Understanding methylamphetamine drug markets in an Australian context

By

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Certificate of authorship and originality

I, Ana Popovic declare that this thesis, is submitted in fulfilment of the requirements for the degree of Doctor of Philosophy, in the Faculty of Science at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Publications and presentations

Publications:

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Presentations:

A. Popovic, M. Morelato, C. Roux, A. Beavis (2019). *Chemometrics in illicit drug intelligence.* FoSTER, University of Technology Sydney, Australia, 29 November 2019.

A. Popovic, C. Roux, A. Beavis (2018). *Chemometrics in illicit drug intelligence.* 24th International Symposium on the Forensic Sciences, ANZFSS, Perth, Australia, 9-13 September 2018.

A. Popovic, C. Roux, A. Beavis (2018). *Chemometrics in illicit drug intelligence.* 8th European Academy of Forensic Science (EAFS), Lyon, France, 27-31 August 2018 (poster).

A. Popovic, C. Roux, A. Beavis (2017). *Illicit drug profiling in forensic intelligence (street seizures).* Doctoral school, Les Diableretes, Switzerland, 28-31 August 2017.

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Abbreviations

2PG	2-Path Graph
ACT	Australian Capital Territory
AFP	Australian Federal Police
AIDIP	Australian Illicit Drug Intelligence Program
AM	Amphetamine
ATS	Amphetamine-Type Stimulants
AUC	Area Under the Curve
CA	Clustering Analysis
CAN	Canberra
CC	Chemical Class
CE	Capillary Electrophoresis
CHAMP	Collaborative Harmonisation of Methods for Profiling of Amphetamine-Type Stimulants
CMP	1-(1',4'-cyclohexadienyl)-2-methylaminopropane
CNS	Central Nervous System
DAD	Diode Array Detector
d-MA	*d*-Methylamphetamine
d-MA-E	*d*-Methylamphetamine Enriched
DNV	Dynamic Network Visualisation
ELSD	Evaporative Light Scattering Detector
ENIPID	Enhanced National Intelligence Picture on Illicit Drugs
EPH	Ephedrine
EUC	Euclidean
FID	Flame Ionisation Detector
FN	False Negative
FP	False Positive

FR	Fruchterman-Reingold
GC	Gas Chromatography
HCA	Hierarchical Clustering Analysis
HS	Headspace
ICP	Inductively Coupled Plasma
IDDR	Illicit Drug Data Report
ILP	Intelligence Led Policing
IRMS	Isotopic Ratio Mass Spectrometry
KK	Kamada-Kawai
L	Logarithm
LC	Liquid Chromatography
LLE	Liquid-Liquid Extraction
l-MA	*l*-Methylamphetamine
l-MA-E	*l*-Methylamphetamine Enriched
LPAC	L-Phenylacetylcarbinol
LR	Likelihood Ratio
MA	Methylamphetamine
MAN	Manhattan
MCF	Modified Cosine Function
MDMA	3,4-Methylenedioxymethylamphetamine
MLP	Multi-Profile
MOP	Mono-Profile
MS	Mass spectrometry
N	Normalisation
NA	Not Applicable
NIM	National Intelligence Model
NMI	National Measurement Institute
NSW	New South Wales

NT	Northern Territory
PCA	Principal Component Analysis
PCC	Pearson Correlation Coefficient
PSE	Pseudoephedrine
QLD	Queensland
RAC	Racemic
RIS	Regulation Impact Statement
ROC	Receiver Operating Characteristic
RT	Reingold-Tilford
SA	South Australia
SCF	Squared Cosine Function
SNA	Social Network Analysis
SPME	Solid-Phase Microextraction
TAS	Tasmania
TN	True negative
TP	True positive
VIC	Victoria
VRR	Variability Reduction Rules
WA	Western Australia
WDR	World Drug Report
WH	Working Hypothesis

Abstract

Decisions by law enforcement agencies regarding crime disruption, prevention and reduction rely on significant volumes of information from various sources. There is a desire to use this information for generating intelligence to support proactive policing rather than reactively responding to crime. Utilising an existing proof of concept, this research explored the application of chemometric techniques to chemical profiles of state-level methylamphetamine seizures, acquired from the Australian Federal Police through the Enhanced National Intelligence Picture on Illicit Drugs capability. The main aim was to create and deliver a methodology that would expand the use of illicit drug profiling for strategic and operational intelligence purposes, to be more effective in the fight against illicit drug trafficking.

The use of comparison metrics and clustering analysis to determine links between illicit drug specimens was evaluated and automated. The scores resulting from comparison metrics were evaluated through two established approaches, i.e. deterministic and Bayesian approaches. Results showed that using the two approaches in combination provided more information about linkages than when either approach was used independently.

Relational, temporal, spatial and quantitative analyses were subsequently used to gain an insight into illicit drug markets. Relational analysis identified clusters of seizures central to the network. Temporal analysis then provided insights into the behaviour of distribution markets, specifically the emergence and extinction of certain groups of seizures over time. Finally, spatial analysis aided the understanding of the inter-jurisdictional nature of illicit drug markets. These analyses allowed for the generation of strategic intelligence relating to when and where the Australian illicit drug market was the most active. Additionally, the strategic level trends identified clusters of seizures which were worth investigating further. These clusters were explored through a case study to provide drug market knowledge at an operational level.

The presentation forensic case data, for intelligence or court purposes, typically involve the preparation of static reports. The final aim of this project was the creation of a visualisation tool, which was created to enhance the way processed data was conveyed. This tool was produced in the form of a web application and was used to aid the exploration of drug markets. It provided an automated way of analysing the forensic case data and producing relevant visualisations in an interactive and timely manner.