Optimal Public Warning Decisions in a Dynamic Context: Calibration for Criminal Incidents in A University

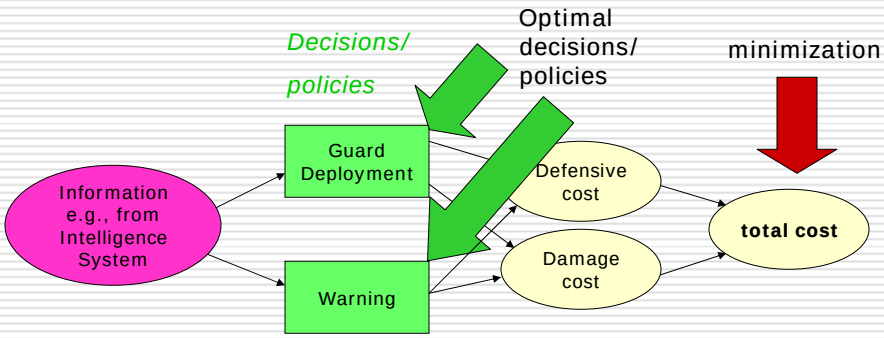
Navid Ghaffarzadegan
PhD Candidate, UAlbany - SUNY

1. Introduction

- Issuing warnings are common defensive policies to increase security.
- It can be for security in an organization, public place, in a city, in a country.
- Warnings improve public awareness as well as guards' readiness.
- Extensive issuance of warning can result in social stress and dissatisfaction.
- From a normative decision making stand point, this trade off leads to finding optimal policies

1. Introduction

- The basic logic in normative models (e.g., see Pinker 2007):

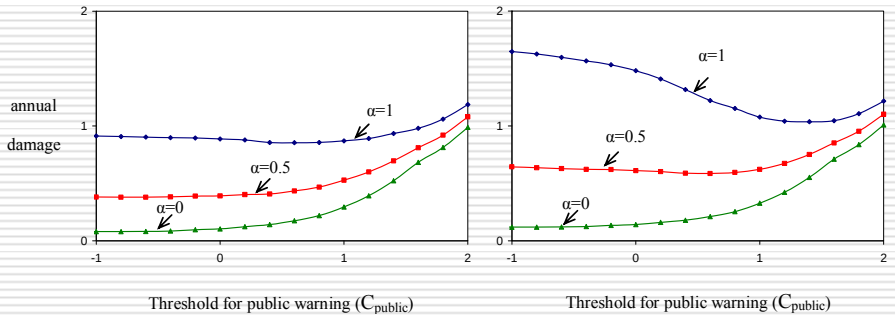


1. Introduction

- The consequences of warning issuance is not limited to the short term period.
  - For example, too much warnings may result in a loss of public sensitivity.
- Adversaries/criminals can react to warning issuance:
  - Deterrence.
  - Reaction to public sensitivity.
- Myopic optimization may be less relevant for warning decision making.
- The necessity of a dynamic approach.

1. Introduction - History

- Ghaffarzadegan and Andersen (2009)
  - built on Pinker's model, added a few feedback loops.
  - Stochastic components, Discrete



- Empirical investigation of an SD version of the model

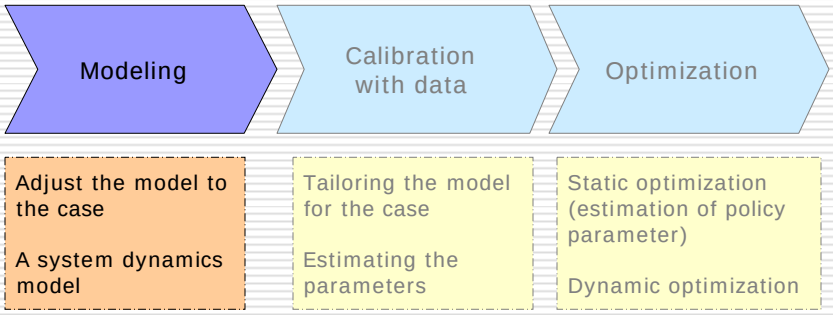
2. Problem Definition

- Scope of this paper: Calibration of the warning Model with a data set
- This paper develops an SD model based on the previous model.
- Investigates optimal warning thresholds
- More specifically: How should we issue warnings in public places? (here: in universities)

