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The Use of Maple Application in Selecting Transportation Modes Between Ships and Airplanes Using Graph Theory

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Abstract: *Efficient transportation mode selection is an important aspect. Choosing an efficient mode of transportation between ships and airplanes significantly impacts public mobility, time efficiency, and costs. This study aims to apply graph theory in modeling transportation network systems and to use the Maple application to determine the optimal route based on travel time and cost. A case study was conducted using intercity transportation route data served by both modes. The results show that Maple effectively supports the modeling of weighted directed graphs and the calculation of the shortest path using Dijkstra's algorithm. This study confirms that the utilization of graph theory and Maple software facilitates transportation decision-making both mathematically and visually.*

Keywords— *Maple, Graph Theory, Transportation, Ship, Airplane*

1. INTRODUCTION

Transportation is a vital aspect of modern human life, especially in supporting interregional mobility, economic growth, and resource distribution. In archipelagic regions like Indonesia, the most dominant modes of transportation are airplanes and ships. Each mode has its own advantages and disadvantages. Airplanes offer high speed but at a relatively high cost, while ships tend to be cheaper but require longer travel times.

In the context of transportation mode selection, users face a dilemma between choosing time efficiency or cost efficiency. Therefore, a systematic and measurable approach is needed to assist the decision-making process in selecting the most optimal transportation mode based on user needs.

Graph theory is a branch of discrete mathematics that allows the representation and analysis of relationships between objects—in this case, nodes (cities) and edges (transportation routes). By incorporating weighting elements such as travel time or cost, weighted graphs can be used to find optimal paths. One of the commonly used algorithms for determining the shortest path is Dijkstra's algorithm.

Moreover, advances in computational technology enable efficient graph analysis using software. Maple, as a powerful symbolic and numerical mathematics software, features a GraphTheory library that can be used to construct, visualize, and computationally analyze graphs.

2. Research Methodology

2.1 Data

The data was obtained from transportation routes between several cities accessible by ship and airplane. The data includes:

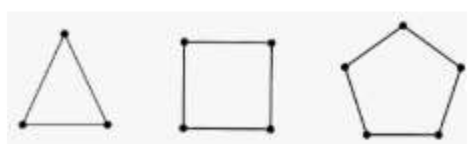
- Names of origin and destination cities
- Travel time (in hours)
- Transportation cost (in thousand rupiahs)

This data is contained in the attached Excel file.

2.2 Graph Modeling

Graph theory is one of the theories studied in discrete mathematics. A graph G is defined as an ordered pair of sets (V, E), denoted by G = (V, E), where V is a non-empty set of vertices (or nodes), and E is a set of edges (or arcs) that connect pairs of vertices. Based on the presence or absence of loops or multiple edges in a graph, graphs can generally be classified into two types:

1. Simple Graph
A simple graph is a graph that contains neither loops nor multiple edges.



2. Non-simple Graph

A non-simple graph is a graph that contains multiple edges or loops. There are two types of non-simple graphs:

a. Multigraph

A multigraph is a graph that contains multiple edges. Multiple edges connecting a pair of vertices can be more than two.

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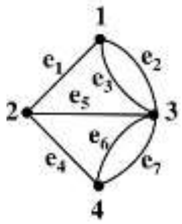

2.3 Maple Application

The following Maple functions were used:

- GraphTheory[Graph]
- GraphTheory[AddEdge]
- GraphTheory[DrawGraph]
- GraphTheory[ShortestPath](using Dijkstra's algorithm)

2.4 Analysis

Comparisons were made based on two criteria:

- Fastest route (minimum travel time)
- Cheapest route (minimum cost)

3. Methodology

3.1 Data and Sources

The transportation route and mode data includes:

- Names of origin and destination cities
- Mode of transportation (ship/airplane)
- Travel time (hours)
- Cost (in thousand rupiahs)

3.2 Analysis Steps

- Organize city and route data into a Microsoft Excel table and represent the routes as weighted graphs
- Create graph syntax in Maple
- Visualize the graph output using Maple
- Compare the results based on mode of transportation and efficiency

4. Results and Discussion

4.1 Visualization of the Transportation Network

Maple provides graphical representations that help in understanding the relationships between cities and the available transportation modes. Based on the data input in Maple (Sumber www.traveloka.com):

