Disaster Relief Simulation

DATA 604: Simulation & Modeling

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1 Abstract

2 Keywords

3 Literature Review

4 Methodology

4.1 Structure

4.1.1 Supplier

A Supplier entity is included in the simulation model. This entity is the source of ReliefSupplies. This entity is used, through design of experiments, to simulate both reliable partner suppliers as well as adhoc suppliers (more variability in their supply). The following variables (Referenced Properties) were created to facilitate the study:

- The time to deliver a shipment of supplies: *SupplierTravelTimeToWarehouse*.

- The maximum number of relief supplies which the supplier will provide: *SupplierMaximumArrivals*

The delivery vehicle, PartnerVehicle, was set to require a full load prior to departing for the Warehouse.

- The capacity of the PartnerVehicle: *SupplierVehicleCapacity*

4.1.2 Warehouse

A Warehouse was added to store disaster relief supplies in preparation for a disaster. This entity was modeled as a server which processes incoming ReliefSupplies and stores them in a ready state for movement to a DistributionSite.

The following variables were created to facilitate design of experiments:

- The storage capacity of the warehouse: *WarehouseStorageCapacity*

The delivery vehicle, WarehouseVehicle, was set to require a full load prior to departing for a distribution site and have periodic failures.

- The capacity of the WarehouseVehicle: *WarehouseVehicleCapacity*

- The frequency of failure: *WarehouseVehicleUptimeBetweenFailures*

The selection weight on the paths from the Warehouse to the Distribution Sites were set to dynamically adjust based on the number of Relief Beneficiaries waiting for Relief Supplies.

4.1.3 Distribution Sites

Two distribution sites are included in the simulation and are modeled as combiners which match Relief Supplies to Relief Beneficiaries.

The following variables were created to facilitate design of experiments:

- The processing time needed to provide a ReliefSupply item to a ReliefBeneficiary: DistSiteProcessingTime

4.1.4 Relief Beneficiaries

The Relief Beneficiaries represent entities who are affected by the disaster and require ReliefSupplies. Two separate sources were included in the model to simulate separate points from which beneficiaries would origination for each distribution site.

The following variables were created to facilitate design of experiments:

- The interarrival time of the ReliefBeneficiaries: *ReliefBeneficiaryInterarrivalTime*
- The maximum number of ReliefBeneficiaries from a given source: *DisasterVictimMaximumArrivals*

4.1.5 Disaster

The "Disaster" is set to begin at a designated time into the simulation. This gives some time to prestage relief supplies through the warehouse (priming the pump).

The following variables were created to facilitate design of experiments:

- The amount of time between simulation start and onset of the disaster: *DisasterTimeOffset*

4.2 Measured Outcomes

4.2.1 Average Beneficiary Time in System

Measured in hours, this response is an important indicator of the performance of the system.

4.2.2 Relief Supplies Distributed

How many relief supplies were distributed?

4.2.3 Unsatisfied Beneficiaries

Naturally, we wanted this response to be zero (0) throughout all simulations.

4.2.4 Maximum Distribution Site 1 Time Waiting

Measured in hours, this response helped us understand the degree of the worst case scenario for distribution site 1 beneficiaries in need of relief supplies.

4.2.5 Maximum Distribution Site 2 Time Waiting

Measured in hours, this response helped us understand the degree of the worst case scenario for distribution site 2 beneficiaries in need of relief supplies.

4.3 Design of Experiments

4.3.1 Supplier: Partner vs Ad Hoc

How does a dedicated supplier whose production time is lower (more units of production are committed to our orders), versus an adhoc supplier whose production time is longer, affect the measured outcomes.

