|  |  |
| --- | --- |
| University of Leicester logo | **MA1254 – Case Study 2** |

**Keeping down the cost**

The manager of a frozen food storage depot has contacted the University of Leicester for advice on how to reduce their operating costs. The University of Leicester has appointed you and your teams as consultants and has asked you to help this industrial partner.

The manager has informed you that the storage area temperature cannot rise above-18°C, because otherwise the food would be deemed no longer safe to eat. Although the storage area is well insulated, the temperature inevitably rises, at a rate that varies during the year. To be more precise, historical data shows that the temperature rises at about 1.2°C an hour in the coldest winter days and at about 1.8°C an hour in the hottest summer days. To counteract this temperature increase and ensure that food is stored safely, the manager operates three refrigeration units. These units operate down to temperatures of -23°C, and each unit is controlled by an individual thermostat (one for each unit) that can be set to activate the unit if the temperature rises above the set value. If activated, each refrigeration unit reduces the temperature by roughly 0.8°C an hour, and costs £120 per hour to run at the day time rate.

At present, the manager employs the following cooling strategy: one unit operates all the time, the thermostat for one of the other two units is set at just below -18°C, and the other is set at exactly -18°C. If activated, these two units remain active until the temperature falls to -23°C, at which point they are turned off automatically. Periodically, the order of the units is changed to prevent excessive wear to one of them.

To reduce the operating costs, the manager would like to modify the strategy to take advantage of the fact that the cost of electricity between 23:30 and 06:30 (night time rate) is one third that of the day rate.

**Task:** Please recommend a better cooling strategy and estimate how much the manager could save by adopting it. Note: It goes without saying that the manager would like to save as much as possible. However, one needs to take into account that turning on and off the refrigerating units very frequently could damage them.

The manager then informs you that they are considering purchasing a fourth unit, or maybe

upgrading the refrigeration units to make them operate down to -24°C, and asks you whether this would allow them to save significantly more on electricity costs in the long run.

**Task:** Please help the manager understand whether these options are worth pursuing.