

Exercise Set 2.2: Applications of Linear Programming Problems

1. A company manufactures staplers, regular and heavy duty. The number of hours per week it takes to assemble and finish each type of stapler, and the profit for each type of stapler is given in the table below:

	Regular	Heavy Duty
Assemble	2	4
Finish	1	3
Profit	\$15	\$32

The assembly department has at most 160 hours available per week and the finishing department has at most 105 hours available per week.

- Give the objective function.
- Give the system of constraints.
- Set-up the linear programming problem.
- How many of each type of stapler must be sold to maximize the company's profit?
- What is the maximum profit?

2. A company produces bed frames, twin bed frames and bunk bed frames. The number of hours per week it takes to fabricate and paint each type of bed frame, and the profit for each type of frame is given in the table below:

	Twin	Bunk
Fabricate	6	10
Paint	4	5
Profit	\$125	\$250

The fabricating department has at most 300 hours available per week and the painting department has at most 180 hours available per week.

- Give the objective function.
- Give the system of constraints.
- Set-up the linear programming problem.
- How many of each type of bed frames must be sold to maximize the company's profit?
- What is the maximum profit?

3. Tied Up designs clip-on neck ties and clip-on bow ties. Each neck tie takes 4 minutes in the cutting department, 6 minutes in the sewing department and will produce a \$15 profit. Each

bow tie takes 2 minutes in the cutting department, 5 minutes in the sewing department

and will produce a \$9 profit. The maximum number of hours available per week in the cutting department and the sewing department is 20 and 40, respectively.

- Give the objective function.
- Give the system of constraints.
- Set-up the linear programming problem.
- How many of each type of tie must be sold to maximize the company's profit?
- What is the maximum profit?

4. A Gift for You makes floral arrangements and fruit baskets. The small business has a maximum of 40 hours per week available in the assembly department and a maximum of 10 hours per week in the packaging department. Each floral arrangement takes 20 minutes to assemble and 6 minutes to package. Each fruit basket takes 15 minutes to assemble and 2 minutes to package. The profit for each floral arrangement is \$50 and the profit for each fruit basket is \$35. The company wants to maximize their profit.

- Give the objective function.
- Give the system of constraints.
- Set-up the linear programming problem.
- How many floral arrangements and fruit baskets must be sold to maximize their profit?
- What is the maximum profit?

5. Sauces Galore produces two types of spaghetti sauce, spicy and regular. Each can of spicy sauce requires 36 ounces of tomato mix, 4 ounces of spices and 16 minutes of processing. Each can of regular sauce requires 24 ounces of tomato mix and 20 minutes of processing. The company has at least 720 ounces of tomato mix, no more than 100 ounces of spices and no more than 8 hours of processing time per day. The company will make a profit of \$6 for each can of spicy sauce and \$3 for each can of regular sauce, and they wish to maximize their profit.

- Give the objective function.
- Give the system of constraints.
- Set-up the linear programming problem.

Exercise Set 2.2: Applications of Linear Programming Problems

- D. How many cans of spicy and regular spaghetti sauce must be sold per day to maximize their profit?
E. What is the maximum profit?

6. Sauces Galore produces two types of alfredo sauce, garlic and regular. Each can of garlic alfredo sauce requires 32 ounces of a creamy mix, 4 ounces of garlic powder and 15 minutes of processing. Each can of regular alfredo sauce requires 20 ounces of a creamy mix and 25 minutes of processing. The company has at least 800 ounces of creamy mix, no more than 120 ounces of garlic powder and no more than 10 hours of processing time per day. The company will make a profit of \$9 for each can of garlic alfredo sauce and \$5 for each can of regular alfredo sauce, and they wish to maximize their profit.

- A. Give the objective function.
B. Give the system of constraints.
C. Set-up the linear programming problem.
D. How many cans of garlic and regular alfredo sauce must be sold per day to maximize their profit?
E. What is the maximum profit?

7. You are a nutritionist at a nursing home and a few elderly need more vitamin A and biotin in their diet. Two brands of pills will be suitable. You advise them to take at least 260 units of vitamin A and at least 160 units of biotin over a period of time. The number of units of vitamin A, biotin and sodium in each pill of each brand is given in the table below:

	Brand I	Brand II
Vitamin A	2	4
Biotin	4	2
Sodium	3	3

The amount of sodium in their diet must be minimized.

- A. Give the objective function.
B. Give the system of constraints.
C. Set-up the linear programming problem.

- D. How many pills of Brand I and Brand II must be mixed to meet the minimum requirements and at the same time minimize the sodium intake?
E. What is the minimum sodium intake?

