

## Optimization Problems

1. A school organizes an outdoor trip to Gaspésie. A group of 54 students at most can participate in this activity. Organizers plan to rent at least 10 tents. Two types of tents are recommended: large tents that cost \$50 and can accommodate six people, and small tents that cost \$30 and can accommodate four people. There will be at least one large tent used to store the luggage. How many large and small tents will the organizers have to rent if the organizers want to minimize rental costs?
2. A city neighbourhood is offering bicycle repair courses that are limited to a maximum of 12 participants. There are two types of courses offered: a one-hour beginner's course that costs \$16 and a two-and-a-half hour advanced course that cost \$12. The municipality lends the required equipment for a maximum of 18 hours per week. It was determined that the number of people registered for the advanced course had to be at most equal to twice the number registered for the beginner's course. If the municipality wants to maximize its revenue, how many people will it allow to register for each course?
3. The Little Oven Bakery offers its customers two types of pastries: cookies and tarts. It always sells at least as many cookies as tarts. In a given week, it never bakes fewer than 60 or more than 90 pastries. The number of cookies combined with twice the number of tarts sold does not exceed 120 pastries in all. If the cookies and tarts sell for \$3 and \$5 respectively and the production costs are \$35, how many cookies and tarts must the bakery produce to maximize its profit?
4. A company manufactures guitars. It can produce at most 24 electric guitars and 30 acoustic guitars per month. An electric guitar sells for \$80 and an acoustic guitar sells for \$100. Given the sales figures, it is specified that triple the number of electric guitars combined with quadruple the number of acoustic guitars must not exceed 144 per month. If the company's objective is to maximize its revenue, how many of each type of guitar should it produce?
5. The organization committee of a neighbourhood party must rent tables for the guests and wants at most 8 tables. A company rents two types of tables: those that set 20 people and those that seat 50 people. The first type cost \$20 per table and the second type cost \$40 per table. A total rental budget of \$280 was set aside. Members of the organizing committee want to ensure the greatest possible number of seats without going over budget.

6. Francois and Danny want to use markers to make a giant poster featuring the logo of their favourite sports team, the Montreal Canadiens. To reproduce the logo, they need at most five times more red than blue. The area to colour will be at most  $240 \text{ cm}^2$ . The two friends estimate that a blue marker, which cost \$1, will cover  $20 \text{ cm}^2$  and that a red marker, which costs \$2, will cover  $30 \text{ cm}^2$ . They already bought two of each colour marker. In total, how many of each colour marker will they have to buy if they want to minimize the cost of their project?
7. A small workshop produces two very popular skateboard models. Model 1 requires 20 minutes of sawing and 40 minutes of sanding, while Model 2 requires 25 of sawing and 35 minutes of sanding. Model 1 sells for \$55 and Model 2 sells for \$60. The workshop is open 5 days a week. The saw cannot be used more than 2h40min per day, while the sander cannot be used for more than 4h per day. The workshop owner sells at least 20 Model 2 skateboards per week. The weekly number of Model 2 skateboards is greater than twice the number of Model 1 skateboards sold. The workshop owner claims that the maximum weekly revenue he can generate is \$2000. Is he right? Justify your answer.
8. An apple grower wants to plant two varieties of apple trees on a newly purchased property. She claims that variety A will produce an average of 320 apples per year, while variety B will produce an average of 400 apples per year. Variety A sells for \$35 and variety B sells for \$48 per tree. Since the two varieties of apples will not be harvested at the same time of year, the apple grower wants to have similar numbers of the two varieties of trees. The number of each variety of tree cannot correspond to more than two-thirds the total number of trees. Determine the number of each variety of tree that the apple grower must purchase if she wants to minimize the overall purchase price, knowing that the projected overall annual production is at least 10,000 apples and that there must be fewer than 45 trees on the property.
9. Zoey owns a small cafe where she sells sandwiches, including two types with chicken: a chicken salad sandwich and a club sandwich. The chicken salad sandwich contains 110g of chicken while the club sandwich 140g of chicken. Zoey always sells more than 25 chicken sandwiches per day and the number of club sandwiches sold is always equal to or greater than the number of chicken salad sandwiches sold. Chicken salad sandwich sells for \$4.50 and a club sandwich sells for \$5.25. Zoey claims that the maximum daily income that she can generate by selling these two types of sandwiches, knowing that she has 3.5kg of chicken available per day, is approximately \$135. Is she right? Justify your answer.
10. Martin is a pastry chef and makes two types of cakes for Valentine's Day: a round cake and a rectangular cake. The ingredients for the round cake cost \$7.50 and the ingredients for the rectangular cake cost \$8. The round cake requires 300 g of icing and the rectangular cake requires 440g of icing. The round cake sells for \$13 and the rectangular cake sells for \$16. Determine the number of each type of cake that Martin must make if he wants to generate the greatest total return from sales in one day. The cost of ingredients must be at most \$360 and Martin has 16kg of icing available. Moreover, he notices that he always sells at least 20% more round cakes than rectangular cakes.