TRAVEL DEMAND MODELING WITH MOBILE NETWORK BIG DATA.

(STUDY AREA: WESTERN PROVINCE OF SRI LANKA)

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Doctor of Philosophy

Department of Transport Management and Logistics Management

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DECLARATION OF ORIGINALITY

I declare that this is my work. This thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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STATEMENT OF THE SUPERVISORS

The above candidate has carried out the research for the PhD under my supervision.

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Signature of the supervisor: Date:07/08/2025

Co- Supervisor: Dr. Shehan Perera

Signature of the supervisor: Date:08/08/2025

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ABSTRACT

The increasing travel demand necessitates dynamic traffic control mechanisms, which rely heavily on human mobility data for effective implementation. Traditional gathering of mobility information, such as household surveys, is costly and time-consuming. However, the advent of big data offers an unprecedented opportunity to analyze human mobility on a large scale in a cost-effective and real-time manner. Specifically, Call Detail Record (CDR) data, a subset of Mobile Network Big Data (MNBD), provides valuable insights into human mobility patterns. Yet, this data requires extensive processing to convert into structured travel information suitable for integration into travel demand models.

In response to this challenge, this study introduces a novel methodology that leverages CDR data to inform the four-step modeling process, encompassing Trip Generation/Attraction, Origin-Destination (OD) information, and Network Assignment. Utilizing a stay-based approach with pseudo-anonymized CDR data, the methodology identifies trip nodes by tracking the presence of mobile phone users within specific temporal and spatial cells. This approach facilitates extracting individual mobility characteristics, including activity sequences and trip generations/attractions. Moreover, it allows for determining trip purposes based on the origins and destinations and generating OD matrices from CDR data using mapped spatio-temporal data. Individual commuting routes are then defined based on the frequency of appearances and weighted caller activities along each potential route.

The methodology was applied to a CDR dataset comprising randomly selected 400,000 users over one month within the Western Province of Sri Lanka. The findings were validated against data from traditionally collected household visit surveys. The validation results demonstrated a significant correlation at each stage of the four-step process, underscoring the potential of repurposed, privacy-preserved mobile phone data to significantly enhance dynamic travel demand analysis.

Keywords – Mobile Network Big Data, Call Detail Record, OD Matrix, Network Assignment

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LIST OF ACRONYMS

MNBD	Mobile Network Big Data
CDR	Call Detail Records
VLR	Visitor Location Register
CA	Caller Activities
HVS	Household Visit Survey
WP	Western Province
DSD	Divisional Secretariat Divisions
GND	Grama Niladhari Divisions
BTS	Base Transceiver Station
O- D MATRIX	Origin – Destination Matrix

LIST OF APPENDICES