8. You are a nutritionist at Golden Plus, a retirement community. A few of your clients are deficient in vitamin E and calcium. Two brands of pills will be suitable. You advise them to take at least 280 units of vitamin E and at least 300 units of calcium over a period of time. The number of units of vitamin E, calcium and cholesterol in each pill of each brand is given in the table below:

	Brand I	Brand II
Vitamin E	2	4
Calcium	2	5
Cholesterol	4	5

The amount of cholesterol in their diet must be minimized.

- A. Give the objective function.
B. Give the system of constraints.
C. Set-up the linear programming problem.
D. How many pills of Brand I and Brand II must be mixed to meet the minimum requirements and at the same time minimize the intake of cholesterol?
E. What is the minimum cholesterol intake?

9. A patient's doctor advises her to buy two types of pills that will replenish the deficiency of vitamin A, potassium and beta carotene in her diet. Each type of Pill I contains 20 units of vitamin A, 15 units of potassium, 6 units of beta carotene, and costs \$0.13. Each type of Pill II contains 15 unit of vitamin A, 30 units of potassium, 20 units of beta carotene, and costs \$0.17. The patient needs a minimum of 2250 units of vitamin A, a minimum of 3000 units of potassium and a minimum of 1600 units of beta carotene. She wishes to minimize the cost of the pills.

- A. Give the objective function.
B. Give the system of constraints.
C. Set-up the linear programming problem.

Exercise Set 2.2: Applications of Linear Programming Problems

D. How many pills of each type must be mixed to meet the minimum requirements and at the same time minimize the cost?

E. What is the minimum cost?

10. You are a nurse practitioner at a local clinic and one of your patients is deficient in calcium, iron and vitamin A. You advise him to buy two types of pills that will help. Each type of Pill I contains 4 units of calcium, 3 units of iron, 4 units of vitamin A, and costs \$0.10. Each type of Pill II contains 1 unit of calcium, 2 units of iron, 7 units of vitamin A, and costs \$0.15. Your patient needs a minimum of 200 units of calcium, a minimum of 250 units of iron and a minimum of 420 units of vitamin A. He wishes to minimize the cost of the pills.

- A. Give the objective function.
- B. Give the system of constraints.
- C. Set-up the linear programming problem.
- D. How many pills of each type must be mixed to meet the minimum requirements and at the same time minimize the cost?
- E. What is the minimum cost?

11. An athlete wants cut out as much fat from his diet as possible. He wants to combine two diet plans. Each ounce of Diet Plan I contains 2 grams of fat, 15 grams of carbohydrates and 10 grams of protein. Each ounce of Diet Plan II contains 1 gram of fat, 6 grams of carbohydrates and 2 grams of protein. He's decided that each day he would like to take in at least 90 grams of carbohydrates and a maximum of 50 grams of protein.

- A. Give the objective function.
- B. Give the system of constraints.
- C. Set-up the linear programming problem.
- D. How many ounces of each type of diet should he eat per day to minimize the intake of fat?
- E. What is the minimum number of grams of fat taken in per day?

12. A dietician was hired by a private pre-school to formulate two meals for their 3 – 4 year olds. Each ounce of Meal I contains 3 units of protein,

2 units of carbohydrates and 1 unit of fat. Each ounce of Meal II contains 2 units of protein, 4 units of carbohydrates and 0.5 unit of fat. The dietician has determined that each meal must provide at least of 6 units of protein and no more

than 8 units of carbohydrates. The school wants to minimize the fat intake.

- A. Give the objective function.
- B. Give the system of constraints.
- C. Set-up the linear programming problem.
- D. How many ounces of each meal should be used to minimize fat?
- E. What is the minimum number of units of fat?

13. You are in charge of renting Suburbans and vans for your family reunion. You know that at most 36 children (all 7 years old and younger) are attending and that at least 32 adults (the rest that have not confirmed have no children) are attending. Each Suburban accommodates 6 children, 4 adults and costs \$75 to rent. Each van accommodates 4 children, 4 adults and costs \$100 to rent.

- A. Give the objective function.
- B. Give the system of constraints.
- C. Set-up the linear programming problem.
- D. How many Suburbans and vans should be rented to minimize cost?
- E. What is the minimum cost?

14. You are in charge of renting Suburbans and vans for your family reunion. You know that at most 40 children (all 7 years old and younger) are attending and that at least 36 adults (the rest that have not confirmed have no children) are attending. Each Suburban accommodates 4 children, 3 adults and costs \$85 to rent. Each van accommodates 4 children, 4 adults and costs \$95 to rent.

- A. Give the objective function.
- B. Give the system of constraints.
- C. Set-up the linear programming problem.
- D. How many Suburbans and vans should be rented to minimize cost?
- E. What is the minimum cost?