## Gold Star #2

Answer the following questions on the second page as it relates to finding the optimal solution using Linear Programming for this problem:

## Prescriptive Analytics problem – The Field Trip Revisited

Ms. Dana Brown is considering taking a field trip with her 4th grade Enrichment students. Part of the field trip experience involves riding a bus and stopping by McAlister's Deli for lunch. Ms. Brown has more students interested in the trip then she can likely handle … she is constrained by a number of factors.

First, she has a limit to how many people can comfortably fit on the old yellow school bus. Up to 42 students can fit on the school bus, but then there would be no room for any adults. Based on 'average butt size", an adult takes up 1.25 seats as compared to a student. (So, 4 adults take up the space of 5 students). The bus does not have to be totally full. So – consider it to have a capacity of 42 student butts, and that an adult takes up 1.25 units.

Second, she must bring at least 35 people total (adults plus children) on the field trip.

RATIO

Third, the PTA indicated that the number of adults on the field trip must be at least 20% of the total number of people on the bus. So, for example, if the bus has 20 people, at least 4 of them must be adults.

If Ms. Brown's goal is to minimize the cost of lunches for the students and adults that go on the field trip (**MIN 6*Adults + 4*Students**), what is the optimal number of adults and students she can bring on the field trip?

A, S

$$1.25A + S \leq 42$$

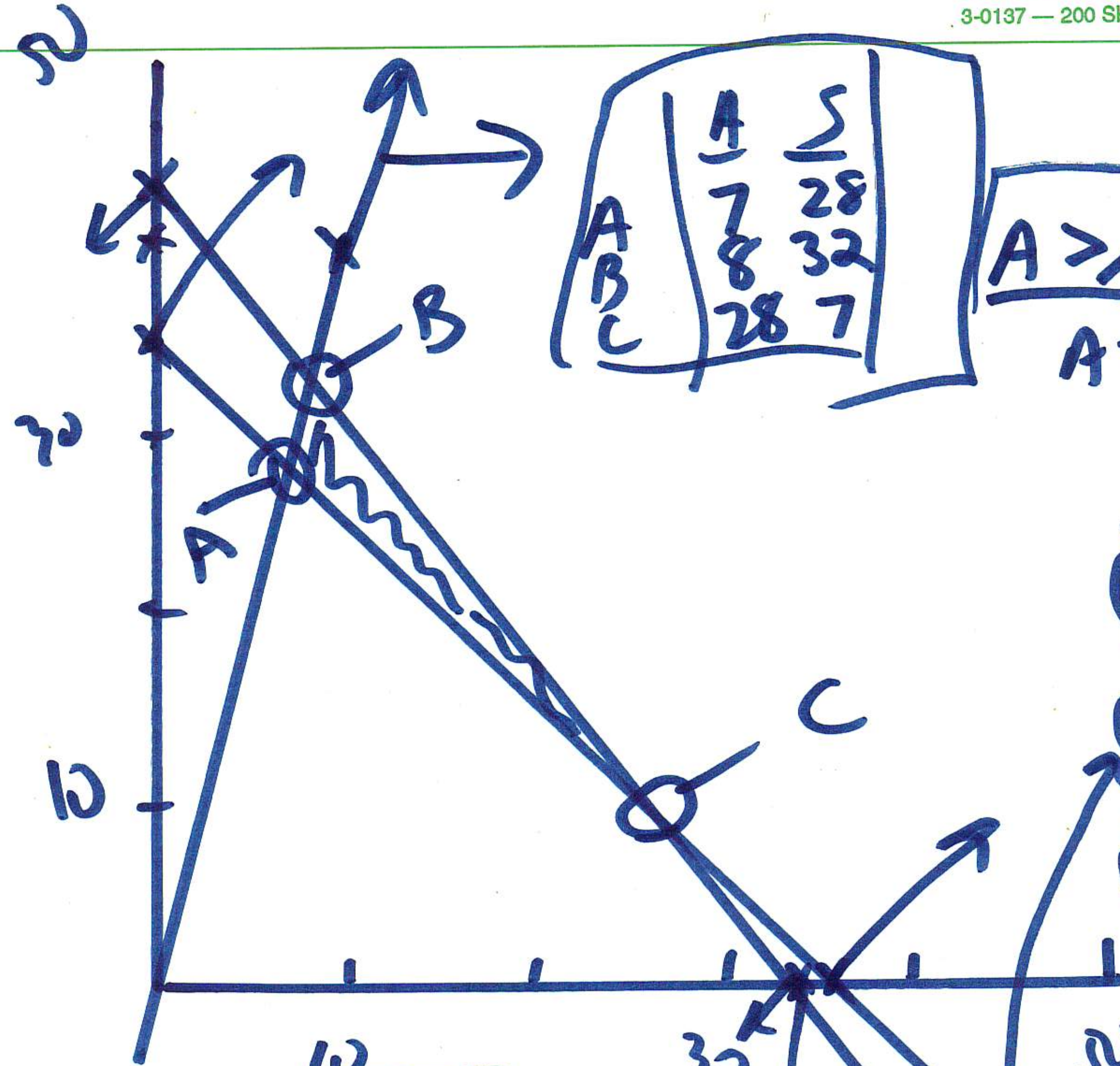
$$A + S \geq 35$$

$$A \geq .2(A+S) \rightarrow .2A + .2S$$

GRAPH:

$$.8A \geq .2S$$

$$\boxed{A \geq 1/4\, S}$$




| | A | S |
|---|---|---|
| A | 7 | 28 |
| B | 8 | 32 |
| C | 28 | 7 |

$\frac{4}{5} \cdot \frac{42}{4} =$

$\boxed{A \geq \frac{1}{4} S}$

$A = \frac{1}{4} S$

$S = 40$
$A = 10$

Ⓐ $A = \frac{1}{4}S$
$A + S = 35$

Ⓑ $A = \frac{1}{4}S$
$\frac{5}{4}A + S = 42$

Ⓒ $\frac{5}{4}A + S = 42$
$A + S = 35$

A) $\frac{1}{4}A = 7$
$A = 28$
$S = 7$

$\frac{5}{4} S = 35, \quad S = \frac{4}{5} \cdot 35 = \underline{28}$

$\frac{5}{4}\left(\frac{1}{4}S\right) + S = 42 \quad \frac{21}{16} S = 42 \Rightarrow S = 32, \; A = 8$

Question 1: For each (Adult, Student) possible solution listed below, indicate yes or no, is it an extreme point of the LP models' feasible region?

a) (33.6, 0) X
b) (28,7)
c) (7,28)
d) (35,0) X
e) (0,42) X
f) (8,32)

Question 2: For each statement below (A= number of adults, S= number of students), does it represent the third constraint (ratio constraint) correctly and in a proper Linear Programming format? Answer yes or no.

a) A/S >= .2 X
b) A/(A+S) >= .2 X

NON LINEAR

c) A>= .2 X
d) A>= .2S X

$A \geq .2(A+S)$

e) A>= .25S
f) 0.8A - .2S >= 0.

$.8A \geq .2S$

Question 3: Of A) through F) above (in Question 1), which extreme point is optimal?

Question 4: What is the objective function value of the optimal solution identified above in Question 3?

MIN 6A + 4S

| A | S | O.V. = |
| --- | --- | --- |
| 7 | 28 | 42 + 112 = 154 |
| 8 | 32 | 48 + 128 = 176 |
| 28 | 7 | 168 + 28 = 196 |