1. A CFO of a certain retail chain realised that one of the reasons for failing profits is that the shops are closed early. So, he decided to move from 2 shifts a day to 3 shifts a day. Every shop requires staff in three departments, namely, Accounts, Front Desk and Supplies and the staff are equally skilled in all departmental activities. He calculated the minimum and maximum number of staff needed for each shift and for each shop in order ensure efficient operation and this information is provided in the following table.

|  |  |  |  |
| --- | --- | --- | --- |
| Department\ Shift | Shift 1 | Shift 2 | Shift 3 |
| Accounts | (6,8) | (11,12) | (7,12) |
| Supplies | (4,6) | (11,12) | (7,12) |
| Front Desk | (2,4) | (10,12) | (5,7) |

The CFO wants to create a schedule that effectively makes use of his staff. The accounts, Supplies and Front desk department need at least 26, 24, and 19 staff respectively and shifts 1, 2 and 3 cannot have more than 22, 32, and 25 staff respectively. Help the CFO to formulate this as an optimisation problem and create a spreadsheet model to determine a feasible schedule with the least number of staff needed for a shop.

1. The Monty Hall problem is a game show, where there are three closed doors. Behind one of these doors is a prize. You can win this prize, if you can correctly pick the door. You are first asked to pick a random door. The host, Monty, will open one of the other two doors at random and shows you that it does not have the prize. Now you are given an option to either change or stick with your decision. The recommended strategy is to switch your decision. Simulate this strategy for the Monty hall problem using macros in excel to play the game 100 times and determine the number of times you won the price.
2. The Australian Bureau of Statistics publish their monthly data on the number of livestock slaughtered at [https://www.abs.gov.au/statistics/industry/agriculture/livestock-and-meat- australia/latest-release](https://www.abs.gov.au/statistics/industry/agriculture/livestock-and-meat-australia/latest-release)

Create a spreadsheet model to implement simple exponential forecasting to forecast the number of pigs slaughtered in the next four months. Find the optimal values for the parameters of your model.

1. Write a VBA function to implement simple exponential smoothing that takes the timeseries, smoothing parameter and initial level as input and returns the forecast for the next observation in the series.
2. **CASE STUDY:** A small manufacturing company, called MAD Ltd, to build a spreadsheet model for demand forecasting. The Operations Manager of the client organization has prepared an outline requirements specification for the spreadsheet model. This specification is provided below. Client Spreadsheet Model Requirements Specification At MAD Ltd we have a portfolio of 600 products, which are classed into five categories according to their value as measured by annual demand and unit cost as shown in the table below.

|  |  |  |
| --- | --- | --- |
| Products | Demand/year (each product) | Cost (£) (per unit) |
| V | 1550 | 40 |
| W1-W10 | 650 | 5 |
| X1-X12 | 120 | 50 |
| Y1-Y02 | 30 | 5 |
| Z1-Z493 | 15 | 3 |

Currently we use simple exponential smoothing to forecast demand on a quarterly basis for all products. However our current forecasts are not as accurate as we would like because forecast error is too large for some products. This is leading to problems such as carrying too much inventory or failing to meet demand. We would like a spreadsheet tool that has the functionality for generating adaptive demand forecasts from past sales data. This will include the following capabilities. We want to be able to forecast demand when there might be seasonal patterns and/or trends as well as random variation in the sales data. We want to be able to use the spreadsheet model for all our products and to update forecasts every quarter as new sales data becomes available to generate updates. We also want the spreadsheet model to provide sensible estimates of forecast error, so that we can understand the accuracy and precision of forecasts in relation to actual sales for products over meaningful time windows to support management reporting.

We want to be assured of the validity of the calculations being conducted in the spreadsheet model, therefore we have made available sales data for product X1. This data is shown in the table below.

Past Sales of Product X1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Quarter** | **1** | **2** | **3** | **4** |
| 2014 | 8 | 10 | 7 | 15 |
| 2015 | 15 | 17 | 14 | 28 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 2016 | 25 | 26 | 21 | 40 |
| 2017 | 31 | 34 | 28 | 57 |

We would like to be able to have a case study of using the spreadsheet model with Product X1 data to make sure we understand the choices we need to make in choosing model inputs and interpreting the output from the model. We want to be able to check the credibility of analysis. We might also use this example to train other colleagues in using the forecasts generated by the spreadsheet model. We also want to have visibility of the internal calculations in your forecast modelling as well as the code so that they can be verified. Finally, we would like guidance on how operations staff should use the spreadsheet tool for our full product range and advice on how our IT staff should maintain the spreadsheet model

In summary our required deliverables are:

1. A spreadsheet model that meets our requirements as explained in our specification.
2. A written report (maximum 2 pages) that includes (a) guidance for using and maintaining the spreadsheet model and its generalisability to forecast other products (not just X1) (b) assumptions and rationale for your modelling choice and

(c) analysis/interpretation of product X1 data in a form that is understandable to our manager