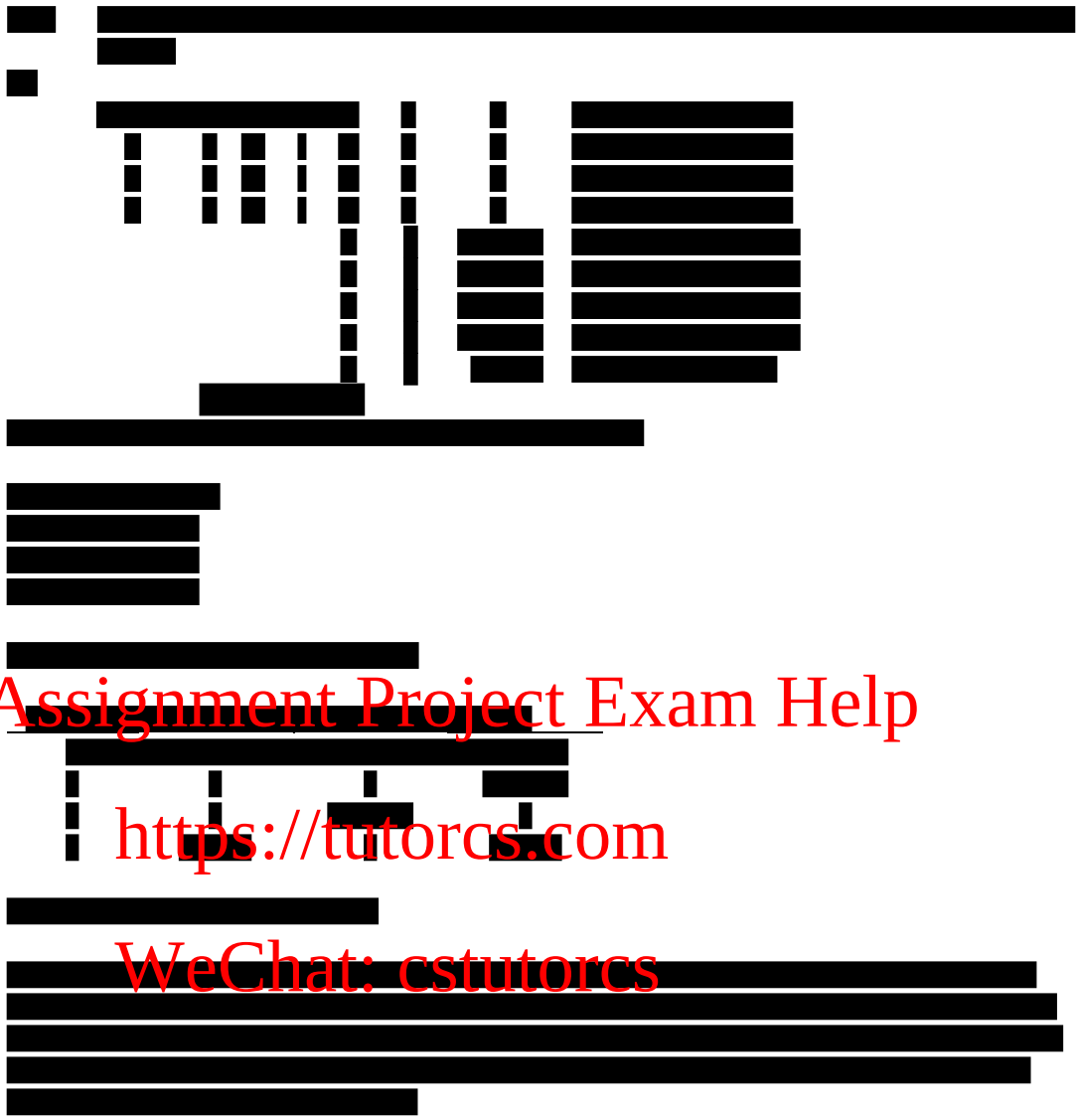


13. Let BR = pounds of Brazilian beans purchased to produce Regular
BD = pounds of Brazilian beans purchased to produce DeCaf
CR = pounds of Colombian beans purchased to produce Regular
CD = pounds of Colombian beans purchased to produce DeCaf

