

Big Depot Hurricane Planning Game

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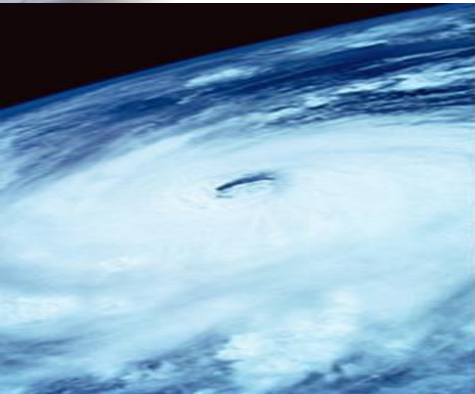
**Georgia Institute
of Technology**

Scope of Humanitarian Logistics

- Humanitarian operations
- Ongoing needs of the society
- Relief logistics; disaster management;
- Challenges in the supply chain for the procurement, delivery, warehousing and distribution of the aid.

Natural Disasters

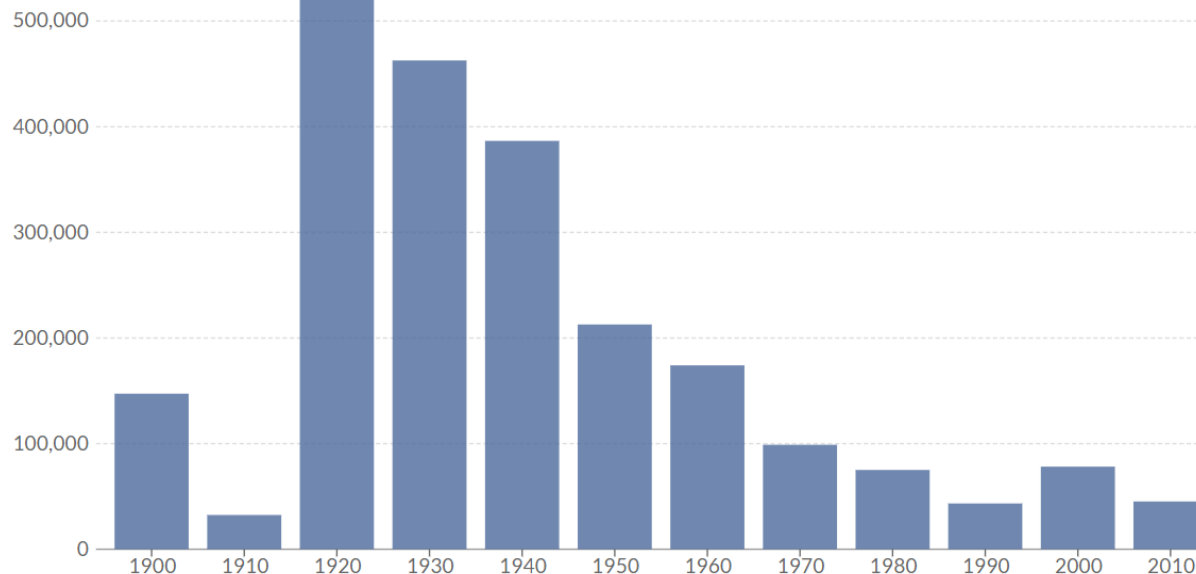
- Dangerous and large-scale events
- Beyond the control of people
- Loss of life and property.
- Kill on average 45,000 people per year globally
- Responsible for 0.1% of deaths over the past decade.



- Dramatic decline in global deaths from natural disasters
- Knowledge-sharing of how to increase resilience to natural disasters
- Effective response systems

Decadal average: Number of deaths from disasters

Disasters include all geophysical, meteorological and climate events including earthquakes, volcanic activity, landslides, drought, wildfires, storms, and flooding. Decadal figures are measured as the annual average over the subsequent ten-year period.