2. Problem Definition

Method: Simulation

Steps:



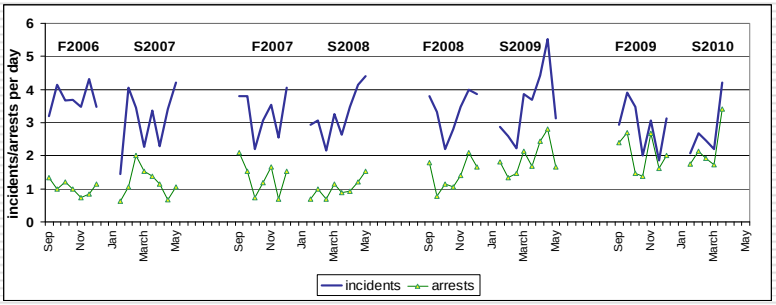
3- Modeling

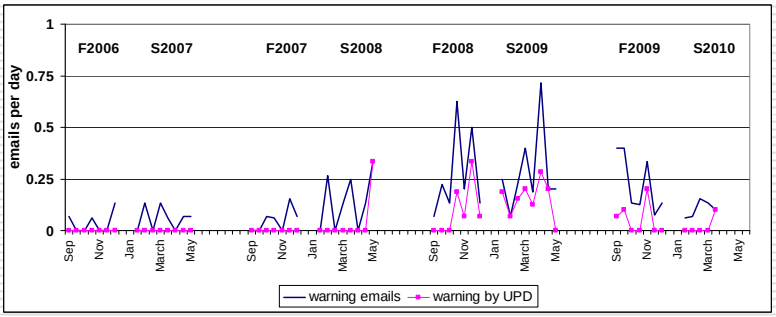
- Case: We use data on security at UAlbany
- Data on criminal incidents
  - Most of the crimes are thefts (public reaction is important)

Incident Type: Petit Larceny. - STATUS: CLOSED
Date ~ Time Reported: 12/15/2008 ~ 1832
Date ~ Time Occurred: 12/15/2008 ~ 1520
Incident No.: 29096-08
Location: Podium - Main Library
Nature of Complaint: Laptop stolen from study cubicle when left unattended.
[Note:This incident involved the theft of property that had been left unsecured/unattended.]

New York State DCJS Status: Closed By Investigation
University at Albany Status:

Data: Criminal incidents and warning emails 2006-2010

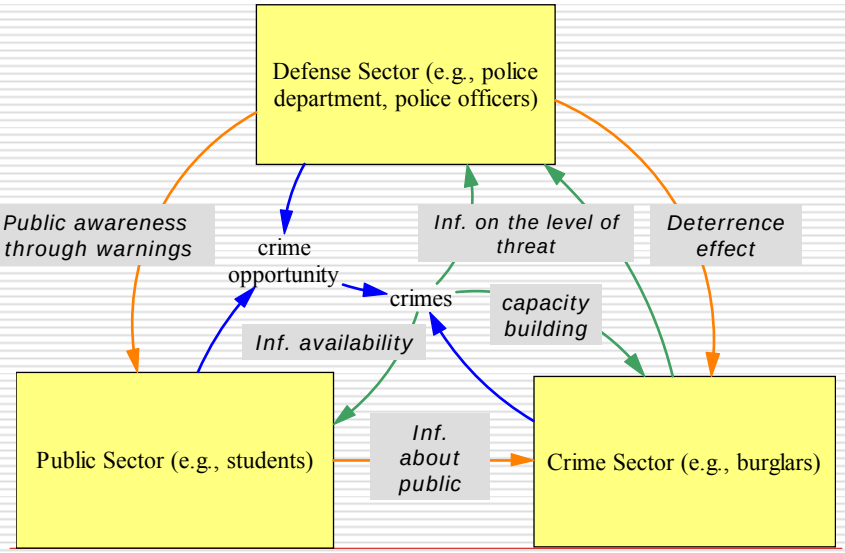




3. Modeling

- The original model:
  - Public policy and Behavioral decision making literature.
    - Crime Opportunity vs. Crime capacity
  - Previous SD models of crime dynamics and security
  - Pinker's model of warning
- Three main sectors:
  - Defense sector
  - Crime sector
  - Public sector