Type of Bean	Cost per pound ($)
Brazilian	1.10(0.47) = 0.517
Colombian	1.10(0.62) = 0.682

Total revenue = 3.60(BR + CR) + 4.40(BD + CD)

Total cost of beans = 0.517(BR + BD) + 0.682(CR + CD)

Total production cost = 0.80(BR + CR) + 1.05(BD + CD)

Total packaging cost = 0.25(BR + CR) + 0.25(BD + CD)

Total contribution to profit = (total revenue) - (total cost of beans) - (total production cost)

∴ Total contribution to profit = 2.033BR + 2.583BD + 1.868CR + 2.418CD

Regular % constraint

BR = 0.75(BR + CR)
0.25BR - 0.75CR = 0

DeCaf % constraint

BD = 0.40(BD + CD)
0.60BD - 0.40CD = 0

Pounds of Regular: BR + CR = 1000

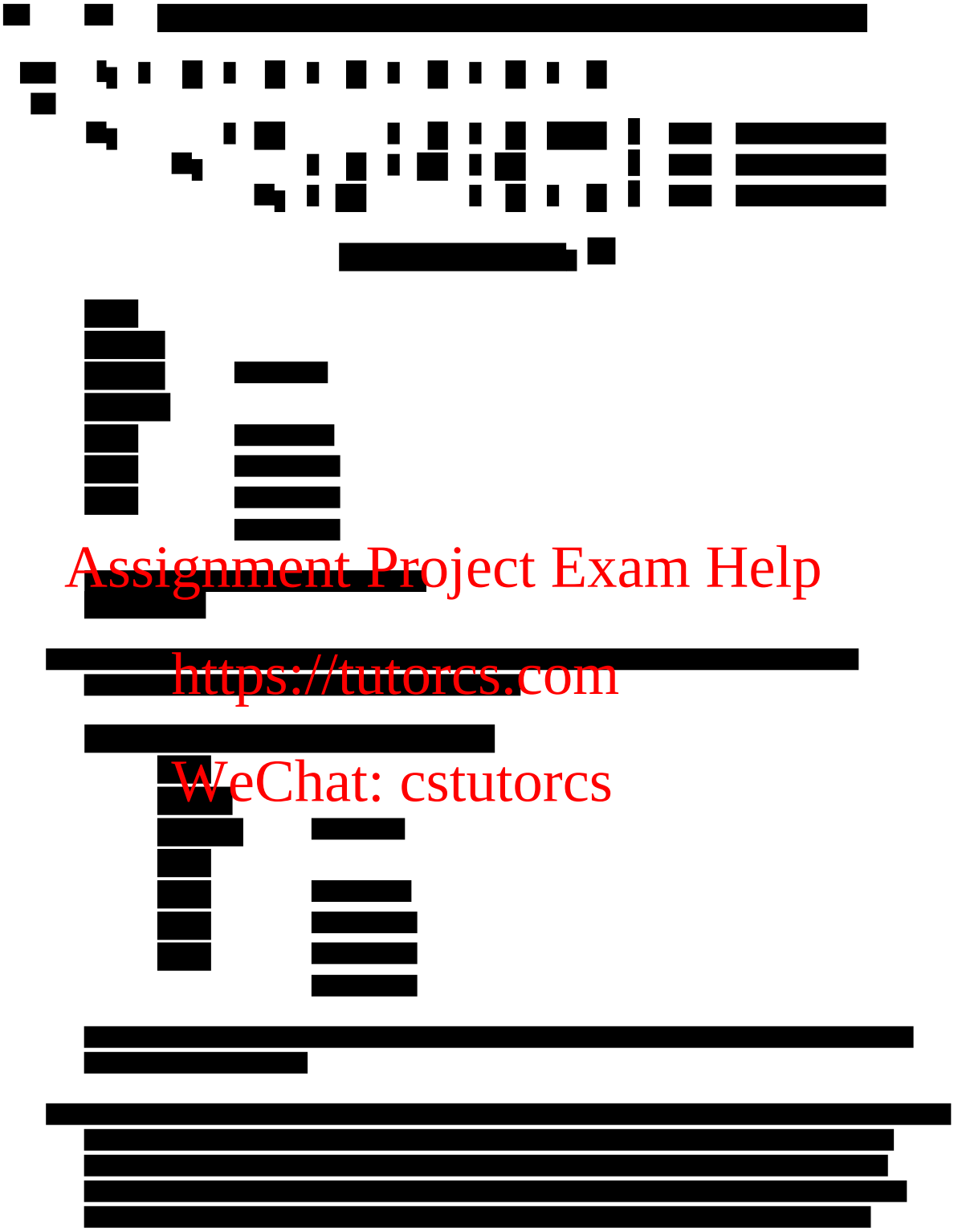
Pounds of DeCaf: BD + CD = 500

The complete linear program is

$$
\begin{array}{lrcrcrcl}
\text{Max} & 2.033BR & + & 2.583BD & + & 1.868CR & + & 2.418CD \\
\text{s.t.} & & & & & & & \\
 & 0.25BR & & & & - 0.75CR & = & 0 \\
 & & & 0.60BD & & - 0.40CD & = & 0 \\
 & BR & & & + & CR & = & 1000 \\
 & & & BD & + & CD & = & 500 \\
 & & & BR, BD, CR, CD \geq 0 & & & &
\end{array}
$$

The optimal solution is BR = 750, BD = 200, CR = 250, and CD = 300.

The value of the optimal solution is $3233.75



17. a. Let FM = number of frames manufactured

FP = number of frames purchased
SM = number of supports manufactured
SP = number of supports purchased
TM = number of straps manufactured
TP = number of straps purchased

$$\begin{aligned}