Disaster Timeline

Pre-disaster

- Mitigation &
- Preparedness

Disaster

- Response

Post-disaster

- Recovery

Disaster Timeline

Pre-disaster

- Mitigation &
- Preparedness

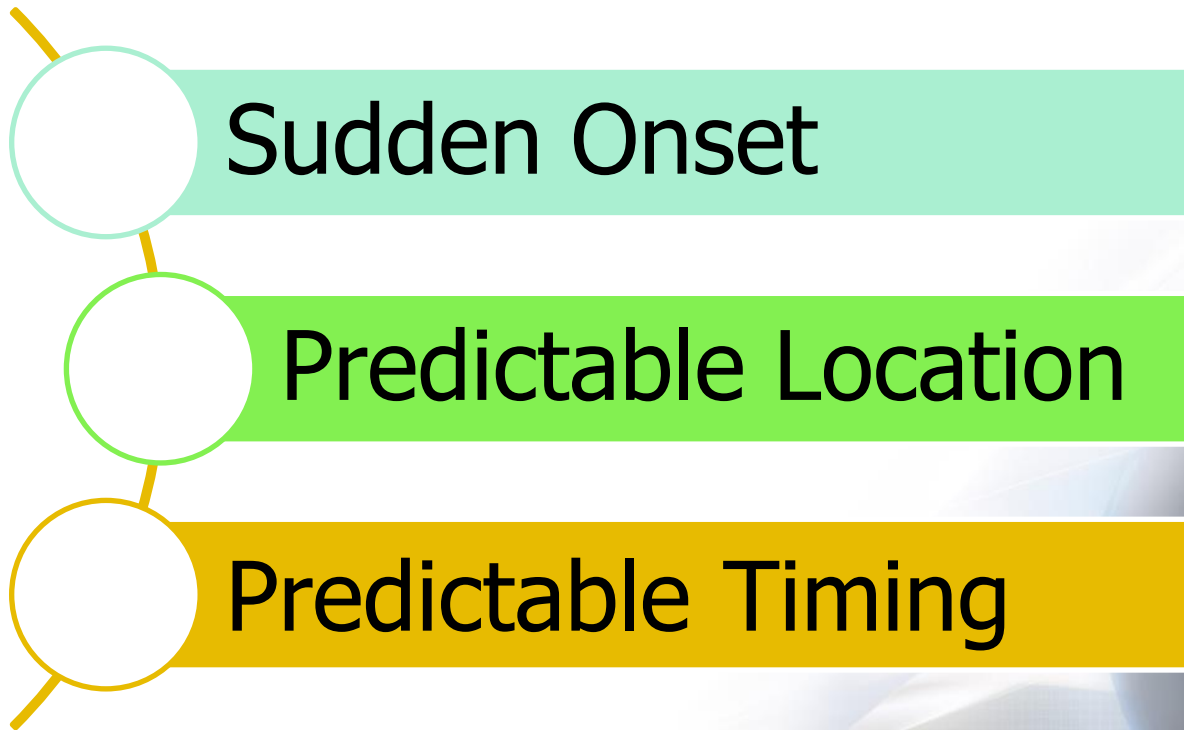
Disaster

- Response

Post-disaster

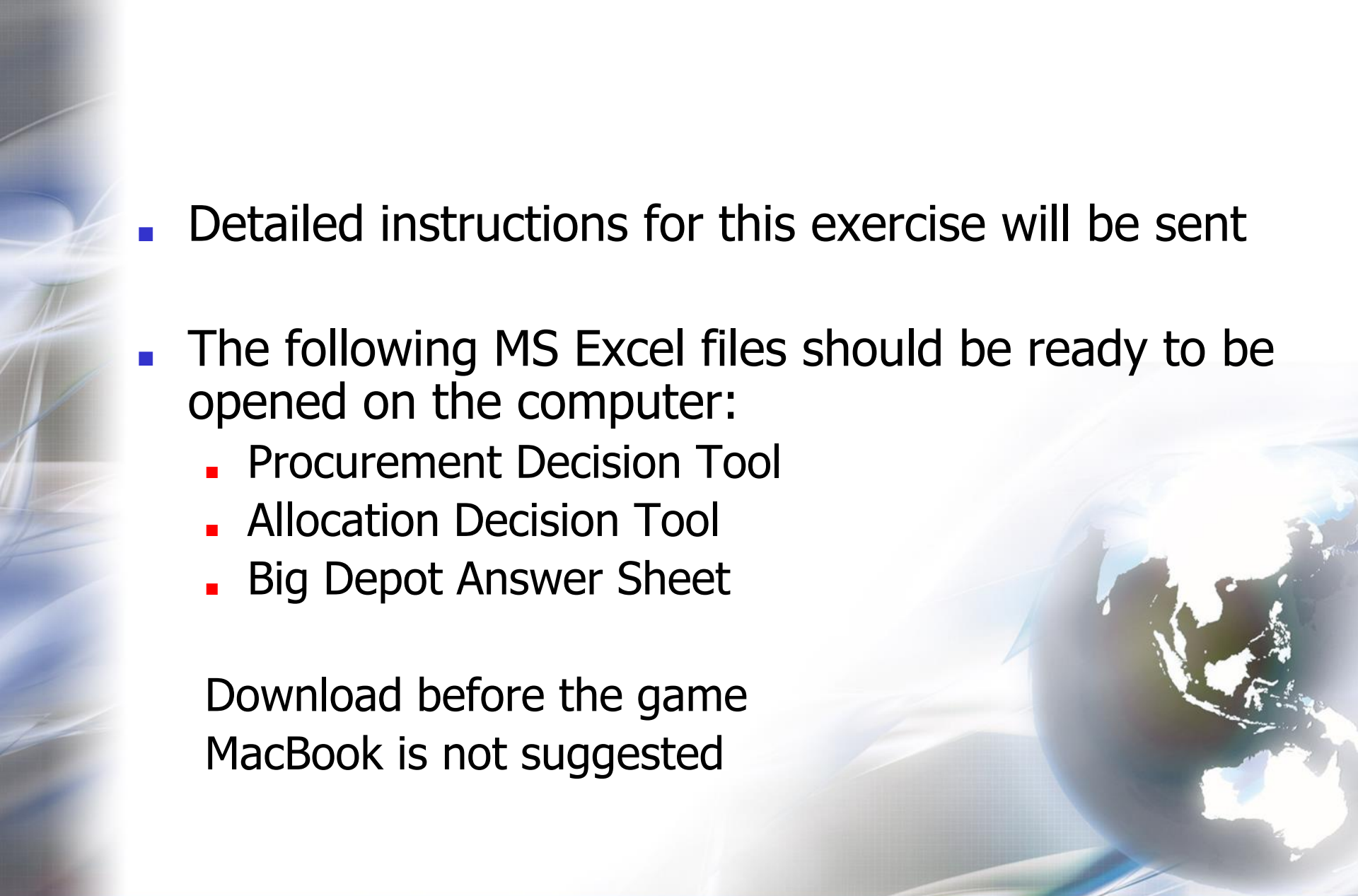
- Recovery

Hurricane



Game Set-up

- 10% in-class game
- November 2 Wednesday during lecture hours in class
