Question — 1

$I = \{1, 2, 3, 4, 5, 6\}$

Index of Products.

Data

Product	Octane	Sulfur	cost $/gal
Fuel 1	92	5	$2.98
Fuel 2	93	6	$3.17
Fuel 3	94	7	$3.23
Additive 1	99	0	$20.50
Additive 2	101	−1	$23.75
Additive 3	103	−2	$27.43

P_i O_i S_i C_i

$$MIN\ cost = \sum_{i \in I} P_i C_i$$

ST

$$\sum_{i \in I} P_i \geq 250 \quad ; \text{ Constrain on gallons.}$$

$$10\% \cdot \sum_{i=1}^{3} P_i - \sum_{i=4}^{6} P_i \geq 0 \quad ; \text{ Constrain on additive.}$$

$$\sum_{i \in I} \frac{P_i O_i}{\sum_{i \in I} P_i} \geq 95 \quad ; \text{ constrain on Octane.}$$

$$3 \leq \frac{\sum_{i \in I} S_i P_i}{\sum_{i \in I} P_i} \leq 6 \quad ; \text{ Sulfer constrain.}$$

Question - 2

$I \in \{1, 2, 3, 4, 5, 6, 7\}$; Ingot indicies.

$J \in \{1, 2, 3, 4\}$; Properties of material ore indicies.

$K \in \{1, 2, 3, 4, 5\}$; Ore indicies.

Data

Ingot Specification Matrix → j

	Tensil strength	Compressive strength	Flow	Rust proof
Ingot 1 →	9	4	7	9
Ingot 2 →	6	3	6	8
Ingot 3 →	11	5	4	7
Ingot 4 →	4	2	9	8
Ingot 5 →	7	5	4	7
Ingot 6 →	8	4	2	9
Ingot 7 →	9	3	6	8

$i = S_{ij}$

S_{ij} is the $[i^{th}, j^{th}]$ element in 'S' matrix.

Demand row matrix.

$$D = [10{,}000 \quad 12{,}000 \quad 8{,}000 \quad 4{,}000 \quad 10{,}000 \quad 11500 \quad 13750]$$

$\rightarrow i$

D_i is the i^{th} element in 'D' matrix.

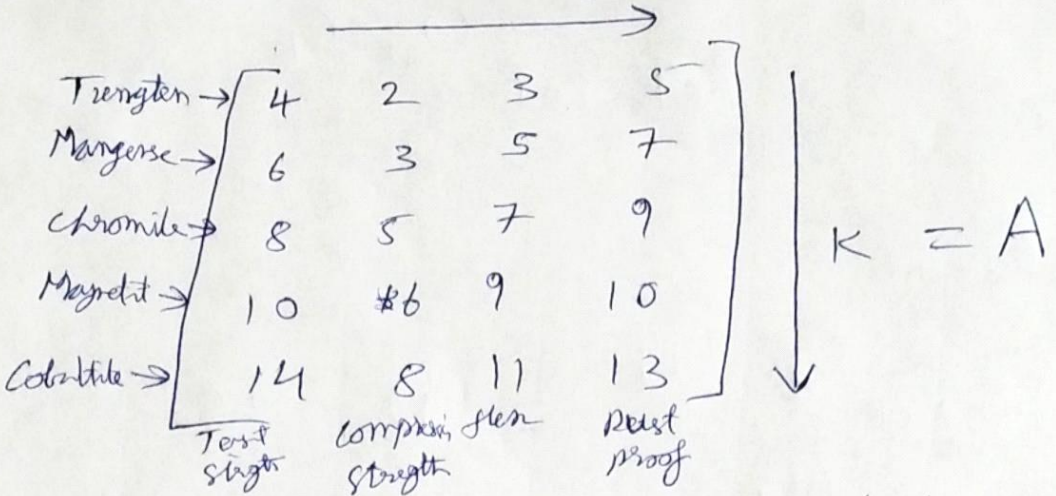
Cost row matrix.

$$C = [1{,}000 \quad 1{,}300 \quad 4{,}250 \quad 2{,}150 \quad 9{,}750]$$

$\rightarrow K$

C_K is the K^{th} element in 'C' matrix.

