

# ARTY'S TIE-DYED T-SHIRTS

Arty Binewski is making his plans for the Fremont Fair where he sells four types of custom made sweatshirts. These types are

- (a) tie-dyed,
- (b) single dyed with a silkscreen caption,
- (c) single dyed with a silkscreen design, and
- (d) single dyed and hand painted with silkscreen paint.

Arty makes these sweatshirts in batches of 20 shirts and has bought 400 white sweatshirts at Costco for \$7 a shirt. He figures that he has on hand enough dye for 30 batches of single dyed shirts. However, the tie-dyed shirts require 3 dyings. This dye is top quality stuff and each shirt costs about \$.75 for a single dye. Arty also has on hand enough silkscreen paint for 25 batches of the type (b) sweatshirts, however, the type (c) and (d) sweatshirts require about twice as much paint per shirt. The silkscreen paint he uses is also quite expensive and Arty estimates that each type (b) shirt requires about \$0.2 worth of paint. Between now and the time the Fremont fair opens Arty estimates that he'll have about 50 hours to devote to this project. Being a linear programming fanatic, he decides to determine his production by solving an appropriate linear program to maximize his profit. The initial and final tableaus for this LP follow.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>s</i> <sub>1</sub>	<i>s</i> <sub>2</sub>	<i>s</i> <sub>3</sub>	<i>s</i> <sub>4</sub>	
<i>shirts</i>	1	1	1	1	1	0	0	0	20
<i>paint</i>	0	1	2	2	0	1	0	0	25
<i>labor</i>	2	1	2	3	0	0	1	0	50
<i>dye</i>	3	1	1	1	0	0	0	1	30
	180	160	200	240	0	0	0	0	0

where the variables *a*, *b*, *c*, and *d* represent the number of 20 shirt batches for each of the 4 types of shirts (a), (b), (c), and (d), respectively. Thus, in particular, the cost coefficients are in dollars of profit per batch of 20 shirts (e.g. each type (a) shirt produces a profit of \$9). The optimal tableau is as follows:

1	0	0	0	-1/2	0	0	1/2		5
0	0	-1	0	5/2	-2	1	-3/2		5
0	1	0	0	3	-1	0	-1		5
0	0	1	1	-3/2	1	0	1/2		10
0	0	-40	0	-30	-80	0	-50		-4,100

Answer each of the following questions as if it were a separate event. Do not consider the cumulative effects between problems unless explicitly requested to do so. Clearly label all of your final solutions and show all of your work. Partial credit can only be assigned if there is a clear line of reasoning so try to be neat.

- a) Arty would like to produce at least a few of each type of shirt. At what price should he sell the type c) shirts in order to make it efficient to produce at least a few of them?
- b) Arty is also considering the possibility of making some batik sweatshirts. Just as for the tie-dyes these require a three dye process, they use no paint, but do require about 3 hours of work for each batch of 20 shirts. If he sells these shirts for \$19.25 each, what is the new production schedule?
- c) Should Arty buy more dyes and paints for his sweatshirts? If so, how much should he spend on each (dyes and/or paints) in order to maximize the return on this investment? (Justify your answer! A single pivot, or at least a partial pivot, is required to answer this question.)