- Play it with your project teams
- Every team must have at least one computer
- Do not forget to bring USB

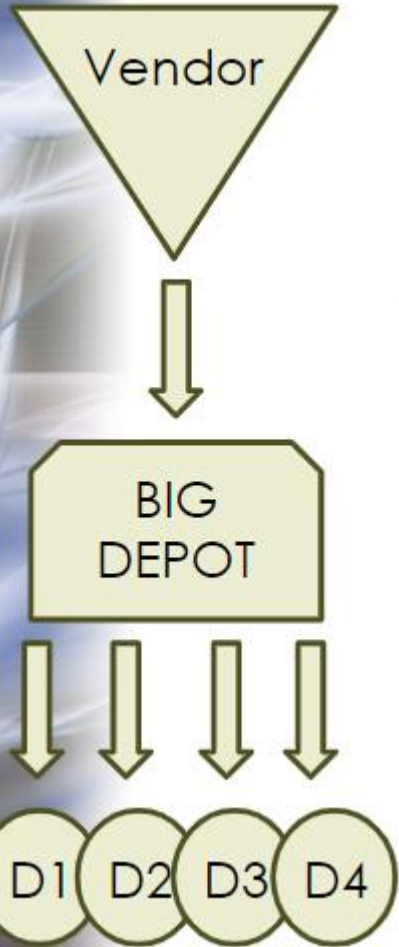
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- Detailed instructions for this exercise will be sent
 - The following MS Excel files should be ready to be opened on the computer:
 - Procurement Decision Tool
 - Allocation Decision Tool
 - Big Depot Answer Sheet