4.3.2 Control Variables

The following table shows key parameters (control variables) for each scenario:
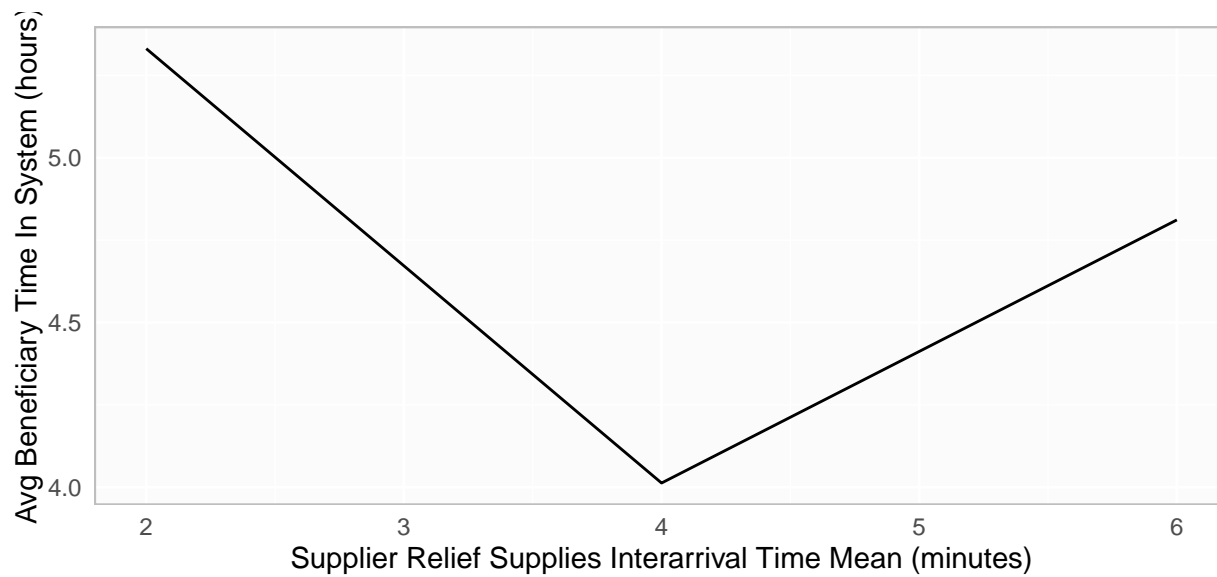
Name	ReliefSuppliesInterarrivalTime	WarehouseTravelTimeToDistSite1
Partner Supplier	Random.Normal(1, 0.1)	Random.Normal(6,0.5)
Adhoc Supplier	Random.Normal(4, 0.1)	Random.Normal(6,0.5)
Midlevel Supplier	Random.Normal(2.5, 0.1)	Random.Normal(6,0.5)
Midlevel Access to Dist Site 1	Random.Normal(1, 0.1)	Random.Normal(4,0.5)
Quick Access to Dist Site 1	Random.Normal(1, 0.1)	Random.Normal(2,0.5)

5 Results

5.1 Supplier Production Committment
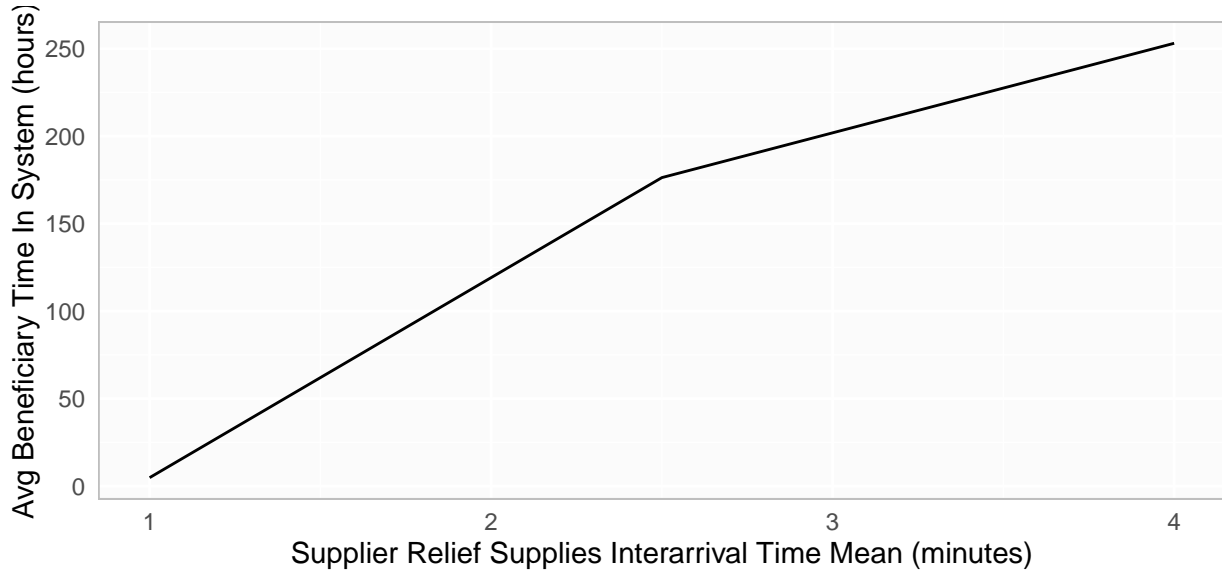
5.2 Warehouse Access to Distribution Site

6 Summary

7 Appendix: Raw Code