

Mathematical Models of Crime

Alvaro J. Riascos Villegas
University of los Andes and Quantil

July 6 2018

Contenido

1 Introduction

Contents

1 Introduction

Models of Crime in Practice

- Many urban centers are currently using crime prediction models: Los Angeles CA, Atlanta GA, Chicago IL, New York NW, Alhambra CA, San Francisco CA, Modesto CA, Santa Cruz, CA.
- We applied state of the art modelling to the city of Bogota.
- 329,793 crime between 2004 y 2014 (georeferenced data, with time and date stamps).
- We compared several models: Point models, ellipses, KDE and spatio temporal models.

Models of Crime in Practice

- Many urban centers are currently using crime prediction models: Los Angeles CA, Atlanta GA, Chicago IL, New York NW, Alhambra CA, San Francisco CA, Modesto CA, Santa Cruz, CA.
- We applied state of the art modelling to the city of Bogota.
- 329,793 crime between 2004 y 2014 (georeferenced data, with time and date stamps).
- We compared several models: Point models, ellipses, KDE and spatio temporal models.

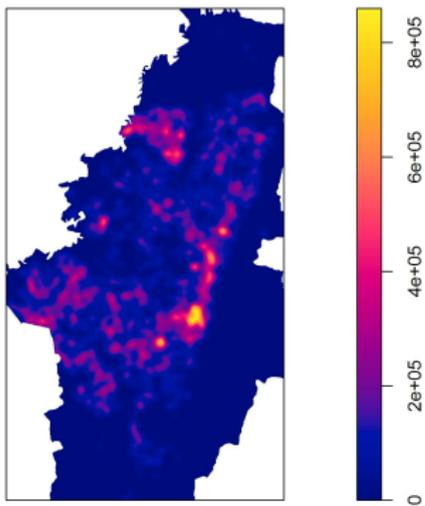
Models of Crime in Practice

- Many urban centers are currently using crime prediction models: Los Angeles CA, Atlanta GA, Chicago IL, New York NW, Alhambra CA, San Francisco CA, Modesto CA, Santa Cruz, CA.
- We applied state of the art modelling to the city of Bogota.
- 329,793 crime between 2004 y 2014 (georeferenced data, with time and date stamps).
- We compared several models: Point models, ellipses, KDE and spatio temporal models.

Models of Crime in Practice

- Many urban centers are currently using crime prediction models: Los Angeles CA, Atlanta GA, Chicago IL, New York NW, Alhambra CA, San Francisco CA, Modesto CA, Santa Cruz, CA.
- We applied state of the art modelling to the city of Bogota.
- 329,793 crime between 2004 y 2014 (georeferenced data, with time and date stamps).
- We compared several models: Point models, ellipses, KDE and spatio temporal models.

Heat map for a 1-year period of crime



The State of the Art: Spatio temporal models

- The model is based on the introduction of two types of events: background and replica events.

Modelo Espacio - Temporal: Motivación

Mohler et al.: Self-Exciting Point Process Modeling of Crime

101

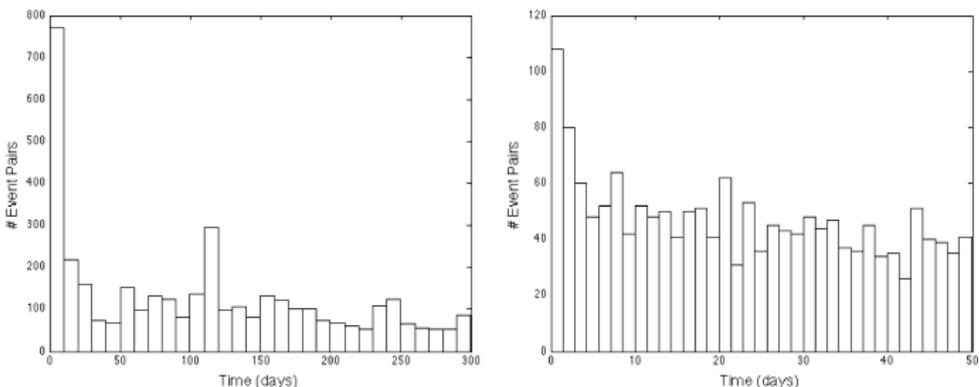


Figure 1. On the left, histogram of times (less than 300 days) between Southern California earthquake events of magnitude 3.0 or greater separated by 110 kilometers or less. On the right, histogram of times (less than 50 days) between burglary events separated by 200 meters or less.

Modelo Espacio - Temporal: Motivación

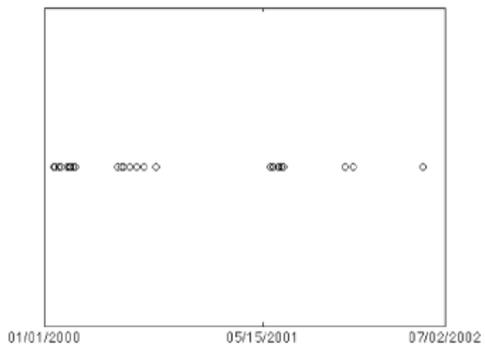


Figure 2. Times of violent crimes between two rivalry gangs in Los Angeles.

Specification of a Spatio Temporal Model

- Consider a model where crime intensity $\lambda(t, x, y)$ satisfies

$$\lambda(t, x, y) = \mu(t, x, y) + \sum_{k:t_k < t} g(t - t_k, x - x_k, y - y_k) \quad (1)$$

- We use crime data between the 16th of april and the 30th of june de 2017: 16.402 events.
- The model is validated in one particular locality of Bogotá.