Download before the game
MacBook is not suggested

Introduction to the problem

- Big Depot is a retailer of furniture and general home improvement products
- The GOAL: ensure that the necessary materials are delivered to their stores in the right amount and at the right time during the hurricane period.
- There are 6 product types: Cover set, Lighting set, Generator, Bottled water, Recovery set, Cleanup set
- 4 regional distribution centers (DCs)

Doing Good with Good OR



- The Disaster Management Team (YOUR TEAM) is in charge of deciding:
 - How much should we buy from each product category before the hurricane
 - in what proportions the purchased products will be distributed to regional warehouses.



The Goal: Meeting all the
demand after the hurricane with
the minimum total cost

Procurement Decisions

- Vendors offer discounted prices for pre-disaster purchasing
 - Vendors ship the reserved items to DCs
 - Limited budget for the advance orders
- The stores meet ALL the unfulfilled demand by expedited delivery

TASK-1 PURCHASING DECISIONS

Demand is uncertain

It is cheaper to buy before the hurricane

There is a budget

If you buy less product than the demand, after the hurricane it will become more expensive

If you buy more than the demand there is no salvage value

Background- Allocation Decisions

- Allocate reserved inventory proportionally to the demand of the region
- Reserved inventory might be re-allocated when information about demand is updated
- Shorter lead times when shipping from regional DCs (rather than vendor) to stores

What does this mean?

These inventory allocation decisions were made initially, given de current information

	Initial Inventory	Initial Distribution
DC 1	3,000	30%
DC 2	4,000	40%
DC 3	1,000	10%
DC 4	2,000	20%

New information is given!

Demand Location
10%
30%
0%
60%

Need to re-allocate 4,000 units! \$\$\$!

	Extra	Deficit	Final Inventory	Required Distribution (given Demand Location)
DC 1	-2,000		1,000	10%
DC 2	-1,000		3,000	30%
DC 3	-1,000		0	0%
DC 4		+4,000	6,000	60%
	-4,000	+4,000		

TASK-2 ALLOCATION DECISION

- Note that there is a transportation cost between DCs if you cannot meet the demand for a DC
- Demand is still uncertain.
- Scenarios are provided for each hurricane path
 - Probability of each scenario
 - Demand distribution for each scenario

Decision Tools

- Two decision tools were developed:
 - Procurement Decision Tool
 - Allocation Decision Tool
 - Enable macros when opening the files
- These tools compute:
 - Expected costs of given decisions
 - Cost of given decisions, given a specific scenario
- Now, evaluate your proposed decisions and improve them using these tools.

Procurement Decision Tool

Merchandise Procurement Problem

Instructions:
 Information about past demand distribution for each item group is given below. Available merchandise reservation budget is also given. Task: Fill the **green cells** with the number of units to reserve for each group.
 NOTE: If the budget is violated a **message in red** will appear. Also, the expected total cost will be shown for the chosen quantities to reserve. A demand scenario could be entered in the **yellow cells** and the total cost will be calculated and shown as well.

