PROJECT REPORT

METRICSTICS (DELIVERABLE - 1)

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Github:
https://github.com/WeiQi5588/SOEN-6611
By Team M

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Introduction

There has been a growing recognition of the pivotal role that descriptive statistics play in data analysis. Descriptive statistics provide a quantitative framework for characterizing the features of a dataset. By employing measures of central tendency, frequency distributions, and variability, descriptive statistics offer valuable insights into the underlying structure and patterns within the data, laying the groundwork for further analysis and interpretation. In this context, we consider a random variable denoted as x, which draws values from a finite dataset x1, x2, x3, ..., xn, where each value carries an equal probability. Within this framework, we introduce the concepts of minimum (m) and maximum (M), representing the smallest and largest values in the dataset, respectively. Additionally, we identify the mode (o) as the value with the highest frequency. For measures of central location, we introduce the median (d), which represents the middle value when the dataset size is odd, and the arithmetic mean when it is even.

1.1 System Information

A key system is being developed as part of the development of the Logistics and Supply Chain Analytics Solution, known as "METRICSTICS," to conduct a thorough study of logistics and supply chain performance. This system will examine statistical analyses of logistical data with the goal of giving the logistics management team the tools they need to efficiently track trends in logistics operations over time. It will enable thorough examinations of historical records in the logistics and supply chain area, enabling well-informed decision-making based on the priceless insights gained. Professionals in logistics, such as Warehouse Manager, Logistics Managers, Inventory managers and Procurement Managers, make up the majority of "METRICSTICS"'s stakeholders and will gain the most from the insights and features this analytics solution provides.

1.2 Assumptions

The project has the following assumptions:

1. **Random Variables and Data Set**

   - The system operates on random variables that can take values from a finite data set $x_1, x_2, x_3, \ldots, x_n$ with each value having the same probability.

2. **Probability Distribution:**

   - The probability distribution of the random variable is assumed to be uniform, as each value in the data set has the same probability.

3. **Uniqueness of Minimum and Maximum:**

   - The probability distribution of the random variable is assumed to be uniform, as each value in the data set has the same probability.

4. **Uniqueness of Mode:**

   - The mode o may not be unique. There can be multiple modes if multiple values occur with the highest frequency.

5. **Calculation of Median for Even n:**

   - When the number of observations (n) is even, the median d is calculated as the arithmetic mean of the two middle values.

6. **Calculation of Standard Deviation:**

   - The standard deviation (σ) is calculated based on the squared differences between each observation and the arithmetic mean.

7. **Accuracy of Data:**

   - It is assumed that the data provided to the system is accurate and free from errors.

8. **Input Data Source:**

   - The system can accept data from different sources, including real-world data from authoritative sources or artificially generated data from a random data generator.

1.3 Constraints

The project has some potential constraints:

1. **Computational Resources:**

   - The system's performance may be limited by the available computational resources, such as processing power, memory, and storage.

2. **Input Data Quality:**

   - The accuracy and reliability of the descriptive statistics may be affected by the quality and integrity of the input data. Inaccurate or incomplete data may lead to unreliable results.

3. **Data Size:**

   - The system may face limitations in processing very large datasets, potentially leading to longer processing times or resource constraints.

4. **Statistical Assumptions:**

   - The accuracy of the descriptive statistics relies on the validity of certain statistical assumptions, such as the assumption of a uniform probability distribution for the data.

5. **Output Interpretation:**

   - Users must be able to interpret the descriptive statistics correctly to derive meaningful insights from the results. Inadequate understanding may lead to misinterpretation.

Problem 1: Goal-Question-Metric

2.1 Goal

Purpose
To conduct a comprehensive analysis of historical logistics and supply chain data to gain a deep understanding of the trends and patterns that have evolved over time.

Perspective
Assess the historical logistics and supply chain data from the viewpoint of logistics and supply chain management.

Environment
Within the context of developing the Logistics and Supply Chain Analytics Solution (METRICSTICS).

