The statement produces the employee name, salary, department ID, and maximum salary earned in the employee department for all employees who earn less than the maximum salary in their department.

Data Modelling & Visualization

11) Simulation should be used to analyse spreadsheet models where one or more of the input variables _____.

a. is subject to random variability (i.e. uncertainty)
b. is a discrete variable
c. is non-negative
d. has a defined mean

12) Which of the following best describes the time series below?



a. Stationary time series
b. Stationary time series with additive seasonal effects
c. Non-stationary time series with no seasonal effects
d. Non-stationary time series with multiplicative seasonal effects

13) In a simple linear regression _____.

a. an arithmetic equation is used to explain the relationship between an independent variable and a dependent variable
b. there is always more than one independent variable
c. independent variables are always subject to uncertainty
d. we always seek to minimise the sum of weighted percentage deviations

14) Dummy variables are used in a regression model when potential explanatory variables _____.

a. are negative
b. are categorical and cannot be measured on a quantitative scale
c. are outliers
d. do not measure the outcome accurately

15) The objective function in a goal programming problem seeks to _____.

a. maximise the common denominator of goals
b. maximise the multiple of weighted percentage deviations from goals
c. minimise the multiple of percentage deviations from goals
d. minimise the sum of weighted percentage deviations from goals

16) Constraint functions in a linear programming problem _____.

a. are always non-negative in nature
b. contain deviational variables
c. represent hard constraints
d. represent soft constraints

17) A visualization distorts the visual representation of data if _____.

a. the visual effect is not consistent with the corresponding numerical representation of the data
b. it contains chart junk
c. there are inconsistencies in visual encoding
d. it contains a non-stationary time series

18) Which of the following is not one common way in which the graphical integrity of a visualization is compromised?

a. Distortion of the visual representation of data in the visual
b. Design variation in the visual
c. Lack of context in the visual
d. The overuse of colour in the visual

19) The lie factor measures the amount of graphical distortion in a visual. Which of the following lie factor values indicates no graphical distortion in a visual?

a. -0.50
b. 0.50
c. 1.00
d. 2.00

20) The narrative framework introduces three elements that a visualization should possess. Which of the following is not one of the three elements?

a. Visual design
b. Messaging
c. Interactivity
d. **Colour usage**