Data

	Cover Set	Lightning Set	Generators	Bottled Water	Recovery Set	Cleanup Set
Prices (\$/unit)						
Discounted Price, α	\$60.00	\$15.00	\$100.00	\$3.00	\$25.00	\$10.00
Expected % increase in price	.50%	.50%	.50%	.50%	.50%	.50%
Expedited Price, α	\$114.00	\$37.50	\$300.00	\$3.60	\$37.50	\$13.00

Total Demand (units)	Cover Set	Lightning Set	Generators	Bottled Water	Recovery Set	Cleanup Set
Mean	4,500	14,000	2,500	35,000	5,000	8,000
95% Percentile	8,612	19,757	4,967	46,514	9,935	14,908
5% Percentile	388	8,243	33	23,486	65	1,092
Std Dev	2,500	3,500	1,500	7,000	3,000	4,200

Reservation Budget: \$950,000

Design:

	Reserved units	Reservation Cost (\$)
Cover Set	9,000	\$540,000
Lightning Set	13,000	\$195,000
Generators	2,225	\$222,500
Bottled Water	5,000	\$150,000
Recovery Set	4,500	\$112,500
Cleanup Set	10,500	\$105,000
Total Reservation Cost (\$)		\$950,000

Expected Total Cost (\$)
 Expected Total Cost (\$): **\$1,506,641**
 Expected Reservation Cost (\$): **\$950,000**
 Expected Expedited Cost (\$): **\$556,641**

Demand scenario:

	Demand (units)	Total Cost (\$)
Cover Set	4,557	\$300,000
Lightning Set	14,080	\$235,493
Generators	2,534	\$315,261
Bottled Water	35,160	\$123,575
Recovery Set	5,068	\$133,815
Cleanup Set	8,096	\$105,000
Demand scenario Total Cost (\$)		\$1,213,144
Demand scenario Reservation Cost		\$950,000
Demand scenario Expedited Cost (\$)		\$263,144
Savings due to advanced reservation (\$)		\$1,016,494

Scenario #: Run Scenario

General Instructions

Expected TOTAL procurement cost

YOUR SOLUTION for advance purchasing

The budget

You can choose to enter a specific demand scenario

Allocation Decision Tool

General Instructions:
 Three potential scenarios for the demand distribution across DCs and a probability of occurrence for each scenario are given. Select the scenario you want to use. The selected scenario will be used for the allocation. The selected scenario will be used for the allocation. The selected scenario will be used for the allocation.

Potential demand distributions across DC Regions

Scenario Path:	Peak	DC1	DC2	DC3	DC4
1	40X	40X	30X	20X	10X
2	30X	20X	30X	30X	10X
3	30X	10X	10X	20X	20X

Average Transportation Cost from DC to DC (\$/unit)

	DC1	DC2	DC3	DC4	
DC1		\$1.11	\$1.75	\$1.74	\$2.62
DC2			\$1.75	\$1.11	\$1.38
DC3				\$1.74	\$1.88
DC4					\$2.62

Reserved Units

Item Type	Center Sol	Lighting Sol	Generators	Bullied Water	Remediation Sol	Cleanup Sol
Units	5,000	5,000	2,225	5,000	5,000	5,000

Allocation

Allocated: 100% of the demand

Allocated at DC

DC	Allocation
C1	20%
C2	20%
C3	20%
C4	20%

Item Type

Item Type	Center Sol	Lighting Sol	Generators	Bullied Water	Remediation Sol	Cleanup Sol
Units Allocated at DC	5,000	5,000	445	5,000	5,000	5,000
DC1	5,000	5,000	445	5,000	5,000	5,000
DC2	5,000	5,000	445	5,000	5,000	5,000
DC3	5,000	5,000	445	5,000	5,000	5,000
DC4	5,000	5,000	445	5,000	5,000	5,000

Expected Transportation Cost due to Re-allocation (\$): \$16,428

Demand Distribution Summary

DC	Demand
DC1	40X
DC2	30X
DC3	20X
DC4	10X

Re-allocation Cost (\$): \$7,643

Scenario 1

General Instructions

YOUR SOLUTION
for inventory
allocation

Enter solution from
procurement problem

Expected TOTAL
re-allocating cost

Message in red: %'s
should sum 100%

You can choose a
specific path
scenario

TASK-3 PURCHASING AND ALLOCATION DECISION WITH TOOLS



Revealed Demand Locations

- The hurricane hit, now we will share the real demand for each DC
- **TASK-4 ALLOCATION BTW DCs**
- You will determine the inventory quantities to be re-allocated given your last allocation decision by using the tools again



Please don't forget your aim which is
MINIMIZING COST