3. Modeling – the original model



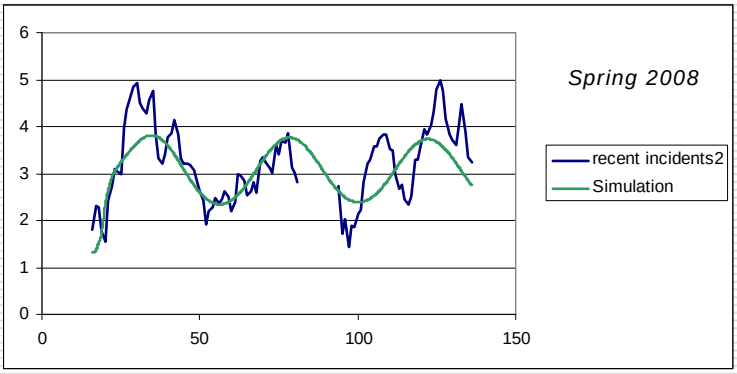
3. Modeling

- I tailored the model for criminal incidents in UAlbany in one semester.
- Assumption: crime capacity doesn't change in a semester. (constant base rate)
  - Exogenous crime capacity
  - Endogenous reaction from the police department and public

Modeling → Calibration with data → Optimization

Modeling	Calibration with data	Optimization
Adjust the model to the case A system dynamics model	Tailoring the model for the case Estimating the parameters	Static optimization (estimation of policy parameter) Dynamic optimization

