Strathmore
UNIVERSITY

STRATHMORE INSTITUTE OF MATHEMATICAL SCIENCES (SIMS)
MASTER OF SCIENCE IN DATA SCIENCE AND ANALYTICS
ASSIGNMENT 1
DSA 8205: OPTIMIZATION FOR DATA SCIENCE

DATE: 1st December, 2022 **TIME**: 1 week

Question One

(i) Consider the following linear programming model for a farmer purchasing fertilizer

$$\begin{array}{lrcll} \text{Minimize W} & = 6x_1 + 3x_2 & & & \\ \text{Subject to:} & 2x_1 + 4x_2 & \geq & 16 & \text{lb of nitrogen} \\ & 4x_1 + 3x_2 & \geq & 24 & \text{lb of phosphate} \\ & x_1, x_2 & \geq & 0 & \end{array}$$

where x_1 = bags of super-gro fertilizer, x_2 = bags of crop-quick fertilizer and W= farmer's total cost (\$) of purchasing fertilizer. Solve this model using simplex method.

(ii) A Printing Company is facing a tight financial squeeze and is attempting to cut costs wherever possible. At present it has only one printing contract, and luckily, the book is selling well in both the hardcover and the paperback editions. It has just received a request to print more copies of this book in either the hardcover or the paperback form. The printing cost for the hardcover books is \$ 600 per 100 books while that for paperback is only \$ 500 per 100. Although the company is attempting to economize, it does not wish to lay off any employee. Therefore, it feels obliged to run its two printing presses - I and II, at least 80 and 60 hours per week, respectively. Press I can produce 100 hardcover books in 2 hours or 100 paperback books in 1 hour. Press II can produce 100 hardcover books in 1 hour or 100 paperbacks books in 2 hours. Determine how many books of each type should be printed in order to minimize costs (use simplex method).

Question Two (15 Marks)

(i) Use the simplex method to solve the following LP problem.

$$\begin{array}{lrcl} \text{Maximize Z} & = 3x_1 + 5x_2 + 4x_3 & & \\ \text{Subject to:} & 2x_1 + 3x_2 & \leq & 8 \\ & 2x_2 + 5x_3 & \leq & 10 \\ & 3x_1 + 2x_2 + 4x_3 & \leq & 15 \\ & x_1, x_2, x_3 & \geq & 0 \end{array}$$

(ii) A company makes two kinds of leather belts, belt A and belt B. Belt A is a high quality belt and belt B is of lower quality. The respective profits are Rs 4 and Rs 3 per belt. The production of each of type A requires twice as much time as a belt of type B, and if all belts were of type B, the company could make 1,000 belts per day. The supply of leather is sufficient for only 800 belts per day (both A and B combined). Belt A requires a fancy buckle and only 400 of these are available per day. There are only 700 buckles a day available for belt B. What should be the daily production of each type of belt? Formulate this problem as an LP model and solve it using the simplex method.

(iii) An Air Force is experimenting with three types of bombs P, Q and R in which three kinds of explosives, viz., A, B and C will be used. Taking the various factors into account, it has been decided to use the maximum 600 kg of explosive A, at least 480 kg of explosive B and exactly 540 kg of explosive C. Bomb P requires 3, 2, 2 kg, bomb Q requires 1, 4, 3 kg and bomb R requires 4, 2, 3 kg of explosives A, B and C respectively. Bomb P is estimated to give the equivalent of a 2 ton explosion, bomb Q, a 3 ton explosion and bomb R, a 4 ton explosion respectively. Under what production schedule can the Air Force make the biggest bang?

(iv) A farmer has 1,000 acres of land on which he can grow corn, wheat or soyabean. Each acre of corn costs $ 100 for preparation, requires 7 men-days of work and yields a profit of $ 30. An acre of wheat costs $ 120 to prepare, requires 10 men-days of work and yields a profit of $ 40. An acre of soyabean costs $ 70 to prepare, requires 8 men-days of work and yields a profit of $ 20. If the farmer has $ 1,00,000 for preparation and can count on 8,000 men-days of work, determine how many acres should be allocated to each crop in order to maximize profits?

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