Raw ore attribute matrix



A_{jk} = is the $[j^{th}, k^{th}]$ element in 'A' matrix

Decision Variable matrix. Amount of material ore per Ingot.

	Tungsten	Magnese	chromite	Magnetite	Cobaltile
Ingot 1 →	Tu_1	Mn_1	ch_1	Ma_1	Co_1
Ingot 2 →	Tu_2	Mn_2	ch_2	Ma_2	Co_2
Ingot 3 →	Tu_3	Mn_3	ch_3	Ma_3	Co_3
Ingot 4 →	Tu_4	Mn_4	ch_4	Ma_4	Co_4
Ingot 5 →	Tu_5	Mn_5	ch_5	Ma_5	Co_5
Ingot 6 →	Tu_6	Mn_6	ch_6	Ma_6	Co_6
Ingot 7 →	Tu_7	Mn_7	ch_7	Ma_7	Co_7

O = (i ↓, K →)

O_{ik} is the $[i^{th}, k^{th}]$ element in 'O' matrix.

$$\text{MIN} \quad \text{Cost} = \sum_{k \in K} \sum_{i \in I} O_{ik} \cdot C_k$$

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Demand constraint

$$\frac{\sum_{j \in J} \sum_{k \in K} O_{ik} \cdot A_{kj}}{\sum_{k \in K} A_{kj}} \geq D_i \; ; \; i \in I$$

Specification constraint

$$\frac{\sum_{k \in K} O_{ik} \cdot A_{kj}}{\sum_{k \in K} O_{ik}} = S_{ij} \; ; \; i \in I, j \in J$$

Constrain on material count.

$$O_{ik} \geq \{ \text{matrix of zeros of order } i \times k \; ; \; i \in I, k \in K.$$

indecies

$i \in \{1, 2, 3, 4, 5, 6, 7\}$ → Slot machine types.

$j \in \{1, 2, 3, 4\}$ → floors.

Data

H = on-hand machine count.

H_i is i^{th} element in H.

A = Area per squarefeet for machine type.

A_i is i^{th} element in A.

E = Expected revenue column per machine type.

E_i is i^{th} element in E.

O = Operation cost per machine type.

O_i is i^{th} element in O.

M = Maintenance effor per machine type.

M_i is i^{th} element in M.

F = Floor area set.

F_j is j^{th} element in F.

Total Area available = 3000 sq.feet.

Total hours available for maintenance = 5×167 hours.

Decision Variable matrix.

Floors →

$$x_{ixj} = \begin{bmatrix} x_{11} & x_{12} & x_{13} & x_{14} \\ x_{21} & x_{22} & x_{23} & x_{24} \\ x_{31} & x_{32} & x_{33} & x_{34} \\ x_{41} & x_{42} & x_{43} & x_{44} \\ x_{51} & x_{52} & x_{53} & x_{45} \\ x_{61} & x_{62} & x_{63} & x_{46} \\ x_{71} & x_{72} & x_{73} & x_{47} \end{bmatrix}$$

Type of Machine ↓ i

$$\text{MAX} \sum_{i \in I} \sum_{j \in J} (E_i - O_i) x_{ij}$$

ST

constrain on machine count.

$$0 \leq \sum_{j \in J} x_{ij} \leq H_i \; ; \; i \in I$$

constrain on worker effort.

$$0 \leq \sum_{j \in J} \sum_{i \in I} M_i \cdot x_{ij} \leq 5 \times 167$$

constrain on square feet.

$$0 \leq \sum_{i \in I} A_i \cdot x_{ij} \leq F_j \; ; \; j \in J$$