COMP4130 Linear and Discrete Optimization
Workshop 5: Network Flow Optimization

School of Computer Science
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Purpose: Formulate and solve LP models for various network flow optimization problems using both LP-Solve and the Excel Solver.

Step 1

Formulate the optimization models in LP-Solve for the MEDEQUIP and BUNEL network optimization problems in Lecture 5. You may also develop the spreadsheet optimization models in Excel for these two problems, following the different layouts suggested in Lecture 5.

Step 2

Develop the optimization model in Excel and LP-Solve to solve the following network flow optimization problem.

ARMY Problem

An army needs to move troops from three training camps to four different bases. The number of soldiers in each camp, the number of soldiers required in each base, and the cost of moving a soldier from each camp to each base is given in the table below. The objective is to determine the number of soldiers to be moved from each camp to each base at the minimum total cost.

In addition, it is required to identify which camp should train more soldiers if the total number of soldiers is insufficient to meet all base requirements. However, the number of additional soldiers trained at any camp must not exceed 75% of the total shortfall. Apart from the transportation costs, no additional cost is incurred for the extra training.

Moving Cost Per Soldier ($)					
	Base 1	Base 2	Base 3	Base 4	Supply
Camp 1	34	26	29	31	400
Camp 2	42	33	28	35	350
Camp 3	36	29	32	38	500
Demand	275	375	350	325	

Step 3

Identify the type of network flow problem (Transportation Problem, Minimum Cost Flow Problem, or Maximum Flow Problem). Be sure to also write the algebraic model in compact notation. Develop the optimization model in Excel (the LP-Solve model is optional) to solve the following network flow optimization problem.

DISTRIBUTION Problem

A company operates a distribution network consisting of factories, warehouses, and customers. The objective is to minimize the total cost of shipping products from factories to warehouses, from factories directly to customers, and from warehouses to customers.

For each warehouse, the number of products received from the factories must equal the number of products shipped to customers. The costs of shipping per product, along with factory capacities, warehouse capacities, and customer demands, are provided in the tables below. The task is to determine the optimal distribution plan that achieves the minimum total shipping cost.

Cost of Shipping Per Product ($)				
	Warehouse 1	Warehouse 2	Warehouse 3	Warehouse 4
Factory 1	0.50	0.50	1.00	0.20
Factory 2	1.50	0.30	0.50	0.20

Cost of Shipping Per Product ($)					
	Customer 1	Customer 2	Customer 3	Customer 4	Customer 5
Factory 1	1.75	2.5	1.5	2.0	1.5
Factory 2	2.0	2.5	2.5	1.5	1.0

Cost of Shipping Per Product ($)					
	Customer 1	Customer 2	Customer 3	Customer 4	Customer 5
Warehouse 1	1.5	1.5	0.5	1.5	3.0
Warehouse 2	1.0	0.5	0.5	1.0	0.5
Warehouse 3	1.0	1.5	2.0	2.0	0.5
Warehouse 4	2.5	1.5	0.2	1.5	0.5

Warehouse Capacities			Factory Capacities			Customer Demands	
Warehouse 1	45000		Factory 1	60000		Customer 1	30000
Warehouse 2	20000		Factory 2	60000		Customer 2	23000
Warehouse 3	30000					Customer 3	15000
Warehouse 4	15000					Customer 4	32000
						Customer 5	16000