Operations Research: Semester Project Report

SUBMITTED BY: Muhammad Laiq Ali (20L-1310)
SECTION: BSE - 5B
SUBMITTED TO: Sir Hakeem-Ur-Rehman

NATIONAL UNIVERSITY OF COMPUTER AND EMERGING SCIENCES

QUESTION # 1

The best possible weekly profit from producing all different kinds of bicycles is 16150. To do this, 150 20-inch girls' bicycles, 100 20-inch boys' bicycles, 100 26-inch girls' bicycles, and 100 26-inch boys' bicycles must be produced weekly.

1. We had 50 of the minimal female models remaining after all of the assembly and production minutes had been used up, giving us a slack of 50.
2. Since only 400 of the maximum 800 26-inch-tyre bicycles were made, there was a 400-unit supply, which rendered this variable non-binding.
3. The shadow price for the minimum boys model total is -3, meaning that each unit of the boys model represented a -3 loss.
4. The values up to which the decision and slack variables' values may be increased or lowered without affecting the profit are determined by the sensitivity analysis of the model.

QUESTION # 2(a)

The weekly maximum profit that may be made from producing all the appliances is 87051.2821. This may be accomplished by churning out 133.33 refrigerators, 448.71 washers, and 266.67 stoves per week. The calculations indicate that it would be foolish to invest in the production of either gas or electric dryers.

1. Even if we increase the number of these slack variables, the profit, which is $8755.12821, won't be impacted if the net contribution cell of these slack variables is equal to zero.
2. Producing an additional unit of that variable if the slack value is negative will reduce the profit by that amount.
3. Total washer/dryer minimum is 380.769. The limitation is not binding because more can still be created. The limitations are nevertheless binding and the values are 0, as Moulding/Pressing Totals, Stove Totals, and Refrigerator Totals have all been created to their maximum.

QUESTION # 2(b)

When stoves are 266.66667, washers are 227.15447, electric dryers are 63.577236, gas dryers are 163.57724 and refrigerators are 133.33333.
Then, the optimal value of the objective function is = 84965.0408.

The washer dryer at cell 1767.23577235772 has a slack value of 632.764227642276. The packaging totals at a cell value 2767.56097560976 has a slack value of 232.439024390244.

Washer, packaging and E.Dryer < = G.Dryer Totals are non binding variables and molding, stove and refrigerators are binding constraints.

QUESTION # 3

By manufacturing 22.93578 standard Z345s, 22.9358 industrial W250s, and 45.8716 industrial W250s, the highest ideal profit is 54128.44. This yields 91.74 goods in total.

1. The iron slack of 460.550458715596, the Min Z345 slack of 2.93577981651378, and the Max Z345 slack of 45.8715596330275 show that these materials are still available even after a profit of 54128443669725.

2. Even if we increase the number of these specific slack variables, the profit will not be affected if the Net Contribution cell of those particular slack variables is equal to zero.

3. Nevertheless, adding an extra unit of each slack variable might reduce profit if the value is negative.

4. Because there is slack, Iron, Min Z345 and Max Z345 can have additional units, which makes the constraint non-binding. Producing more of them won't change the best solution, though. The time has also passed.

QUESTION # 4

Investments of 7,500 in EAL stock, 2,500 in TAT stock, 30,000 in long-term bonds, and 10,000 in tax-deferred annuities can provide a maximum ideal profit of 5,250. This meets the last criteria by producing a total investment of $10,000 in stocks only.

1. TDA and TAT's shadow prices show that they can reduce profits by 0.15 and 0.16, respectively.

2. Bond investments total $30,000. This is a 20000 increase over stock investments. This results in a 20000 slack and nullifies the Bonds >= Stocks requirement.

3. Shadow pricing shows the anticipated rise in profit by manufacturing the permissible number of units of items.

QUESTION # 5

When the number of full comforters produced daily are 240, number of full queens produced daily are 312 and the number of full kings produced daily are 120 then the objective function is maximize of 5568.
Fabrics, cutting and king totals are binding constraints and stuffing total and queen totals are non-binding constraints.
Stuffing total has slack of 12, sewing minute total has 7968, full totals have 120 slack and queen totals have 192 slack in total.