2.2 SMART Principles

The goal is considered SMART (Specific, Measurable, Attainable, Realistic, and Timely) for the following reasons:

- **Specific:** The METRICSTICS program is particularly specific in that it specifically defines the goal of examining historical logistics and supply chain data to get a thorough understanding of trends and patterns within the area. This focus enables us to give specific and meaningful information to logistics and supply chain managers, allowing informed decision-making.

- **Measurable:** The project's success is measurable through the formulation of key performance indicators and questions. These indicators could include measures of annual logistics cost reduction, inventory turnover rates, on-time delivery performance, and supply chain cycle time reduction. We can assess the influence of METRICSTICS by quantifying these aspects.

- **Attainable:** The aim is Attainable, as the application of METRIC-STICS allows for the examination of past logistics and supply chain data. METRICSTICS equips logistics professionals with the necessary tools and infrastructure to collect, process, and analyze pertinent data, ultimately providing them with important insights.

- **Realistic:** The goal of METRICSTICS is realistic in relation to the jobs and responsibilities of logistics and supply chain management. It allows them to obtain a thorough understanding of previous performance, optimize logistics and supply chain strategies, and set realistic goals for future improvements. As a result, METRICSTICS skills are perfectly aligned with the requirements of logistics experts.

- **Timely:** The project is Timely since it focuses on the study of historical logistics and supply chain data spanning certain time periods, ensuring a well-defined timeframe for completing analyses. This approach ensures that we stay on track to achieve our goal within the designated timeframe and budget.

In brief, METRICSTICS follows the SMART principles of being Specific, Measurable, Attainable, Realistic, and Timely. These criteria lead our efforts to provide an analytics solution that is well-defined, quantifiable, realistic, applicable, and time-bound for logistics and supply chain professionals.

2.3   Question And Metric

- **Question 1:** What is the average lead time for procurement of raw materials on a monthly and quarterly basis?

  Metric:

  M1. Average monthly lead time

  M2. Average quarterly lead time

  Mechanism:

  i.Owner = Procurement Managers

  ii.Frequency Collected = Following procurement data entry

  iii.Frequency Reported = Monthly and Quarterly

- **Question 2:** What is the percentage change in shipping costs for each shipping method, both monthly and quarterly?

  Metric:

M3. Maximum monthly shipping cost increase percentage

M4. Minimum monthly shipping cost decrease percentage

M5. Maximum quarterly shipping cost increase percentage

M6. Minimum quarterly shipping cost decrease percentage

Mechanism:

i.Owner = Logistics Managers

ii.Frequency Collected = Following shipping cost data update

iii.Frequency Reported = Monthly and Quarterly

- **Question 3:** How do we identify fluctuations in warehouse storage space utilization on a monthly and quarterly basis?

  Metric:

  M7. Calculate the Monthly Average Storage Utilization Rate

  M8. Calculate the Quarterly Average Storage Utilization Rate

  Mechanism:

  i.Owner = Warehouse Managers

  ii.Frequency Collected = Following warehouse storage data analysis

  iii.Frequency Reported = Monthly and Quarterly

- **Question 4:** Which month and quarter experienced the most significant inventory turnover rate change over the year?

  Metric:

  M9. Standard deviation of monthly inventory turnover rates

  Mechanism:

  i.Owner = Inventory Managers

  ii.Frequency Collected = Following inventory turnover rate analysis

  iii.Frequency Reported = Monthly and Quarterly

- **Question 5:** Which month and quarter experienced the most significant supplier delivery time changes over the year?

  Metric:

  M10. Standard deviation of monthly supplier delivery times

  Mechanism:

  i.Owner = Procurement Managers

ii.Frequency Collected = Following supplier delivery time analysis

iii.Frequency Reported = Monthly and Quarterly

- **Question 6:** How can we identify the top 10 suppliers with the most consistent on-time deliveries on a monthly and quarterly basis?

