Q3

Demand (in 10-gallon cartons)		
June	July	August
400	500	300

max qty. 450 (cartons/month) per supplier

	Price($)/carton		
	June	July	August
S1	100	110	120
S2	115	108	125

refrigerating cost → \$ 10/carton/month

↳ fun of the avg. no. of cartons on hand during the month.

⇒ Model development to determine the optimum schedule for buying ice cream from the 2 suppliers

let x_{ij} suggest buying schedule

where, $i = 1,2$ [based on supplier number]

$j = 1,2,3$ [month].

Constraints:

$$0 \leq x_{ij} \leq 450, \forall i = 1,2, \forall j = 1,2,3.$$

$$x_{11} + x_{21} \geq 400$$

$$SP1 + x_{12} + x_{22} \geq 500$$

$$SP_2 + x_{13} + x_{23} \geq 300$$

where: $SP1 = x_{11} + x_{21} - 400$ &

$SP2 = SP_1 + x_{12} + x_{22} - 500$

①

and objective fun: min. $Z = 100x_{11} + 110x_{12} + 120x_{13} + 115x_{21} + 108x_{22} + 125x_{23} + 10SR_1 + 10SR_2 + 10SR_3$

②

where, SR_1, SR_2 and $SR3$ is the average quantity in a month of June, July and August for which refrigeration cost is applicable.

we can calculate $SR1$, $SR2$ and $SR3$ in following way:

new qty in beginning of month   the surplus qty at end of month = SP1

June: SR1 :→ $\dfrac{(x_{11}+x_{21}) + (x_{11}+x_{21}-400)}{2}$

where,
SR1 = Avg. qty. for refrigeration in month 1
SP1 = Surplus at end of month 1
$= x_{11}+x_{21}-400$

$\therefore \boxed{SR1 = x_{11}+x_{21}-200}$ ← (3)

July: SR2 :→ $\dfrac{(SP1 + x_{12}+x_{22}) + (SP1 + x_{12}+x_{22}-500)}{2}$ (SP2)

$\therefore SR2 = (SP1) + x_{12}+x_{22}-250$

$\therefore \boxed{SR_2 = (x_{11}+x_{21}-400) + x_{12}+x_{22}-250}$ ← (4)

Aug.: SR3 :→ $\dfrac{(SP_2 + x_{13}+x_{23}) + (SP2 + x_{13}+x_{23}-300)}{2}$

$\therefore SR_3 = (SP2) + x_{13}+x_{23}-150$
$= (SP1 + x_{12}+x_{22}-500) + x_{13}+x_{23}-150$
$= ((x_{11}+x_{21}-400)+x_{12}+x_{22}-500) + x_{13}+x_{23}-150$

$\therefore \boxed{SR_3 = x_{11}+x_{21}+x_{12}+x_{22}+x_{13}+x_{23}-1050}$ ← (5)

$\therefore$ Putting values from eqn (3), (4) and (5) into eqn: (2), we get,

$\therefore$ Objective fun: min $z = 100x_{11} + 115x_{21} + 10(x_{11}+x_{21}-200)$
$+ 100x_{12} + 108x_{22} + 10[(x_{11}+x_{21}-400)+x_{12}+x_{22}-250]$
$+ 120x_{13} + 125x_{23} + 10(x_{11}+x_{21}+x_{12}+x_{22}+x_{13}+x_{23}-1050)$

$\therefore \boxed{\min z = 130x_{11} + 135x_{21} + 120x_{12} + 128x_{22} + 130x_{13} + 135x_{23} - 19000}$

and inserting values of SP1, SP2 in eqn (1), we get,

S.t.
$x_{11}+x_{21} \geq 400$
$x_{11}+x_{21}+x_{12}+x_{22} \geq 900$
$x_{11}+x_{21}+x_{12}+x_{22}+x_{13}+x_{23} \geq 1200$
$0 \leq x_{ij} \leq 450, \quad \forall i=1,2, \forall j=1,2,3.$