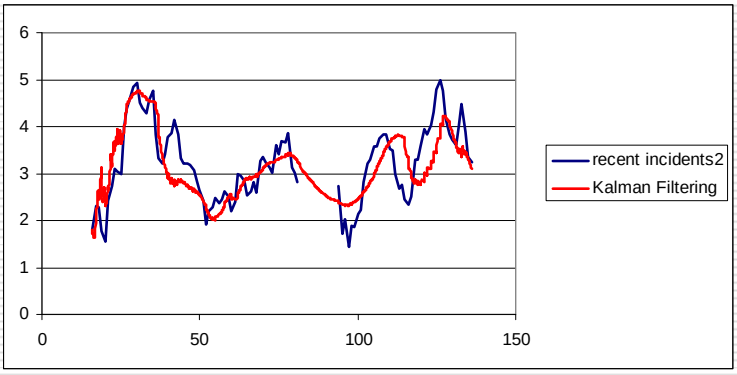
4. Calibration with data



R^2=0.78, MSE = 0.69

U^M=0.10, U^C=0.54, U^S=0.35

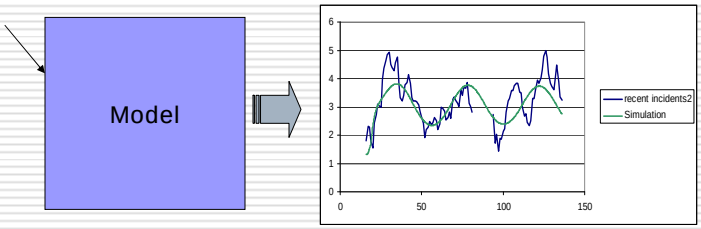
4. Calibration with data

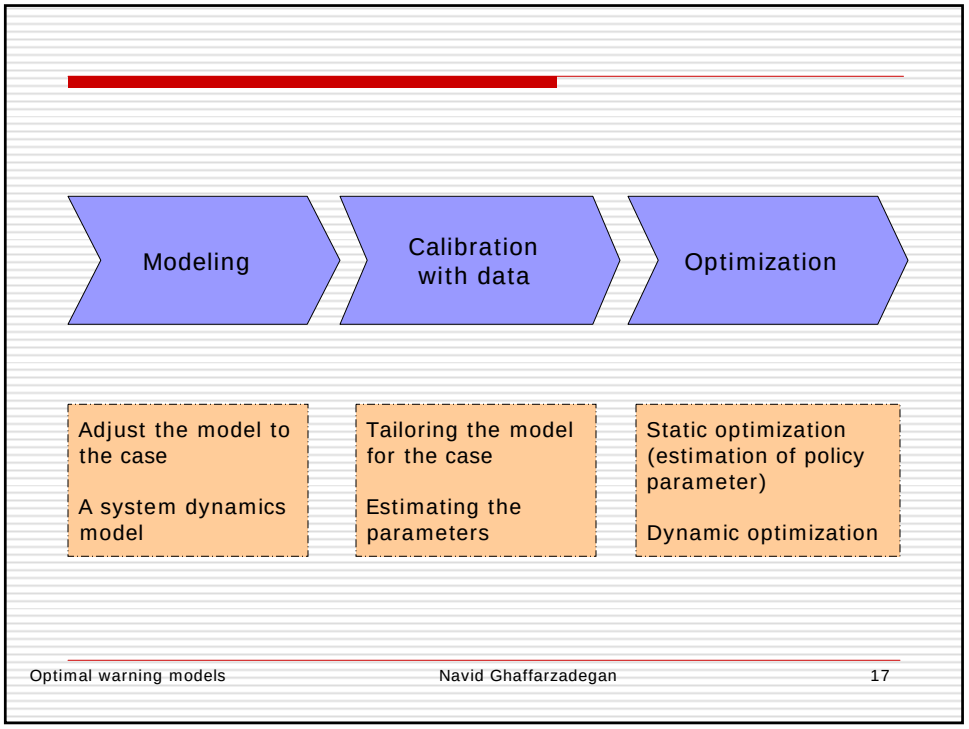


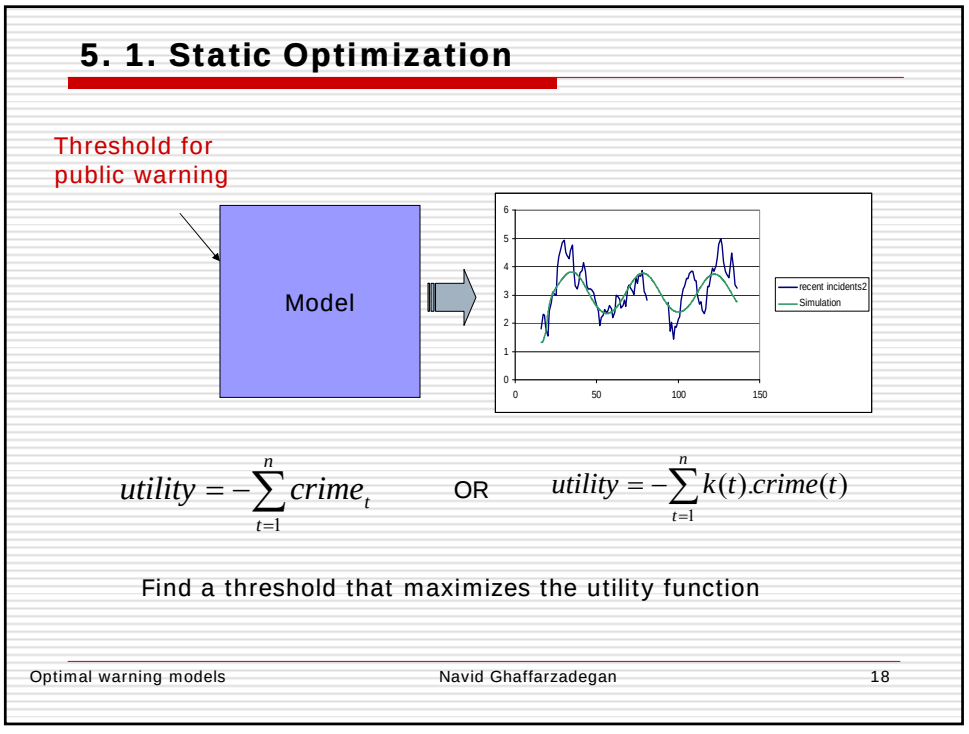
Kalman Filtering to re-check parameter estimations