  Metric:

  M11. Count the number of times each supplier has on-time deliveries in a month and quarter

  M12. Sort suppliers by their on-time delivery frequency

  Mechanism:

  i.Owner = Procurement Managers

  ii.Frequency Collected = Following supplier performance data collection

  iii.Frequency Reported = Monthly and Quarterly

- **Question 7:** What is the most commonly used transportation route for shipments on a monthly basis?

  Metric:

  M13. Count the number of shipments on each route in a month and find the route with the highest count.

  Mechanism:

  i.Owner = Logistics Managers

  ii.Frequency Collected = Following shipment data analysis

  iii.Frequency Reported = Monthly

- **Question 8:** In which region do we experience the highest number of shipping delays on a yearly basis?

  Metric:

  M14. Count the number of shipping delays by region for the entire year and find the region with the highest count.

  Mechanism:

  i.Owner = Logistics Managers

  ii.Frequency Collected = Following yearly shipping delay analysis

  iii.Frequency Reported = Yearly

- **Question 9:** How can we determine the day of the year with the highest order fulfillment activity?

Metric:

M15. Count the number of order fulfillments each day in a year and find the day with the highest count.

Mechanism:

i.Owner = Warehouse Managers

ii.Frequency Collected = Following yearly order fulfillment analysis

iii.Frequency Reported = Yearly

- **Question 10:** What is the average transit time for shipped products for each carrier on a monthly and quarterly basis?

  Metric:

  M16. Average monthly transit time by carrier

  M17. Average quarterly transit time by carrier

  Mechanism:

  i.Owner = Logistics Managers

  ii.Frequency Collected = Following shipping data entry

  iii.Frequency Reported = Monthly and Quarterly
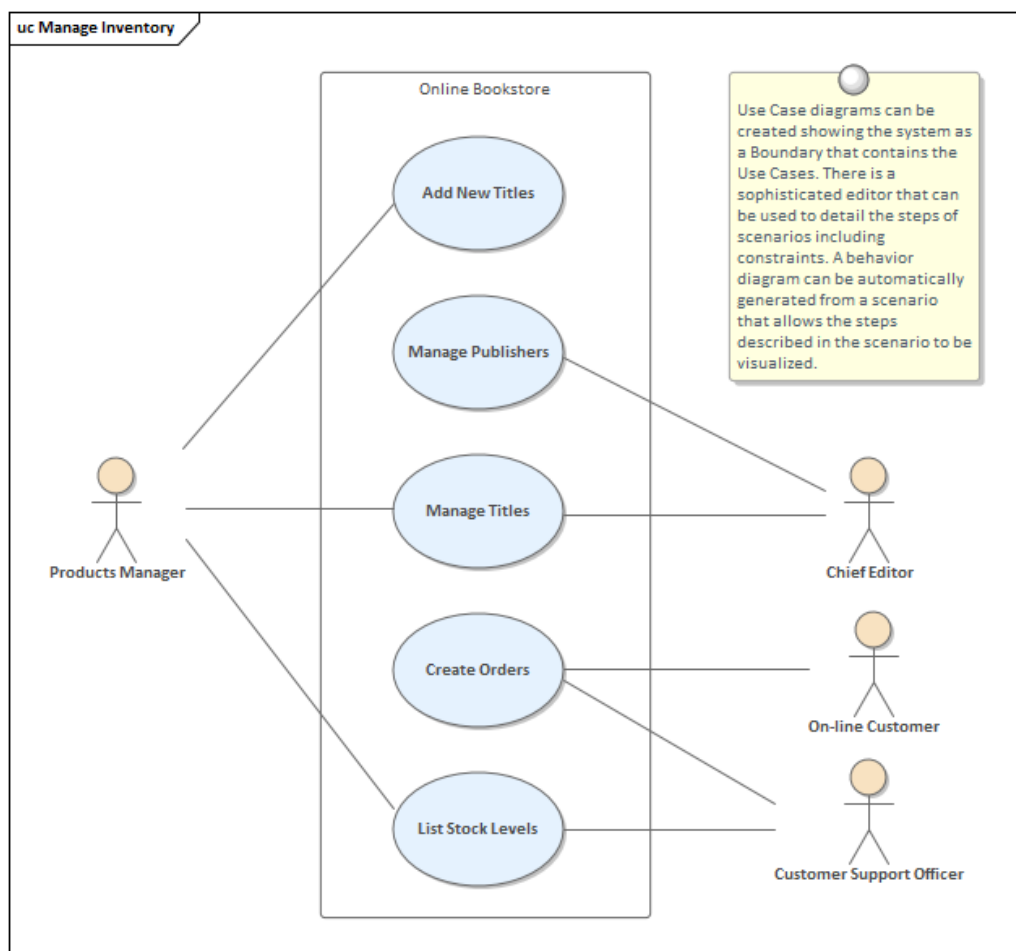
Problem 2: Use Case Model

