



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**SCHOOL OF INFORMATICS & INNOVATIVE SYSTEMS**  
**UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF BUSINESS**  
**INFORMATION SYSTEMS**  
**3<sup>TH</sup> YEAR 2<sup>ND</sup> SEMESTER 2024/2025 ACADEMIC YEAR**  
**MAIN CAMPUS**

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**COURSE CODE: ITB 2304**

**COURSE TITLE: BUSINESS INTELLIGENCE AND DATA WAREHOUSING**

**DATE: 23/4/2025 EXAM SESSION: 9.00-11.00**

**TIME: 2 HOURS VENUE: CL3 / CL2**

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**INSTRUCTIONS:**

- 1. Question 1 is compulsory**
- 2. Answer any other two questions.**
- 3. Candidates are advised not to write on the question paper.**
- 4. Candidates must hand in their answer booklets to the invigilator while in the examination room**

## QUESTION 1 (30 marks)

### **Scenario: GlobalMart**

GlobalMart is a leading retail company operating both brick-and-mortar stores and an e-commerce platform. Facing fierce competition, rapidly changing customer preferences, and digital disruption, GlobalMart has decided to invest in a comprehensive Business Intelligence (BI) and Data Warehousing (DW) initiative. The goal is to build an integrated analytics platform that supports decision-making across the enterprise. The initiative includes the following components:

- **BI & Analytics Overview:** Recognizing the evolving need for data-driven decision support, GlobalMart is transitioning from traditional computerized decision support systems to advanced analytics and data science. This involves understanding the historical evolution, defining BI and analytics, and establishing a modern BI framework.
- **Descriptive Analytics:** The company will analyze historical sales, web analytics, and operational data using statistical modeling and visualization. This will include calculating measures of central tendency, dispersion, and building dashboards for business reporting.
- **Data Warehousing:** GlobalMart plans to design a data warehouse that integrates data from multiple sources using robust ETL processes. The architecture will include data marts, support OLAP operations for multidimensional analysis, and differentiate between OLAP and OLTP systems.
- **Predictive Analytics:** The company will implement data mining techniques, including text and social media analytics, to forecast sales, predict customer behavior, and monitor sentiment.
- **Prescriptive Analytics:** Finally, GlobalMart will use optimization and simulation methods—such as decision modeling, what-if analysis, and simulation techniques—to refine inventory management and marketing strategies.
- **Performance Measurement:** To ensure success, GlobalMart will establish performance measurement systems (using KPIs, balanced scorecards, and Six Sigma principles) to monitor and continuously improve the BI initiative.

You are part of the team that is implementing this BI & DW initiative. Address the following queries that management has raised.

- a) Define Business Intelligence (BI). (2 marks)
- b) Briefly highlight two key changes in the business environment that have driven the need for advanced decision support systems in GlobalMart. (2 marks)
- c) Identify two major developments that enabled the evolution from traditional computerized decision support systems to modern analytics and data science. (2 marks)
- d) Outline the differences between descriptive, predictive, and prescriptive analytics, giving an example for each from GlobalMart's context. (3 marks)

- e) Briefly explain three key components of a modern BI framework. (3 marks)
- f) Briefly discuss how mathematical programming optimization and simulation can support decision-making in GlobalMart's operations. (2 marks)
- g) Outline the key stages of the data mining process and show how each stage is critical for GlobalMart's predictive analytics initiatives. (4 marks)

The key stages include:

- h) Briefly highlight three the potential challenges GlobalMart might encounter when implementing predictive analytics, particularly in text and social media analytics and suggest a possible solution for each. (6 marks)

Challenges include:

- i) GlobalMart might face as it implements the BI and DW initiative
  - i) Identify and briefly highlight three potential challenges. (3 marks)
  - ii) Explain how each of the performance measurement systems, Key Performance Indicators (KPIs), balanced scorecards and Six Sigma, can help address these challenges. (3 marks)

## QUESTION 2 (20 marks)

- a) Consider the following dataset and answer the following questions.

### Transaction ID Items Purchased

1	A, B, C
2	A, D
3	B, C, E
4	A, C, D, F
5	B, E, G
6	C, D, F
7	A, B, E, G
8	D, E
9	A, C, F
10	B, D, G
11	A, B, C, D
12	C, E, F, G
13	A, D, F
14	B, C, G
15	A, E, F

- i) Briefly explain the meaning of support, confidence, and lift in association rule mining. (3 marks)

- ii) Calculate the support count of the following individual items from the dataset: A, B, C, and D. (4 marks)
  - i) Identify all frequent 2-itemsets with a minimum support of 3 transactions. (5 marks)
  - ii) Derive the confidence for the rule  $\{A\} \rightarrow \{C\}$  given the dataset and the frequent itemsets found earlier. (3 marks)
- b) Explain any four characteristics of a data warehouse? (8 marks)

**QUESTION 3 (20 marks)**

- a) Consider following eight points:  
 P1 (2, 2), P2 (1, 14), P3 (10, 7), P4 (1, 11), P5 (3, 4), P6 (11, 8), P7 (4, 3), and P8 (12, 9).
- i) Given two points  $P1 (x_1, y_1)$  and  $P2 (x_2, y_2)$ , give the formula for Euclidean distance (2 marks)
  - ii) Taking P1, P2, and P7 as initial centroids, apply  $k$ -means clustering algorithm combined with Manhattan distance to calculate the first successive positions of those centroids. (10 marks)
- b) Discuss any four challenges that are commonly associated with NLP. (8 marks)

**QUESTION 4 (20 marks)**

- a) A mathematics teacher recorded the length of time,  $y$  minutes, taken to travel to school when leaving home  $x$  minutes after 7 am on seven selected mornings. The results are as follows.

$x$	0	10	20	30	40	50	60
$y$	16	27	28	39	39	48	51

- i. Calculate the corrected sum of squares of the  $x_i$  ( $S_{xx}$ ) and the corrected sum of cross products of  $x_i$  and  $x_i$  ( $S_{xy}$ ) (8 marks)
  - ii. Calculate the least squares estimators of the intercept  $\hat{\beta}_0$ , and the slope  $\hat{\beta}_1$  of the fitted regression line and give the equation of the least squares fit regression line of  $y$  on  $x$ . (6 marks)
- b) Differentiate between sensitivity analysis and what-if analysis. (2 marks)
- c) Briefly enumerate four linear programming problem characteristics. (4 marks)

**QUESTION 5 (20 marks)**

- a) Discuss any five challenges that are commonly associated with NLP. (10 marks)
- b) Making decisions depends on the use of some kind of analytical model. All quantitative models are typically made up of four basic components. With the aid of a suitable diagram, discuss these basic four components (10 marks)