4. Calibration with data

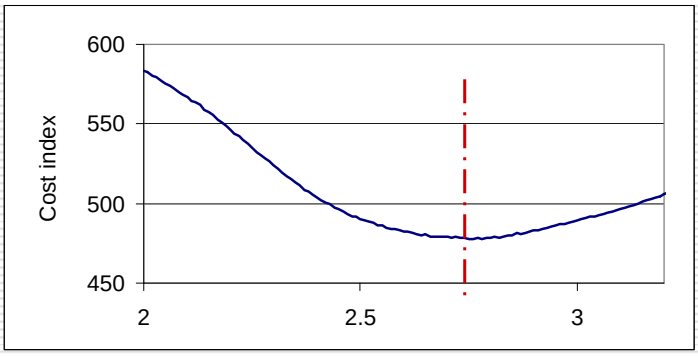
Policy experiments




Modeling
Calibration with data
Optimization
Adjust the model to the case
A system dynamics model
Tailoring the model for the case
Estimating the parameters
Static optimization (estimation of policy parameter)
Dynamic optimization
Optimal warning models
Navid Ghaffarzadegan
17


5. 1. Static Optimization
Threshold for public warning
Model
recent incidents2
Simulation
$utility = -\sum_{t=1}^{n} crime_t$
OR
$utility = -\sum_{t=1}^{n} k(t).crime(t)$
Find a threshold that maximizes the utility function
Optimal warning models
Navid Ghaffarzadegan
18

5. 1. Static Optimization

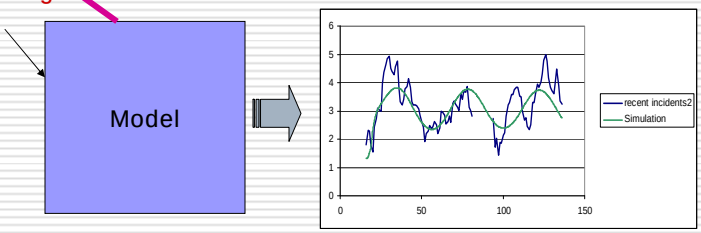


Optimal Public Threshold = 2.75 criminal incidents

Confidence interval for this should come from CI of calibration

5. 2. Dynamic Optimization

Threshold for public warning



$$utility = -\sum_{t=1}^{n} crime_t \qquad \text{OR} \qquad utility = -\sum_{t=1}^{n} k(t).crime(t)$$

Threshold = *f(state variable 1, state variable 2, …)*

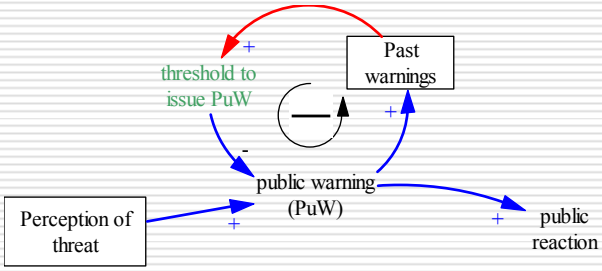
Find a Function that maximizes the utility function

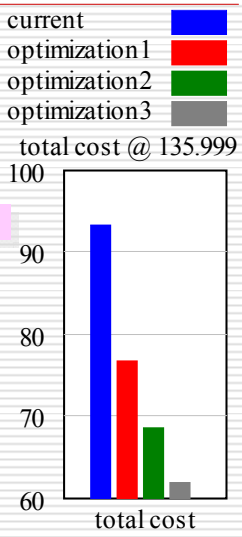
5. 2. Dynamic Optimization

Threshold = 2.75 criminal incidents

Threshold = 2.05+18.82*. past warnings

Issue less warning if you have recently issued warnings.





6. Conclusion

- Modeling: Proposed a model for warning decision making, and simulated.
- Calibration: We investigated if the model fits the data from UAlbany
- Static Optimization: Proposed optimal thresholds
- Dynamic Optimization: Propose feedback structures (as heuristics) that can help

Thank You

Feedback?