QUESTION # 6

The recommended minimum amount of fat in Jim's diet is 76.631. This may be accomplished by including 5.49 apples and 1.395 8-ounce servings of steak in his diet.

200 maximum calories and 95.79 maximum grams of carbohydrates show that even after consuming 76.63 grams of fat, these calories and carbs will still be present.
If the net contribution cell of these specific slack variables equals zero, it suggests that increasing the amount of these slack variables won't have an impact on the consumption of fat.

Because the minimum calories and grams of protein are binding variables, any changes will affect the best solution, requiring a recalculation.

The sensitivity report indicates that changing the amount of fat consumed would vary even if the number of 8-oz pieces of steak consumed is increased by 6 or decreased by 42.45.

Additionally, the final result won't change if the number is 8-oz. portions of milk in the diet are increased or decreased by 0.99137359 or 0.105263158, but the amount of fat consumed would.

The final figure will not change if the diet's apple consumption is reduced by 0.761273885, but the amount of fat consumed would.

QUESTION # 7

Producing 325 student models, 100 plus models, 375 net models, and 425 pro models will result in a weekly maximum ideal profit of 143250.

Total number of Celeron processors, 20 GB hard drives, 100 floppy drives, 100 DVDs, and 17-in. Monitors total are binding restrictions that cannot be changed without requiring a new calculation of the answer.

Even if we had greater capacity before finding an optimal solution, the remaining constraints are nonbinding and contain the slack values given above, indicating that even then, we are only left with that much.

Allowable increases and reductions in the corresponding categories demonstrate that the solution does not need to be recalculated as long as the value of the goal function stays within that range. The profit might change, but the ultimate value of the relevant variable will remain the same.

The solution must be redone if the value exceeds the range, and the final values of the variables will likewise change.

QUESTION # 8

Producing 2 delta assemblies and 4 theta assemblies per day will yield a maximum ideal daily profit of 4,000.

Since there is no slack, the production hours and quality minutes are binding limits.

The total of X70686 chips is a non-binding restriction, and there is a slack of 1, which indicates that even if 1 additional chip were manufactured, the optimal profit would not change.

We don't need to recalculate the solution if the R.H.S stays within that range, according to the permissible increases and reductions in the corresponding categories. The ultimate value of the relevant restriction will not change, but the profit may.

The solution must be redone if the value exceeds the range, and the constraints' ultimate values will likewise change.

One of the binding factors is the shadow pricing. When a particular limitation is increased by one unit, each shadow price shows the per-unit rise in profit.

QUESTION # 9

The minimal optimum cost for Gladstone and Associates is 39800. This may be done by calling 600 people in group 2, 500 people in group 1, 500 people in group 3, 200 individuals in group 3, and 200 people in group 1 over the phone, in addition to contacting 500 people in group 1 in person.

We don't need to recalculate the solution if the value of the goal function stays within the range indicated by the permissible increases and reductions in the corresponding categories. The corresponding variable's ultimate value will remain the same, but the profit may change.

The solution must be redone if the value exceeds the range, and the final values of the variables will likewise change.

We don't need to recalculate the solution if the R.H.S stays within that range, according to the permissible increases and reductions in the corresponding categories. The ultimate value of the relevant restriction will not change, but the profit may.

The solution must be redone if the value exceeds the range, and the constraints' ultimate values will likewise change.

Since the shadow price of the small total is negative, increasing the R.H.S will lower our cost.

QUESTION # 10

Grant wants to limit his sugar consumption, and his ideal intake is 19.8g. To prepare this, combine 0.8 oz of grape nuts, 0.8 oz of product 19, and 0.2 oz of frosted bran with 0.2 oz of multigrain cheerios. The mixture now contains a total of 2 ounces.

1. 100% overall, 10% M/G Total Cheerios, Frosted Bran total, vitamin A total, and vitamin D total are binding restrictions that cannot be changed without requiring a recalculation of the solution.

2. We had greater capacity, but even after finding an ideal solution, we are only left with those restrictions that are non-binding and have the slack values indicated in the table below.

3. One of the binding factors is the shadow pricing. When a particular limitation is increased by a unit, each shadow price shows the per-unit rise in profit.

4. Total has a negative shadow price, meaning that increasing total will result in less sugar consumption.

5. We don't need to recalculate the solution if the value of the goal function stays within the range indicated by the permissible increases and reductions in the corresponding categories. The corresponding variable's ultimate value will remain the same, but the profit may change.

