INSTITUTO SUPERIOR DE AGRONOMIA

Applied Operations Research

Multi-objective Optimization – Exercises

1) Blackstone Mining Company operates 2 coal mines Wythe and Giles producing 3 types of coal: high, medium and low level. The manager is anticipating a demand increase for coal in the coming year. Projections indicate a 48 ton increase in the demand for high-grade coal, a 28-ton increase in the demand for medium-coal and a 100-ton increase in the demand for low-grade coal. To handle these demand increases extra shifts of workers to the mines must be scheduled. The amount of coal that can be produced in a month’s time at each mine by a shift of workers is summarizes in the table below:

|  |  |  |
| --- | --- | --- |
| Coal production by type of coal | Wythe Mine | Giles Mine |
| High | 12 | 4 |
| Medium | 4 | 4 |
| Low | 10 | 20 |

Each extra shift has an extra cost of 40000/month at Wythe and 32000/month at Giles. One an extra shift can be scheduled per month at each mine. The extraction methods lead to the production of toxic water. Running an extra shift leads to the production of 800 and 1250 gallons of toxic water at Wythe and Giles, respectively. Despite safety guidelines are followed, 0.2 and 0.45 life-threatening accidents are expected to occur at Wythe and Giles, respectively

1.1) Define the managers’ problem

1.2) Identify the decision variables

1.3) Write the objective function(s)

1.4) Define the constraints

1.5) Formulate the problem in Excel for solver application considering the multi-objective linear programming weighted normalized method

2) Power generation from biomass is the creation of power from organic material such as solid wood or wood residues. Smallvile, located in a densely forested area, decided to build a biomass plant. **B**ased on a previous economic study it was recommended that the biomass plant should neither exceed 40 Km from each of the 4 surrounding main forests nor be closer than 5 km for safety reasons. Find out the ideal location of the biomass plant considering that it should be located as far away as possible from the village. The coordinates of the 4 forest areas and the village are in the table below.

|  |  |  |
| --- | --- | --- |
|  | X (km) | Y (km) |
| Forest A | 5 | 45 |
| Forest B | 12 | 21 |
| Forest C | 17 | 5 |
| Forest D | 52 | 21 |
| Smallvile | 20 | 20 |

2.1) Define the problem and identify the objective functions

2.2) Identify the decision variables and write the constraints

2.3) Formulate the problem in Excel for solver application considering the multi-objective linear programming:

2.3.1) Objective functions ratio method

2.3.2) Weighted normalized method