Problem:

3. (40 points) A computer chip manufacturer has warehouses in Bangkok and Beijing with 20,000 chips and 30,000 chips, respectively. The manufacturer must ship 5,000 chips to Little Rock, 20,000 chips to London, and 25,000 chips to Los Angeles. The table below gives the the travel time (in hours) between each warehouse and each customer.[4]

	Customer		
	Little Rock	London	Los Angeles
Bangkok	21.9	14.3	16.3
Beijing	16.2	11.3	12.0

Formulate but do **not** solve an linear program that determines how many chips from each warehouse should ship to each customer to minimize the total travel time of the shipped chips. To save some time, you may refer to Bangkok and Beijing as warehouses 1 and 2, respectively, and Little Rock, London, and Los Angeles as customers 1, 2, and 3, respectively. Points for this problem will generally be awarded based upon the following criteria[5]:

- Correctly formulated objective will earn 13 points.
- Correctly formulated constraints will earn 25 points.
- Correct variable bounds will earn 2 points.
- Incorrect formulations with terms with inconsistent units will lose 1 point for each term.
- Incorrect formulations with unclear variable definitions will lose 1 point for each definition.
- An honest attempt at this problem will receive a minimum of 8 points.

[4]Travel times are from Google Maps.

[5]The instructor may deviate from this point system as appropriate.

Solutions:

3.

Let x_{11} be chips from warehouse Bangkok to customer Little Rock.

Let x_{12} be chips from warehouse Bangkok to customer London

Let x_{13} be chips from warehouse Bangkok to customer Los Angeles.

Let x_{21} be chips from warehouse Beijing to customer Little Rock

Let x_{22} be chips from warehouse Beijing to customer London.

Let x_{23} be chips from warehouse Beijing to customer Los Angeles.

Here, Non-negative constraints

$x_{11}, x_{12}, x_{13}, x_{21}, x_{22}, x_{23} \geq 0$

Now,

Minimize

$$Z = 21.9x_{11} + 14.3x_{12} + 16.3x_{13} + 16.2x_{21} + 11.3x_{22} + 12.0x_{23}$$

Here,

Or, total supply = 20000 + 30000 = 50,000

Or, total demand = 5000 + 20000 + 25000 =

50000 = total supply

So,

using equality constraints.

$x_{11} + x_{12} + x_{13} = 20,000$

$x_{21} + x_{22} + x_{23} = 30,000$

$x_{11} + x_{21} = 5000$ $\qquad$ $x_{13} + x_{23} = 25000$

$x_{12} + x_{22} = 20,000$