QUESTION # 11

Total revenue is 2777000. This may be accomplished by manufacturing 14550 refrigerator/ovens, 4,000 french fry makers, and 15,000 toasters, which is more than the minimum estimated profit of $2,000,000. The goal is to maximize profit:

1. The number of french toast makers and the number of minimal french fry makers are the binding factors. We must manufacture the maximum number of fry makers and the lowest number of fry makers, which are 15000 and 4000, respectively, according to the response.

2. We could manufacture up to 15,000 refrigerators and ovens, but we only need to manufacture 14550, leaving us with a 450-unit surplus and rendering this variable non-binding.

3. We could produce as many as 15000 french fry producers at most, but we only needed to produce 4000 at a minimum, giving us a slack of 11000 and making this variable non-binding.

4. French toast makers have a -1.8 shadow pricing, which indicates that each additional one created will cut into the profit by 1.8.

QUESTION # 12(a)

Producing 101.8 plates, 150 mugs, 87.541 steins, and a total of 339.34 goods every day will result in a profit of up to 1083.418 per day.
1. The daily production rate is 150, which is the minimum necessary. There is no slack as a result.

2. We only utilized 1178.85 of the maximum molding minimum, leaving us with a slack of 741.15, making it a non-binding restriction.

3. We had a limit of 3840 ending minutes, which we fully utilized. This left us with no slack and made the constraint a binding one.

4. The RHS will boost our profit by 0.079 per unit because the minimum mugs have a shadow price of -0.079.

QUESTION # 12(b)

By creating 128 plates, 298.67 mugs, and 0 steins per day, the ideal maximum profit is 1290.667.

1. Since we are generating 298.67 cups instead of the required 150, the minimum quantity of mugs is no longer mandatory.

2. Since we are not creating any steins, there is a slack of 853.33, making the number of steins non-binding. The maximum number of steins was 853.33.

3. Due to their non-binding nature, the number of mugs' shadow price is zero.

QUESTION # 13

1. The investment of 30240000 in first trust deeds, 66666.67 in second trust deeds, 20093333 in commercial trust deeds, 12600000 in commercial trust deeds, 5000000 in savings accounts, and 50400000 in residential trust deeds will provide the highest ideal profit of 17876400. As a consequence, a total of $6,300,000 is invested.

2. Each constraint has a shadow price and may be increased or lowered to effect the final profit because they are all binding.

QUESTION # 14

The 225 motorhome cabinets produced in regular time in July, 250 motorhome cabinets produced in regular time in August, 160 motorhome cabinets produced in regular time in September, 285 mobile home cabinets produced in regular time in July, 95 mobile home cabinets produced in overtime in July, 150 mobile home cabinets produced in regular time in August, 131 mobile home cabinets produced in overtime in August, 10 motorhome cabinets stored in September, and 300 mobile home cabinets produced in regular time in September can all be produced at the minimum optimal cost of 367969.

1. Total output in August was 281 while the allowed production was 300, leaving us with a 19-slack and a non-binding limitation.

2. The limitation is no longer in effect because the total output in September was 35, while the permissible production was 300, leaving us with a slack of 265.

3. July's total output was 475, while the allowed production was 1050, leaving us with a slack of 575, rendering the restriction non-binding.

4. The entire amount of overtime output in September was 0, while the amount of overtime that was permitted was 600, giving us a slack of 600 and rendering the restriction non-binding.

5. The overall amount of extra production in August was 655 compared to the 750 permissible output, leaving us with a 95-percent slack, rendering the limitation non-binding.

QUESTION # 15

The ideal profit cap is 197200. To do this, 142.85 acres of wheat, 142.85 acres of corn, and 14.29 acres of soybeans are planted.

1. The variable is bound and there is no slack since the minimum amount of corn that could be planted was 30000/300, which is the same as our answer.

2. As the maximum number of oats that could be planted was 25000/180, which matches our answer, the variable is bound and there is no slack.

3. The variable is bound and there is no slack because the number of plantable acres was 300, which is also the same as our answer.

4. If extra wheat is planted, there will be a profit of 0.267, as the shadow price of the minimum wheat total is -0.267.