3.1   Use Case Diagram

Figure 3.1: Use Case Model

3.2 Use Cases

System	System Name
Identifier	UC-1
Author(s)	- Author Name: - Author Email:
Version	1.0
Priority	High
Name	Analysis of the Lead Time for material procurement
Pre-Condition(s)	- User has a valid account on the system. - Procurement data is available in the system.
Post-Condition(s)	Lead time analysis report is generated.
Trigger	Procurement Manager initiates the analysis.
Normal Flow	1. Procurement Manager logs into the system. 2. Procurement Manager selects the lead time analysis option. 3. Procurement Manager inputs procurement lead time data. 4. System generates a lead time analysis report.
Exceptional Flow	None
Related Actor(s)	Procurement Managers
Related Use Case(s)	None
Description	Procurement Managers analyze lead times for the procurement of raw materials to identify trends and make improvements.

System	[System Name]
Identifier	UC-2
Author(s)	- Author Name: - Author Email:
Version	1.0
Priority	High
Name	Supplier Delivery Time Trends
Pre-Condition(s)	- Valid user account in the system. - Availability of supplier delivery time data.
Post-Condition(s)	Supplier delivery time trend report generated.
Trigger	Procurement Manager initiates analysis.
Normal Flow	1. Procurement Manager logs in. 2. Selects supplier delivery time trend analysis. 3. Inputs delivery time data. 4. System generates supplier delivery time trend.
Exceptional Flow	None
Related Actor(s)	Procurement Managers
Related Use Case(s)	None
Description	Procurement Managers analyze supplier delivery time trends to identify months and quarters with significant changes.

System	[System Name]
Identifier	UC-3
Author(s)	- Author Name: - Author Email:
Version	1.0
Priority	Moderate
Name	Shipping Cost Trend Analysis
Pre-Condition(s)	- Valid user account in the system. - Availability of shipping cost data.
Post-Condition(s)	Shipping cost trend report generated.
Trigger	Logistics Manager initiates analysis.
Normal Flow	1. Logistics Manager logs in. 2. Selects shipping cost trend analysis option. 3. Inputs shipping cost data. 4. System generates shipping cost trend report.
Exceptional Flow	None
Related Actor(s)	Logistics Managers
Related Use Case(s)	None
Description	None.

System	[System Name]
Identifier	UC-4
Author(s)	• Author Name: • Author Email:
Version	1.0
Priority	Moderate
Name	Storage Utilization Monitoring
Pre-Condition(s)	• Valid user account in the system. • Availability of warehouse storage data.
Post-Condition(s)	• Storage utilization monitoring report generated.
Trigger	Warehouse Manager initiates monitoring.
Normal Flow	1. Warehouse Manager logs in. 2. Selects storage utilization monitoring option. 3. Inputs storage utilization data. 4. System generates storage utilization monitoring report.
Exceptional Flow	None
Related Actor(s)	Warehouse Managers
Related Use Case(s)	None
Description	[Add a brief description if needed]

