Final Project Proposal

DATA 604: Simulation & Modeling

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1 Problem Statement & Research Questions

Disasters can be defined as crises that overwhelm, at least for a time, people's capacities to manage and cope.

Planning for disaster relief scenarios can be a tricky endeavour. Where will the next disaster occur? When? On what scale? The historical record can be useful to understand a range of possible answers, but this raises more questions. How many supplies should be pre-positioned in anticipation of a future disaster? What type of supplies should be stocked? How might a given set of supplies be useful for multiple disasters? Questions like these are considered in current research as shown in the papers reviewed for this proposal.

2 Statement of Objectives

The humanitarian logistic chain entails procurement of supplies, storage, transportation, in-country arrival and custom clearance, in-country storage, transportation and distribution. We plan to use a combination of R and Simio to develop and execute a simulation model in order understand the behaviour of a humantarian logistic chain system under various assumptions related to entity attributes and event properties.

The *system* being modeled will be the aspects of the humanitarian logistics chain associated with a single disaster across multiple locations within a country needing relief. Capacity associated with a global storage location, transport to a disaster country, custom entry delays, local storage and local transportation will be considered.

2.1 Entities

The following entities and attributes will be considered in the simulation model:

- Supplier with *attributes* one-time seller (less reliable) or supply chain partner (more reliable)
- Warehouse with *atrributes* global warehouse or local, storage capacity
- Plane with *attributes* fast-speed, smaller capacity, cost/trip
- Ship with *attrbutes* slow-speed, larger capacity, cost/trip
- Truck with *attributes*, slow-speed, small capacity, cost/trip
- Customs with *attribute* length of delay

2.2 Events

Events will include the occurrence of disasters, theft of supplies, and arrival of supplies at disaster country storage locations. We anticipate other events may be identified during the project.

3 Data Set(s)

The Humanitarian Data Exchange provides many different data sets which could be beneficial for this project (United Nations Secretariat, 2016).

Disaster profiles from 1900 to 2015 can be accessed from the Centre for Research on the Epidemiology of Disasters (EM-Dat, 2016). These data will be used to profile the probability distribution of disasters regionally. We will leverage this information when simulating disaster occurrences that will demand the movement of relief supplies.

4 Recent Journal Papers

4.1 Multi-criteria logistic modeling for miliary humanitarian assistance...

This paper describes a model complete with objective function and an array of constraints for aiding in decision support for humanitarian assistance and disaster relief (HA/DR) efforts. Specifically, the model aims to determine the optimal aerial supply chain network for HA/DR given target goals for response time, supply chain cost and unmet demand in the disaster zone (Bastian, Griffin, Spero, and Fulton, 2015).

4.2 Emergency Logistics Planning in Natural Disasters

This paper describes a model for delivering disaster relief via multiple transportation methods (Ozdamar, Ekinci, and Kucukyazici, 2004). The model focuses on minimizing demand for various disaster relief commodities at various disaster locations, while considering an array of constraints. The model considers a disaster that encompasses a region which includes the supply depots whereby a given delivery of disaster relief to one location might simultaneously be a pickup of disaster relief destined for another location in the same disaster. One might imagine an earthquake in which one area has excess food but not enough water, and logistics planners desire to optimizes the sharing of supplies.

4.3 Evaluation

In order to evaluate our model, the simulation will be executed over several iterations with various inputs and parameter values. The outputs, such as time to satisfy demand for relief, unmet demand for relief and cost, will be used to measure the various outcomes.

5 References

Bastian, N., P. Griffin, E. Spero and L. Fulton. “Multi-criteria logistics modeling for military humanitarian assistance and disaster relief aerial delivery operations”. In: Optimization Letters (2015). DOI: 10.1007/s11590-015-0888-1.

EM-Dat. International Disaster Database. 2016. URL: http://www.emdat.be/advanced_search/index.html.

Ozdamar, L., E. Ekinci and B. Kucukyazici. “Emergency Logistics Planning in Natural Disasters”. In: Annals of Operations Research (2004).

United Nations Secretariat. Humanitarian Data Exchange. 2016. URL: https://data.hdx.rwlabs.org/.