NTC Equipment: You are preparing to ship equipment for the advance echelon of a unit deployment. You must ship at least **4 tons of equipment** by some combination of *line haul* or *rail head*. You are allotted **3 tons to ship via rail** at a cost of **$2 per ton**. You are allotted **4 tons of shipping via truck** at **$6 per ton** (all dollar amounts are in hundreds of dollars). All of your equipment must arrive in at most **12 days**. Line haul is typically much faster and takes an average of **2 days per ton** while rail takes an average of **3 days per ton**. Formulate a linear program that minimizes the cost of shipping equipment to NTC.

a) In the *Context of the Problem*, explain how your model conforms to the linear programming assumptions. There are 4 total, choose 2 to explain:

Proportionality (Linearity): Each cost and time component changes directly in proportion to the number of tons shipped, with no nonlinear effects or discounts.

Additivity: The total cost and time are the sum of the individual contributions from rail and truck shipments, with no interaction between them.

Continuous-Variable Assumption: The quantities of equipment shipped by rail and truck can take on any nonnegative real values, allowing fractional tons to be shipped.

Certainty: All coefficients in the model—costs, times, and limits—are known and fixed with complete accuracy.

b) Make a table that outlines the parameters of the problem.

	L	R	
min shipment	1	1	>= 4
rail limit	0	1	<= 3
line haul limit	1	0	<= 4
time	2	3	<= 12

c) Define the decision variables.

L = # of tons of equipment to put on Line Haul to ship to NTC

R = # of tons of equipment to put on Rail to ship to NTC

d) Formulate the constraints and objective function.

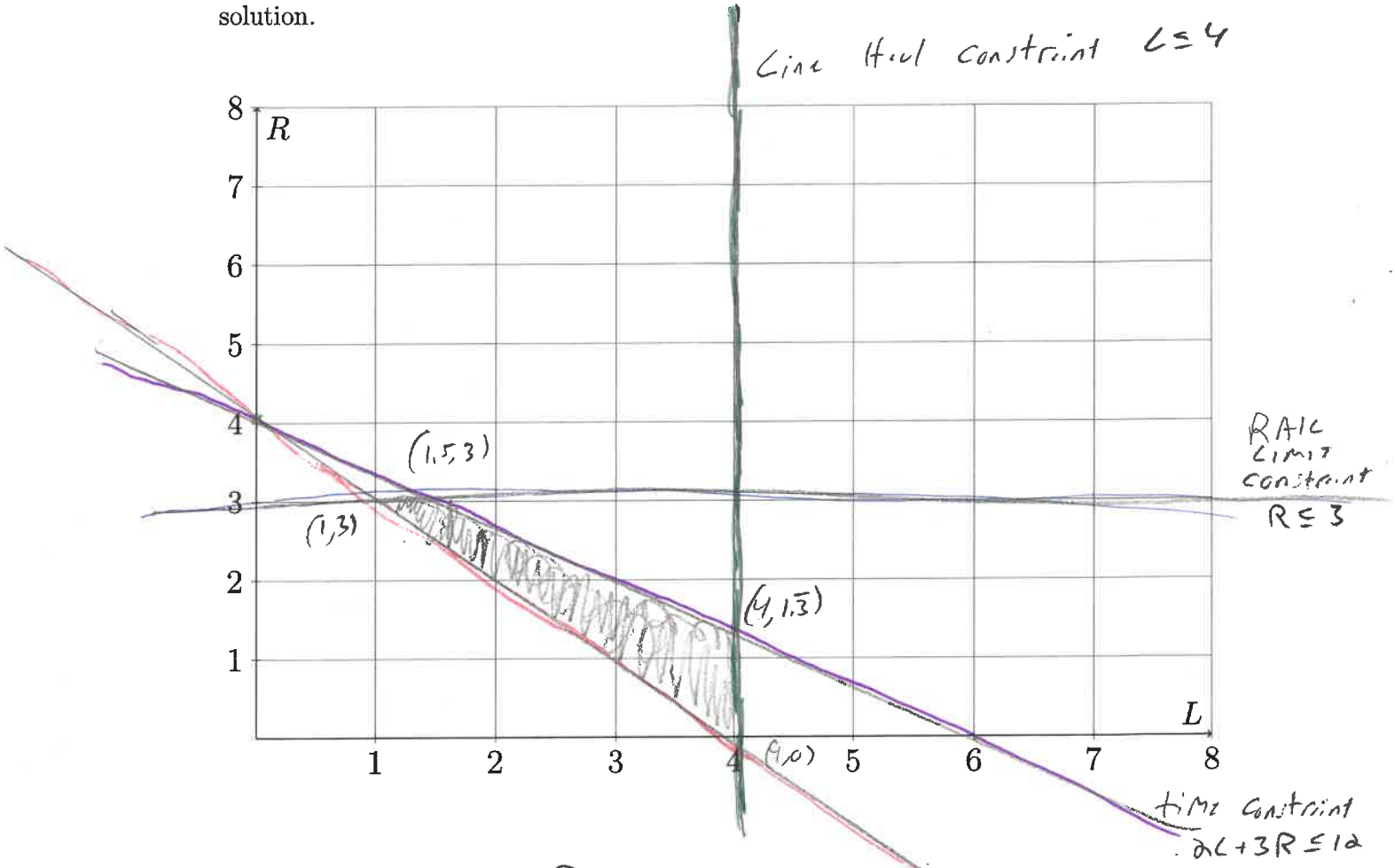
CONSTRAINTS

L + R >= 4
R <= 3
L <= 4
2L + 3R <= 12
L,R >= 0

OBJECTIVE

MIN: 6L + 2R

d) Use the graphical method to define the feasible region and determine the optimal solution.



OBJ → min $6L + 2R$

at (1,3) → $6(1) + 2(3) =$ \$12

at (1.5,3) → $6(1.5) + 2(3) =$ \$15

at (4, 1.$\bar{3}$) → $6(4) + 2(1.\bar{3}) =$ \$26.67

at (4, 0) → $6(4) + 2(0) =$ \$24

OPTIMAL SOLUTION is to use Line Haul for 1 ton and RAIL for 3 tons to ship equipment for a total cost of \$1200