Route	Time	Duration	Travel Date	Ship	Cost
Medan - Tanjung Balai Karimun	13:30 - 12:00	22 Hours 30 Minutes	3 June 2025 - 4 June 2025	KM. KELUD	Rp 541,500
Tanjung Balai Karimun - Batam	13:00 - 16:00	3 Hours	4 June 2025	KM. KELUD	
Batam - Jakarta	20:00 - 04:00	1 Day 8 Hours	4 June 2025 - 6 June 2025	KM. KELUD	
Jakarta - Surabaya	16:00 - 18:00	1 Day 2 Hours	9 June 2025 - 10 June 2025	KM. DOBONSOLO	Rp 1,091,000
Surabaya - Makassar	21:00 - 03:00	1 Day 6 Hours	10 June 2025 - 12 June 2025	KM. DOBONSOLO	
Makassar - Sorong	06:00 - 17:00	2 Days 11 Hours	12 June 2025 - 14 June 2025	KM. DOBONSOLO	
Sorong - Manokwari	20:00 - 11:00	15 Hours	14 June 2025 - 15 June 2025	KM. DOBONSOLO	
				Airplane	
Medan (KNO) - Jakarta (CGK)	18:30 - 20:55	2 Hours 25 Minutes	3 June 2025	Lion Air	Rp 5,121,100
Transit in Jakarta (CGK)	-	3 Hours 35 Minutes	-	-	
Jakarta (CGK) - Sorong (SOQ)	00:30 - 06:30	4 Hours	4 June 2025	Batik Air	
Transit in Sorong (SOQ					

a. Maple Syntax for Ship Transport Mode:

```
with(GraphTheory);

G := Graph({[["Batam", "Jakarta"], 32], [["Jakarta", "Surabaya"], 26], [["Medan", "Tanjung Balai Karimun"], 22.5], [["Sorong", "Manokwari"], 15], [["Makassar", "Sorong"], 59], [["Surabaya", "Makassar"], 30], [["Tanjung Balai Karimun", "Batam"], 3]});

DrawGraph(G, layout = spring);
```

b. Maple Syntax for Airplane Transport Mode:

```
with(GraphTheory);

G := Graph({[["Jakarta (CGK)", "Sorong (SOQ)"], 5.1], [["Medan (KNO)", "Jakarta (CGK)"], 6], [["Sorong (SOQ)", "Manokwari (MKW)"], 0.9]});

DrawGraph(G, layout = spring);
```

4.2 Output Results from Maple Syntax

a. Ship Transport:

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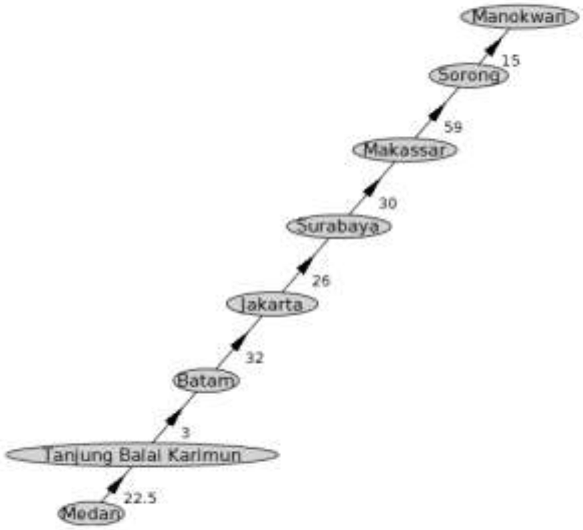
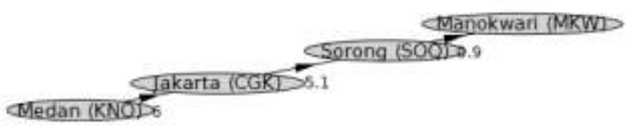


b. Airplane Transport:



5. Conclusion

The sea journey from Medan to Manokwari can be represented as a weighted, directed, linear, connected, and acyclic graph. This graph reflects a structurally efficient sequence of a single shipping route, which can be further analyzed for time and cost optimization. With the addition of complete weights (costs), graph-based methods can also be applied to determine the most economical or fastest path within the port network.

6. References

- Diestel, R. (2017). *Graph Theory* (5th ed.). Springer.
- Maplesoft. (2021). *Maple User Manual*. Waterloo Maple Inc.
- www.traveloka.com