**Instruction**

In this report, you are required to answer ALL FOUR QUESTIONS. Your answers are to be presented in a single report format, and in answering these questions, please

* *state and explain all assumptions, on which your answers are based;*
* *support any answers with the appropriate calculations to arrive at the answer.*

**You are required to upload BOTH your report in PDF FORMAT ONLY and Excel file before the deadline.** While each individual answer might have a different word count from the others, **the overall word count should not exceed 2,500 (+ or – 10%) words.** Late submissions will be penalised according to School regulations.

**Q1.** The Primo Insurance Company is introducing two new product lines: special risk insurance and mortgages. The expected profit is £5 per unit on special risk insurance and £2 per unit on mortgages. Management wishes to establish sales quotas for the new product lines to maximize total expected profit. The work requirements are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Department** | **Work-Hours per Unit** | | **Work-Hours Available** |
| **Special Risk** | **Mortgage** |  |
| Underwriting | 3 | 2 | 2,400 |
| Administration | 0 | 1 | 800 |
| Claims | 2 | 0 | 1,200 |

1. Formulate the decision problem as a LP. (10 marks)
2. Solve the LP using graphical solution method and interpret the obtained result. (10 marks)

**Q2.** The SOUTHERN CONFEDERATION OF KIBBUTZIM is a group of three kibbutzim (communal farming communities) in Israel. Overall planning for this group is done in its Coordinating Technical Office. This office currently is planning agricultural production for coming year.

The agricultural output of each kibbutz is limited by both the amount of available irrigable land and the quantity of water allocated for irrigation by the Water Commissioner (a national government official). These data are following:

|  |  |  |
| --- | --- | --- |
| **Kibbutz** | **Usable Land (Acres)** | **Water Allocation (Acres Feet)** |
| 1 | 400 | 600 |
| 2 | 600 | 800 |
| 3 | 300 | 375 |

The crops suited for this region include sugar beets, cotton, and sorghum, and these are the three being considered for the upcoming season. These crops differ primarily in their expected net return per acre and their consumption of water. In addition, the Ministry of Agriculture has set a maximum quota for the total acreage that can be devoted to each of these crops by the Southern Confederation of Kibbutzim, as shown in a table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop** | **Maximum**  **Quota (Acres)** | **Water Consumption**  **(Acre Feet/Acre)** | **Net Return**  **($/Acre)** |
| Sugar beets | 600 | 3 | 1,000 |
| Cotton | 500 | 2 | 750 |
| Sorghum | 325 | 1 | 250 |

Because of the limited water available for irrigation, the Southern Confederation of Kibbutzim will not be able to use all its irrigable land for planting crops in the upcoming season. To ensure equity between the three kibbutzim, it has been agreed that every kibbutz will plant same proportion of its available irrigable land. For example, if kibbutz 1 plants 200 of its available 400 acres, then kibbutz 2 must plant 300 of its 600 acres, while kibbutz 3 plant 150 acres of its 300 acres. However, any combination of the crops may be grown at any of the kibbutzim. The job facing the Coordination Technical Office is to plan how many acres to devote to each crop at the respective kibbutzim while satisfying the given restrictions. The objective is to maximize the total net return to the Southern Confederation of Kibbutzim as a whole.

1. Formulate the decision problem as a LP and solve it using Excel Solver. (20 marks)
2. Discuss on the obtained results and make suggestions. For example, how sensitive is the optimal solution? (10 marks)

**Q3.** A large multinational oil company is considering its strategy in the North See. The UK government has announced that a new drilling site in the North Sea will be offered for sale on a competitive tender basis, the site going to the company making the highest bid. Provisional exploration of the site indicates that, over its life, it can be expected to generate revenue of around £1,500 million if the oil reserves turn out to be high, but only £500 million if they turn out to be low. Seismic tests have indicated that the probability of high reserves is 0.60.

If the company is successful in its bid, it will also have to decide whether to construct a new oil rig for the site or to move an existing oil rig which is currently operating at an uneconomic site. The costs of the new rig are around £250 million and for moving the existing rig around £100 million. A new rig would be able to boost production by £150 million if reserve levels turned out to be high. The company has decided that if it is to bid for the site, the maximum bid it can afford at present, because of its cash flow situation, is £750 million. In the past, 70 percent of the company’s bids for such sites have been successful.

However, the company is also under pressure to refurbish some of its existing rigs for both efficiency and safety reasons. The £750 million could be used for this purpose instead. If the money is used for refurbishment, there is a 50 percent chance of increasing efficiency to generate a return on the £750 million of 5 percent, and a 50 percent chance of generating a return of 10 percent. If the decision to refurbish takes place after the bid has been made and failed, another £500 million will be required for refurbishment.

1. Construct a decision tree for this problem. (10 marks)
2. Using the decision tree, suggest a suitable decision for management. For example, what is the maximum bid the company would consider? What is the value of perfect information about the size of the reserves on the new site? (20 marks)

**Q4.** The file ‘House Sales.xlsx’ contains monthly data on the number of new one-family houses sold in the United States (in thousands) from January 1991 through December 2014.

1. Discuss whether a simple exponential smoothing work with this data set or not. (10 marks)
2. Forecast number of new one-family houses sold in each month from January 2015 to June 2015 using an appropriate forecasting technique. (10 marks)