MA 110 WORKSHEET(5.3)

NAME ____SOLUTIONS_____

A city council voted to conduct a study on inner-city community problems. A nearby university was contracted to provide sociologists and research assistants. Each Sociologist can provide 10 hours of fieldwork and 30 hours in the Research Center, and costs $500 per week to hire. Each Research Assistant can provide 30 hours of Fieldwork and 10 hours in the Research Center, and costs $300 per week to hire. The weekly labor-hour requirements are at least 180 hours of Fieldwork and 140 hours of Research Center assistance. How many sociologists and how many research assistants should be hired to meet the weekly labor-hour requirements while minimizing the weekly cost? What is the minimum weekly cost?

ORGANIZATION: Finish filling in the table using the information given.

	Sociologist Labor-hours	Research Assistant Labor-hours	Minimum Labor-Hours needed per week
Fieldwork	10	30	180
Research Center	30	10	140
COST PER WEEK	$500	300	

SET UP THE MATH MODEL:

Let x = the number of sociologists   Let y = the number of research assistants

Write ALL the constraints implied by the table. Do not forget the nonnegative constraints.

$$10x + 30y \geq 180$$
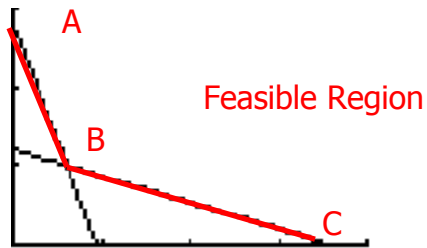$$30x + 10y \geq 140$$
$$x \geq 0, y \geq 0$$

Write the objective function and tell in sentence form whether the objective is to be minimized or maximized.

Minimize the objective C = 500 x + 300 y subject to the above constraints.

GRAPH OF FEASIBLE REGION:

10 x + 30 y $\geq$ 180 becomes y $\geq$ -x/3 + 6 ➔ y-int: (0, 6) & x-int: (18, 0)
30x + 10 y $\geq$ 140 becomes y $\geq$ -3x + 14 ➔ y-int: (0, 14) & x-int: (14/3, 0) = (~5, 0)

A

Feasible Region

B

C

FIND THE CORNER POINTS:

Note **A** is one of the y-intercepts from above – can you tell which one?

B is the intersection point of the lines y = -x/3 + 6 and y = -3x + 14. You can find this algebraically or graphically.

C is one of the x-intercepts from above – can you tell which one?

FIND THE SOLUTION:
Use the corner points to determine the optimal solution(s).

CORNER POINT	X	Y	COST
A	0	14	500(0) + 300(14) = $4,200
B	3	5	500(3) + 300(5) = $3,000
C	18	0	500(18) + 300(0) = $9,000

Write the optimal solution in sentence form.

The weekly cost will be at a minimum of $3,000 if 3 Sociologist and 5 Research Assistants are hired.

INVESTIGATION:

How many labor hours are used each week in field work?

10(3) + 30(5) = 180

How many labor-hours are used each week in research?

30(3) + 10(5) = 140