- We use crime data between the 16th of april and the 30th of june de 2017: 16.402 events.
- The model is validated in one particular locality of Bogotá.

- We use *Precision Accuracy Index*

$$\text{PAI} = \frac{\text{Hit Rate}}{\text{Percentage of Area}}$$

$$\text{Hit Rate} = \frac{\text{Crimes predicted in Hotspots}}{\text{Total Crimes}}$$

$$\text{Percentage Area} = \frac{\text{Area of Hotspots}}{\text{Total Area}}$$

- Hit Rate with 7 weeks of training data and 10% of covered area (i.e., hotspots):

Predicción	bw fijo	bw variable	KDE
Semana 1	0,44	0,57	0,42
Semana 2	0,46	0,59	0,44
Semana 3	0,54	0,62	0,53
Promedio	0,48	0,59	0,46

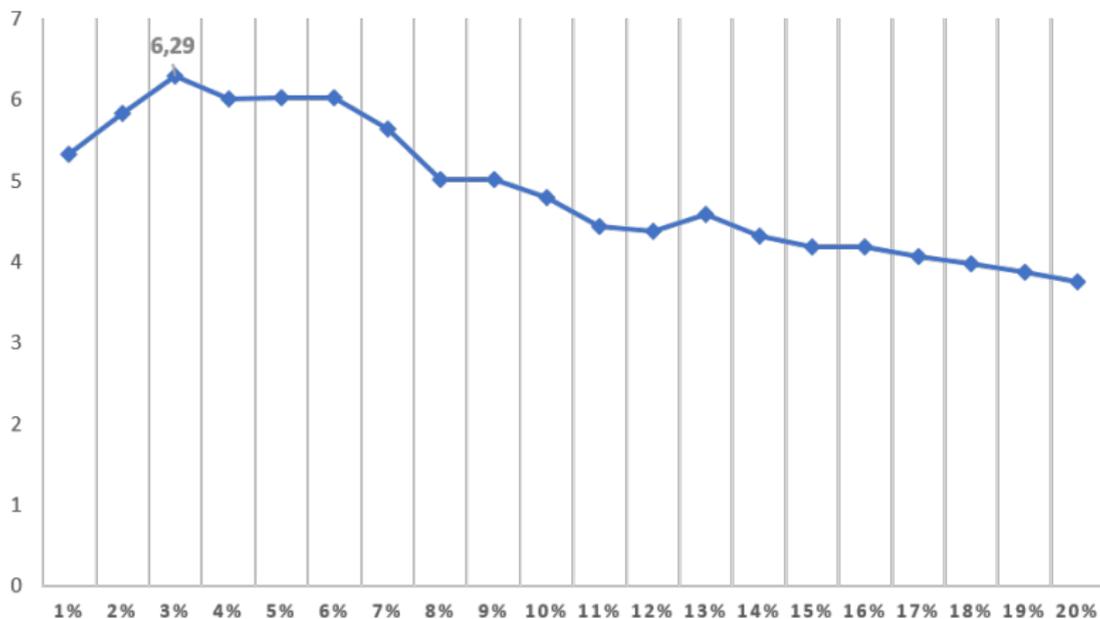
- Hit Rate with 7 weeks of training data and 10% of covered area (i.e., hotspots):

Predicción	bw fijo	bw variable	KDE
Semana 1	0,44	0,57	0,42
Semana 2	0,46	0,59	0,44
Semana 3	0,54	0,62	0,53
Promedio	0,48	0,59	0,46

Validation

- Average PAI based on percentage of covered area.

PAI PROMEDIO SEGÚN PORCENTAJE DE COBERTURA



~/R/Code/codigo_crimen/App - Shiny

http://127.0.0.1:5084

Open in Browser



Publish

Prediccion de crimen

quantil

matemáticas aplicadas

Horas:



Día:

- lunes
- martes
- miercoles
- jueves
- viernes
- sabado
- domingo

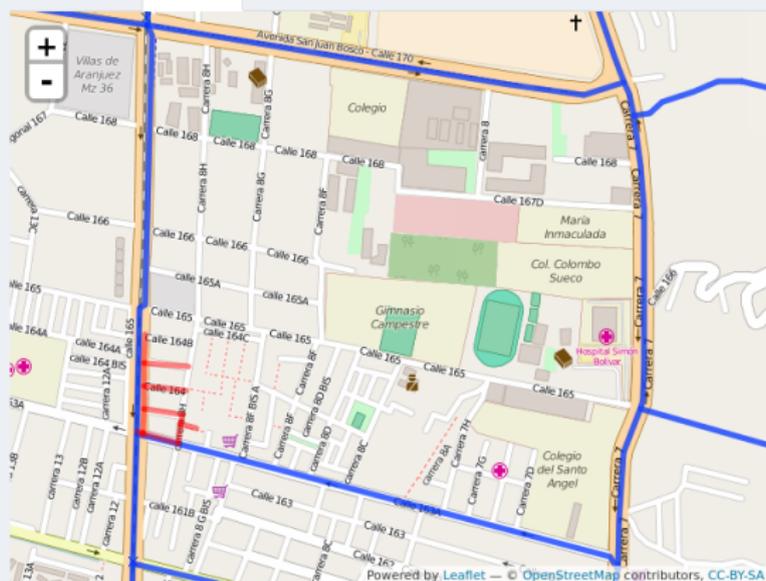
Código del cuadrante:

E01-12

Ejecutar

Mapa de calor

Patrullaje



Street segments