\text{Min } & 38FM + 51FP + 11.5SM + 15SP + 6.5TM + 7.5TP \\
\text{s.t. } & \\
& 3.5FM + 1.3SM + 0.8TM \le 21{,}000 \\
& 2.2FM + 1.7SM \le 25{,}200 \\
& 3.1FM + 2.6SM + 1.7TM \le 40{,}800 \\
& FM + FP \ge 5{,}000 \\
& SM + SP \ge 10{,}000 \\
& TM + TP \ge 5{,}000 \\
& FM, FP, SM, SP, TM, TP \ge 0.
\end{aligned}$$

Solution:

	Manufacture	Purchase
Frames	5000	0
Supports	2692	7308
Straps	0	5000

b. Total Cost = $368,076.91

c. Subtract values of slack variables from minutes available to determine minutes used. Divide by 60 to determine hours of production time used.

Constraint		
1	Cutting:	(Slack = 0) 350 hours used
2	Milling:	(25200 - 9623) / 60 = 259.62 hours
3	Shaping:	(40800 - 18300) / 60 = 375 hours

d. Nothing, there are already more hours available than are being used.

e. Yes. The current purchase price is $51.00 and the reduced cost of 3.577 indicates that for a purchase price below $47.423 the solution may improve. Resolving with the coefficient of FP = 45 shows that 2714 frames should be purchased.

The optimal solution is as follows:

OPTIMAL SOLUTION

Optimal Objective Value
361500.00000

Variable	Value	Reduced Cost
FM	2285.71429	0.00000
FP	2714.28571	3.57692
SM	10000.00000	0.00000
SP	0.00000	0.00000
TM	0.00000	1.15385
TP	5000.00000	0.00000

Constraint	Slack/Surplus	Dual Value
1	0.00000	-2.69231
2	3171.42857	0.00000
3	7714.28571	0.00000
4	0.00000	47.42308
5	0.00000	15.00000
6	0.00000	7.50000