

國立陽明交通大學  
運輸與物流管理學系  
碩士論文

Department of Transportation and Logistics Management  
National Yang Ming Chiao Tung University  
Master Thesis

考慮部分涵蓋之捐血車區位途程問題  
The Bloodmobile Location Routing Problem  
Considering Partial Coverage

研究生：黃詠婕（Huang, Yung-Chieh）  
指導教授：盧宗成（Lu, Chung-Cheng）

中華民國一一四年六月  
June 2025

考慮部分涵蓋之捐血車區位途程問題

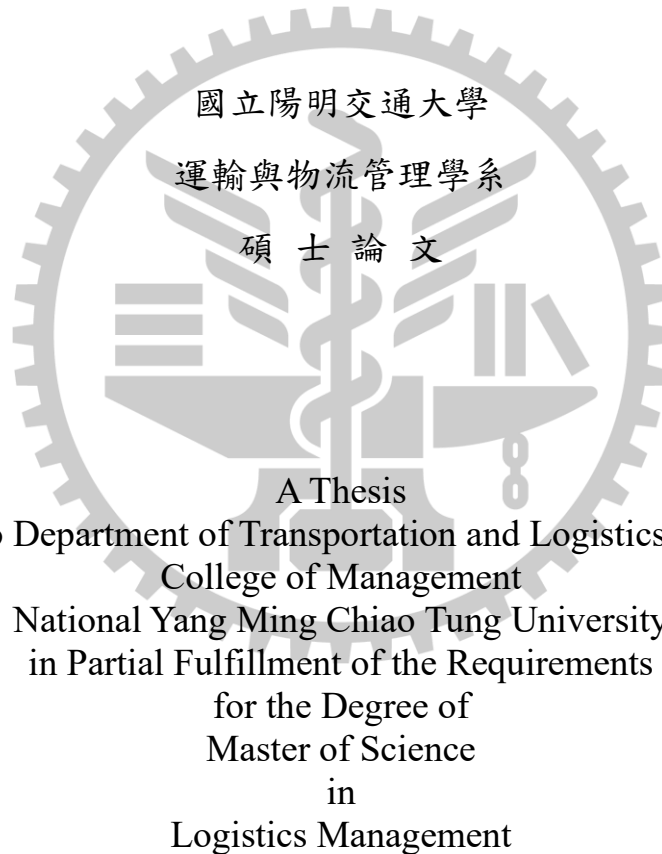
The Bloodmobile Location Routing Problem  
Considering Partial Coverage

研 究 生：黃詠婕

Student：Yung-Chieh Huang

指導教授：盧宗成 博士

Advisor：Dr. Chung-Cheng Lu



June 2025  
Taiwan, Republic of China

中華民國一一四年六月

# 考慮部分涵蓋之捐血車區位途程問題

研究生：黃詠婕

指導教授：盧宗成 教授

國立陽明交通大學運輸與物流管理學系研究所碩士班

## 摘要

本研究探討考慮部分涵蓋之捐血車區位途程問題，從血液收集機構的角度出發，以最小化總成本為目標建構數學模式，成本包含捐血車總旅行成本、捐血車固定成本以及未滿足目標採集血量之懲罰成本。本研究針對該問題建構了一個混合整數線性規劃模式，用以求解在規劃期間內，捐血車預計停留的捐血點以及拜訪這些捐血點的路徑。本研究以部分涵蓋函數，如線性函數以及  $S$  型函數，來量化到捐血點間的距離對於民眾捐血意願的影響，使問題更貼近實務狀況。另外，針對未被滿足的目標採集血量，會藉由懲罰成本來反映在目標式上，希望藉此平衡目標採集血量以及總成本。本研究收集臺灣血液基金會之實際資料，針對臺北、新北市範圍產生測試例題。對於中、小規模範例，使用 Gurobi 最佳化軟體求解所建構的數學模式，為了提升大規模問題的求解效率，進一步發展兩階段啟發式演算法，從測試結果可以看出，若使用啟發式演算法能大幅縮短求解時間。本研究提供血液收集機構在規劃捐血點與捐血車路徑之決策參考，具有理論與實務之貢獻。

**關鍵字：**部分涵蓋、血液供應鏈、捐血車區位途程問題、數學規劃、啟發式演算法

# The Bloodmobile Location Routing Problem

## Considering Partial Coverage

Student: Yung-Chieh Huang

Advisor: Chung-Cheng Lu

Department of Transportation and Logistics Management  
National Yang Ming Chiao Tung University

### Abstract

This study investigates the partial-coverage location–routing problem for bloodmobiles from the perspective of a blood-collection agency. A mixed-integer linear programming model is developed to minimize the total cost—comprising travel costs, fixed costs, and penalty costs for failing to meet target collection volumes—over a given planning horizon. To better reflect real-world donor behavior, both linear and sigmoid partial-coverage functions are independently incorporated, quantifying how the distance between bloodmobiles and donation sites affects donor willingness. Unmet collection targets are penalized in the objective function to balance blood-collection goals against overall cost. Using actual operational data provided by the Taiwan Blood Services Foundation, computational experiments are conducted for the Taipei and New Taipei City regions. For small- to medium-scale test instances, the model is solved optimally using the Gurobi optimizer; for large-scale instances, a two-phase heuristic algorithm is proposed, demonstrating a substantial reduction in solution time. The findings offer both theoretical insight and practical guidance for blood-collection agencies in planning the locations of donation sites and the routing of collection vehicles.

**Keywords:** Partial-coverage 、 Blood Supply Chain 、 Bloodmobile Location Routing Problem 、 Mathematical Programming 、 Heuristic Algorithm