The Cargo Plane Conundrum

A cargo plane has three compartments for storing cargo: front, center, and back. These compartments have capacity limits on both weight and space, as summarized below:

Compartment	Weight Capacity (Tons)	Space Capacity (Cubic Feet)
Front	12	7,000
Center	18	9,000
Back	10	5,000

Furthermore, the weight of the cargo in the respective compartments must be the same proportion of that compartment’s weight capacity to maintain the balance of the plane

Problem (continued)

The following four cargoes have been offered for shipment on an upcoming flight as space is available:

Cargo	Weight (Tons)	Volume (Cubic Feet/Ton)	Profit ($/Ton)
1	20	500	320
2	16	700	400
3	25	600	360
4	13	400	290

Any portion of these cargoes can be accepted. The objective is to determine how much (if any) of each cargo should be accepted and how to distribute each among the compartments to maximize the total profit for the flight.

If you’re a pilot, a passenger, in an airplane-related industry, or if you simply search for images of cargo plane loading, you can appreciate the applicability of this problem

Variable Definition & Objective Function

Your first thought might be:

w_1: weight of Cargo 1 which is accepted (Tons)

w_2: weight of Cargo 2 which is accepted (Tons)

w_3: weight of Cargo 3 which is accepted (Tons)

w_4: weight of Cargo 4 which is accepted (Tons)

Objective function of profit to be maximized (in $):

$$Z = 320w_1 + 400w_2 + 360w_3 + 290w_4$$

What do you find out?

Your definitions aren't granular enough to solve the problem

Each cargo gets distributed among the three compartments. (Remember, there's an "offered quantity" for each cargo.)

$$W_1 \leq 20$$

$$W_2 \leq 16$$

$$W_3 \leq 25$$

$$W_4 \leq 13$$

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These are our first constraints of our model