System	[System Name]
Identifier	UC-5
Author(s)	• Author Name: • Author Email:
Version	1.0
Priority	Moderate
Name	Inventory Turnover Analysis
Pre-Condition(s)	• Valid user account in the system. • Availability of inventory turnover rate data.
Post-Condition(s)	• Inventory turnover analysis report generated.
Trigger	Inventory Manager initiates analysis.
Normal Flow	1. Inventory Manager logs in. 2. Selects inventory turnover analysis option. 3. Inputs turnover rate data. 4. System generates inventory turnover analysis report.
Exceptional Flow	None
Related Actor(s)	Inventory Managers
Related Use Case(s)	None
Description	[Add a brief description if needed]

System	[System Name]
Identifier	UC-6
Author(s)	• Author Name: • Author Email:
Version	1.0
Priority	Moderate
Name	Supplier Performance Ranking
Pre-Condition(s)	• Valid user account in the system. • Availability of supplier performance data.
Post-Condition(s)	• Supplier ranking report generated.
Trigger	Procurement Manager initiates ranking.
Normal Flow	1. Procurement Manager logs in. 2. Selects supplier performance ranking option. 3. Utilizes inputs for supplier performance data. 4. System generates supplier ranking report.
Exceptional Flow	None
Related Actor(s)	Procurement Managers
Related Use Case(s)	None
Description	[Add a brief description if needed]

System	[System Name]
Identifier	UC-7
Author(s)	- Author Name: - Author Email:
Version	1.0
Priority	Moderate
Name	Analyzing Popular Transportation Routes
Pre-Condition(s)	- Valid user account in the system. - Availability of shipment route data.
Post-Condition(s)	Route analytics report generated.
Trigger	Logistics Manager initiates analysis.
Normal Flow	1. Logistics Manager logs in. 2. Selects route analytics option. 3. Inputs shipment route data. 4. System generates route analytics report.
Exceptional Flow	None
Related Actor(s)	Logistics Managers
Related Use Case(s)	None
Description	[Add a brief description if needed]

System	[System Name]
Identifier	UC-8
Author(s)	• Author Name: • Author Email:
Version	1.0
Priority	Low
Name	Calculating Regional Shipping Delay
Pre-Condition(s)	• Valid user account in the system. • Availability of shipping delay data.
Post-Condition(s)	• Regional delay analysis report generated.
Trigger	Logistics Manager initiates analysis.
Normal Flow	1. Logistics Manager logs in. 2. Selects regional delay analysis option. 3. Inputs shipping delay data. 4. System generates regional delay analysis report.
Exceptional Flow	None
Related Actor(s)	Logistics Managers
Related Use Case(s)	None
Description	[Add a brief description if needed]

System	[System Name]
Identifier	UC-9
Author(s)	- Author Name: - Author Email:
Version	1.0
Priority	High
Name	Assessing Inventory Stockout Risk
Pre-Condition(s)	- Valid user account in the system. - Availability of inventory data and demand forecasts.
Post-Condition(s)	Stockout risk assessment report generated.
Trigger	Inventory Manager initiates assessment.
Normal Flow	1. Inventory Manager logs in. 2. Selects stockout risk assessment option. 3. Inputs inventory data and demand forecasts. 4. System generates stockout risk assessment report.
Exceptional Flow	None
Related Actor(s)	Inventory Managers
Related Use Case(s)	None
Description	[Add a brief description if needed]

System	[System Name]
Identifier	UC-10
Author(s)	• Author Name: • Author Email:
Version	1.0
Priority	High
Name	Calculating Demand Forecast Accuracy
Pre-Condition(s)	• Valid user account in the system. • Availability of demand forecast and actual demand data.
Post-Condition(s)	• Forecast accuracy analysis report generated.
Trigger	Inventory Manager initiates analysis.
Normal Flow	1. Inventory Manager logs in. 2. Selects demand forecast accuracy analysis option. 3. Inputs actual demand data. 4. System generates forecast accuracy analysis report.
Exceptional Flow	None
Related Actor(s)	Inventory Managers
Related Use Case(s)	None
Description	[Add a brief description if needed]