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**MMA 861 – Analytical Decision Making**

**Professor Guang Li**

**Individual Assignment** #2

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**Problem 1: IP Modeling - TelecomOptics Revisited**

**Answer:**

TelecomOptics has decided that each market will be supplied by only one manufacturing location. Our linear integer programming model optimizes this allocation to minimize total cost while meeting demand and capacity constraints. The optimal solutions will select three locations – Salt Lake, Memphis and Wichita to supply all six markets at a total cost of $49,717. This approach ensures efficient resource allocation and cost-effective operations.

**Advantages:**

1. Less supply locations simplify logistics with clear supplier responsibility
2. Lower coordination costs based on single manufacturing supply

**Disadvantages:**

1. Higher risk of disruptions because we only depend on one suppliers and no back up.
2. Limited flexibility if demand fluctuates significantly and we only lock the demand centre to single supplier, reducing the ability to reallocate supply dynamically

**Problem 2: Combating Cyber Threat**

**Answer:**

To mitigate the current cybersecurity threat at OmniTech Intelligences, we run an optimization model to determine the most effective deployment of Cyber Defenders while ensuring that all security constraints are met and maximize OmniTech Tower protection values.

Our solutions identifies an optimal allocation with protection socre of 10 for OmniTech Tower. The final allocation of Cyber Defenders is as follows:

* Data Center 1: Software Commander
* Data Center 2: Network Ninja and Data Detective
* Data Center 3: Firewall Titan
* OmniTech Tower: Cryptography Captain and Hardware Hawk

This allocation ensures that all data centers meet or exceed their required security levels while maintaining a strong defense at OmniTech Tower. The model balances security requirements and resource constraints, providing an effective cybersecurity defense strategy for OmniTech Intelligence

**Appendix**

**Question 1:**

**Model Development:**

The objective is to minimize the total cost of total product and transportation cost shipped from supply city to demand city and fixed cost of keeping a plant operational

**Assumptions:**

1. Each demand centre must be supplied by exactly one supply center
2. Each supply centre cannot exceed the given capacity
3. All demand centers must be fully supplied
4. No new supply center can be opened and no partial supply center closures
5. No delays or disruptions in transportation

**Decisions:**

**Objective:**

Minimize

**Constraints:**

(Nonnegativity constraints) for all i,j

(Supply) for i = L,H,S,M,W. for i = L,H,S,M,W

(Demand) for j = A, B, C, D, O, P

**Excel Model**:

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*A screenshot of a spreadsheet

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**Question 2:**

**Model Development:**

The objective is to determine the optimal deployment of Cyber Defenders while satisfying security constraints and maximizing OmniTech Tower’s protection

**Assumptions:**

1. Each Cyber Defender can be assigned to one of the three data centres or remain at OmniTech Towers
2. No Cyber Defender can be assigned to multiple locations at the same time
3. OmniTech Tower’s protection is maximized while ensuring all data centres are also fully secured
4. The vulnerability levels of data centers are static

**Decisions:**

Where:

i represents Cyber Defenders: Network Ninja (NN), Cryptography Captain (CC), Software Commander (SC), Data Detective (DD), Hardware Hawk (HH), Firewall Titan (FT)

j represents data center 1, data center 2, data center 3

**Objective:**

maximize where : Protection value of Omni Tower

**Constraints:**

1. (Nonnegativity constraints) for all i,j
2. Each data center protection score must meet or surpass the vulnerability level:

>= , represents vulnerability level of each data center for all j

1. Each member of the Cyber Defenders can either stay at OmniTech Tower or be assigned to a data center:

+ = 1 for all i

1. Each data center must have at least one and no more than three Cyber Defenders deployed:

1<=<=3 for all j

1. The total number of Cyber Defenders deployed to the data centers should not exceed five:

<=5

1. At least one of the Cryptography Captain and the Network Ninja should remain at OmniTech:

A whiteboard with writing on it

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1. If the Data Detective is deployed at a data center, the Network Ninja should be deployed there:

A graph of a graph with arrows and a line

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1. If the Data Detective and the Hardware Hawk are both deployed at the same data center, they will end up in disagreements and not contribute to the security, meaning that no more than one of these two can be deployed at any data center.

A diagram of a graph

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1. If the Hardware Hawk is deployed at a data center, at least one of the Cryptography Captain or Software Commander should also be deployed there to maintain his productivity.

A graph of a function

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**Excel Model**:



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