FACULTEIT ECONOMIE EN BEDRIJFSKUNDE

UNIVERSITEIT GENT

Invitation

You are cordially invited to the public defence to obtain the academic degree of

DOCTOR OF BUSINESS ECONOMICS

by Dieter Oosterlinck

Modelling Spatio-Temporal Human Behaviour with Mobile Phone Data: A Data Analytical Approach

Supervisors:
Prof. dr. Dries F. Benoit
Prof. dr. Philippe Baecke

Tuesday, 25 May 2021 at 17h30
Via livestream (Zoom) from 'Faculteitsraadzaal FEB'
Please confirm your (online) attendance no later than May 15 by email to
dieter.oosterlinck@ugent.be

EXAMINATION BOARD

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Dean of the Faculty of Economics and Business Administration
Ghent University

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Supervisor
Ghent University

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Abstract

The analysis of spatio-temporal human behaviour is valuable for research purposes and has many applications in business. The traditional survey-based methods are being replaced by actual tracking methods. Mobile phones provide a very well suited means for tracking. The main goal of this dissertation was to investigate how mobile phone data can be used to model spatio-temporal human behaviour. Two data sources were selected, the Bluetooth signal and the standard mobile phone signal. The first results into Bluetooth tracking data, the latter is known as call detail record (CDR) data. These raw CDR/Bluetooth data records as such are insufficient to derive meaningful insights. Therefore, a data analytical approach is applied to create value from these data sources.

Chapter 2 investigates the value of Bluetooth tracking for modelling the spatio-temporal behaviour of people in an indoor shopping mall. The real-life experiment with 56 Bluetooth scanners demonstrated the applicability of Bluetooth tracking for this purpose. The rather high detection ratio of 9.81% ensures that Bluetooth tracking quickly generates a large sample. The experiment revealed that Bluetooth tracking is a valuable approach that also incurs a low overall cost.

Chapter 3 deals with a geographically larger, outdoor setting for which CDR data is more advised than Bluetooth tracking. Many spatio-temporal analyses need the home location as a start point for further analyses. Nevertheless, the approaches for detecting home locations with CDR data have not been validated sufficiently in literature. Therefore, this dissertation benchmarked the existing heuristic methods and introduced both a new heuristic method and a predictive modelling approach. The latter revealed that a labelled predictive modelling approach should be applied when possible. Furthermore, it was shown that the inclusion of social network based variables further improve the performance.

Chapter 4 applies the location data, embedded in CDR data, to the case of fraud detection. The successful business case demonstrated that CDR data can be used to identify customers that use a new telecom product in a non-authorized way. Furthermore, the case required the development of a new analytical method as no historical data about fraud had been observed. It was found that the traditional one-class novelty detection methods were not satisfactory in a setting that deals with human spatio-temporal behaviour. Therefore, expert knowledge was used in order to transform the one-class problem into a two-class problem, so that more traditional, better performing methods could be used.

Curriculum vitae

Dieter Oosterlinck (°1991, Izegem) obtained the degree of Master in Applied Economics: Business Engineering at Ghent University in 2015. Since then, he has been working as a doctoral researcher and teaching assistant at the Data Analytics research group of the Faculty of Economics and Business Administration, Ghent University.

Dieter presented his research at several international conferences. He presented at the European Conference on Operational Research (EURO2016 Poznan, EURO2018 Valencia, EURO2019 Dublin) and the Conference of the International Federation of Operational Research Societies (IFORS2017 Quebec).

The main chapters of the dissertation have been published in international peer-reviewed journals. Chapter 2 has been published in *Applied Geography* (2017), Chapter 3 has been published in *Expert Systems with Applications* (2021) and Chapter 4 has been published in the *European Journal of Operational Research* (2020).