

MORE OPTIMIZATION PROBLEMS

(oh joy...)

Write the constraints and the function rule for each of the following scenarios. Be sure to clearly define your variables.

1. Mr. Sanders raises poultry that he sells once they reach maturity. At present he has at most \$70 to buy chickens at \$2 each and quails at \$5 each. To offer his customers enough variety, he tries to have at least three birds of each kind in his barn. The barn is so small, however, that he can raise no more than 20 birds at a time. He makes a \$2 profit on each chicken and double that on each quail. Find the number of each type of bird to maximize his profit.
2. The owner of a Student Painting company wants to hire students for the summer. He wants a total of 10 to 16 people. He needs at most 4 more female students than male students. Find the minimum number of students of each gender that should be hired.
3. To start a lawn mower's motor, we need to mix oil and gas. Certain conditions must be met so the motor does not overload. First, the tank holds a maximum of 30L of liquid and should be filled with a minimum of 8L of gas and between 5 and 11L of oil. Second, the quantity of gas must always be less than or equal to four times the amount of oil. A litre of gas runs the motor for 4.5min and each litre of oil adds 1.75 min to the time. Find the number of litres of gas and oil that must be poured into the tank to maximize running time.
4. A fertilizer company has to supply an order of at least 120 kg of a mixture containing two special ingredients, nitrogen (N) and phosphorus (P). The mixture must contain at least 10 units of N and at most 20 units. It must also contain between 15 and 24 units of P inclusive. Each unit of N weighs 3kg and each unit of P 5kg. How many units of each should be mixed to minimize cost if a unit of N costs \$4 and a unit of P \$6?
5. A farmer wants to grow cherries and raspberries on a piece of land that is at most 16 hectares in area. Each hectare of cherries requires 5 days of work and each hectare of raspberries requires 3 days. The farmer has at most 60 days available for work. He decides that the number of hectares of raspberries grown will be at most three times the number of hectares of cherries. Each hectare of cherries and raspberries produces a revenue of \$3000 and \$2500 respectively. Find the number of hectares of each to maximize revenue.
6. Mr. Pine owns a forest of birches and maples. In the fall, he has 12 days at his disposal to cut some trees and sell them as firewood. To conserve the forest, his quota indicates that he should cut at most 24 cords of birch and 30 cords of maple. He can cut four cords of birch or three cords of maple a day. Birch brings in \$100 a cord while maple earns him \$150. Find the number of cords of each type that need to be cut to maximize revenue.

7. A baker delivers two types of bread: enriched loaves at \$1.50 each and whole wheat at \$2.00 each. His van can hold at most 200 loaves of bread. He observes that the number of loaves of whole wheat sold each day is always greater than or equal to one quarter the number of loaves of enriched bread sold. He bakes at most 100 loaves of whole wheat and at least 25 loaves of enriched bread daily. There is a profit of 35 cents on each enriched loaf and 28 cents on each loaf of whole wheat. Find the number of loaves to be sold to maximize profits.
8. Mr. Chopin gives piano lessons to children and adults. He does not want to have more than 12 pupils. Adult lessons last one hour and children's lessons last 30 minutes. Since he also teaches music at school, Mr. Chopin has at most eight hours available for private lessons. The cost of an adult lesson is \$20 and a child's lesson \$12 (for the half hour). How many lessons of each type should he give to make as much money as possible?
9. Peter is making concrete and needs sand and cement. The amount of cement used is always greater than or equal to a quarter the amount of sand. The total amount of sand and cement must be at least 600kg. Cement costs \$1/kg and sand costs \$0.01/kg. Find the amount of each necessary to keep costs to a minimum.
10. Angela has set up a small business preparing documents on her computer. She knows it takes 30 minutes to transcribe one page of text. If the page contains graphics, it takes 60 minutes to complete. She has at most 12 hours a week for her business. She has noticed that she never transcribes more than 10 pages a week in all, whether they are text only or include graphics. Also, the number of pages with text is never more than three times the number of pages with graphics. She charges \$2.50 for a page of text and \$4 for a page with graphics. How many pages of each should she prepare to make as much money as possible?
11. Andre and Dave have decided to go backpacking in France and Italy. They want to spend at least 15 days away and have calculated that their average daily cost in France will be \$80 and the daily cost in Italy will be \$150. Nevertheless, they want to spend at least twice as much time in Italy as in France, but have decided to be in Italy for at most 11 days. How many days should they spend in each so that Andre and Dave spend as little money as possible?
12. The cost of printing a yearbook is 10 cents for a black and white page and 25 cents for a colour page. The cost of the engraved cover is \$3 per book. The yearbook committee has decided that there must be at least 30 pages but not more than 90. Twice the number of black and white pages plus 5 times the number of colour pages must not be more than 360. They want at least 5 colour pages. Find the number of each type of page so that the cost of a book is kept to a minimum.
13. A pharmaceutical company has developed a new pill for treating colds. Each pill comes in two shapes, round and oval. The round pill contains 2 units of aspirin, 6 units of bicarbonate and 2 units of codeine. The oval pill contains 1 unit of aspirin, 7 units of bicarbonate and 3 units of codeine. Research has shown that it takes 12 units of aspirin, 68 units of bicarbonate and 24 units of codeine for a successful treatment. Determine the minimum number of each type of pill that a person with a cold must take.