

# A Practical Assignment: SME Borrowing History

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November 1, 2023

## 1 Overview

### 1.1 Objectives

This task provides you with a chance to demonstrate your data analysis, coding, and problem-solving skills, as well as your knowledge of Machine Learning/ Deep Learning. You will be tasked with analyzing a dataset that captures the borrowing history of a small business (SME). Your solution will allow the recruitment committee to gain insight into your problem-solving approach, the organization of your thoughts, and the quality and structure of your delivered solution.

### 1.2 Dataset

A company  $X$  has been dealing with multiple lenders since 2012 and has borrowed, rescheduled, and borrowed again to cover its expenses. Table 1 below shows the first 20 rows and selected columns of the attached data file.

Table 1: First 10 rows of the dataset

Month	Year	LenderA	LenderB	LenderC	LenderD	LenderE	LenderF	LenderG	LenderH	LenderI	LenderJ	LenderK
Oct	2013	74349.00	70109.93	11477.84	4884.00	0.00	61763.24	0.00	0.00	2442.00	0.00	2981.00
Nov	2013	73535.00	66083.05	9607.84	5170.00	0.00	61763.24	2563.00	0.00	2422.09	0.00	6844.09
Dec	2013	71027.00	93500.00	14300.00	4950.00	0.00	59400.00	12232.00	0.00	2640.00	0.00	7150.00
Jan	2014	0.00	15741.00	14300.00	3300.00	262944.00	0.00	3168.00	0.00	0.00	0.00	0.00
Mar	2014	0.00	14850.00	13200.00	3476.00	254177.00	0.00	4400.00	0.00	0.00	0.00	0.00
Apr	2014	0.00	38742.00	11000.00	0.00	249788.00	0.00	4807.00	0.00	0.00	0.00	0.00
May	2014	0.00	35783.00	10450.00	0.00	245410.00	0.00	1980.00	0.00	0.00	0.00	0.00
Jun	2014	0.00	55000.00	0.00	4400.00	241032.00	0.00	550.00	0.00	0.00	0.00	6600.00
Jul	2014	0.00	44000.00	880.00	0.00	236643.00	0.00	5500.00	0.00	550.00	0.00	0.00
Aug	2014	0.00	42207.00	3300.00	4499.00	232265.00	0.00	10450.00	0.00	0.00	0.00	19800.00
Sep	2014	0.00	32835.00	6237.00	0.00	227876.00	0.00	1947.00	0.00	0.00	0.00	15400.00
Oct	2014	0.00	22000.00	0.00	0.00	223498.00	0.00	1980.00	0.00	2200.00	0.00	22000.00
Nov	2014	0.00	18700.00	0.00	0.00	219120.00	0.00	15301.00	0.00	1243.00	0.00	42900.00
Dec	2014	0.00	37400.00	0.00	0.00	214731.00	0.00	11000.00	0.00	0.00	0.00	24200.00
Jan	2015	0.00	88814.00	0.00	0.00	210353.00	0.00	4499.00	0.00	0.00	0.00	11000.00
Feb	2015	0.00	86328.00	1100.00	0.00	205975.00	0.00	1980.00	0.00	0.00	0.00	0.00
Mar	2015	0.00	83281.00	0.00	0.00	201597.00	0.00	1595.88	0.00	0.00	0.00	0.00
Apr	2015	0.00	79486.00	0.00	0.00	197219.00	0.00	8800.00	0.00	2255.00	0.00	8800.00
May	2015	0.00	121869.00	0.00	0.00	192830.00	0.00	11671.00	0.00	2068.00	0.00	5258.00
Aug	2015	0.00	127396.06	14300.00	0.00	179685.00	0.00	55000.00	0.00	13200.00	0.00	0.00

The final few rows of the dataset are presented in Table 2. As can be seen in the attached data file, the company records how much they owe each lender on a regular basis. Additionally, it should be observed that during certain months, the SME may not owe anything to certain lenders, whereas in other months this may change as they borrow or reschedule loans.

Table 2: Last 10 rows of the dataset

Month	Year	LenderA	LenderB	LenderC	LenderD	LenderE	LenderF	LenderG	LenderH	LenderI	LenderJ	LenderK
May	2022	31955.00	99176.00	0.00	0.00	267751.00	51172.00	3971.00	60973.00	19140.00	0.00	10923.00
Jun	2022	31460.00	99176.00	0.00	0.00	264077.00	45430.00	46079.00	121033.00	5500.00	0.00	0.00
Aug	2022	30646.00	127325.00	0.00	0.00	256740.00	41657.00	70059.00	116556.00	0.00	28600.00	0.00
Sep	2022	29425.00	123467.85	0.00	0.00	253077.00	34111.00	66737.00	114026.00	418.00	26400.00	0.00
Oct	2022	28655.00	119617.85	0.00	0.00	249414.00	30338.00	66737.00	111397.00	550.00	24200.00	0.00
Nov	2022	28369.00	115775.00	0.00	0.00	245740.00	22638.00	62084.00	104335.00	14025.00	19800.00	0.00
Feb	2023	26774.00	108064.00	0.00	0.00	234740.00	15125.00	57772.00	98703.00	8800.00	15400.00	0.00
Mar	2023	26202.00	104225.00	0.00	0.00	231077.00	11352.00	56826.00	95810.00	5500.00	13200.00	0.00
Apr	2023	25432.00	100375.00	0.00	0.00	227403.00	7579.00	54618.08	92689.96	0.00	11000.00	0.00
May	2023	24893.00	95975.00	0.00	0.00	223729.00	3773.00	51876.00	89023.00	0.00	8800.00	0.00

## 2 Required Tasks

You are expected to undertake a range of tasks that include data exploration, data visualisation, and predictive modeling. Further information regarding these tasks is provided in the subsequent section.

### 2.1 Data Exploration

Please create a notebook and write the required code to load and explore the dataset file 'smedeb-itsu.xlsx'. As part of the exploration, **please check for any duplicates, missing values** (note that '0' is not a missing value), **or incorrect data,** as the SME team uses manual methods to enter data into the Excel sheet. Please ensure that your code follows a clear and concise style and is thoroughly explained. Consider using markdown language to describe your work and the steps taken during the exploration process.

Furthermore, you are expected to create data visualisations that provide further insights into the dataset. You are free to choose your preferred method of visualizing the data, although two specific visualisations are required. First you will need to reproduce Figure 1 that shows the development of average debts over the years.

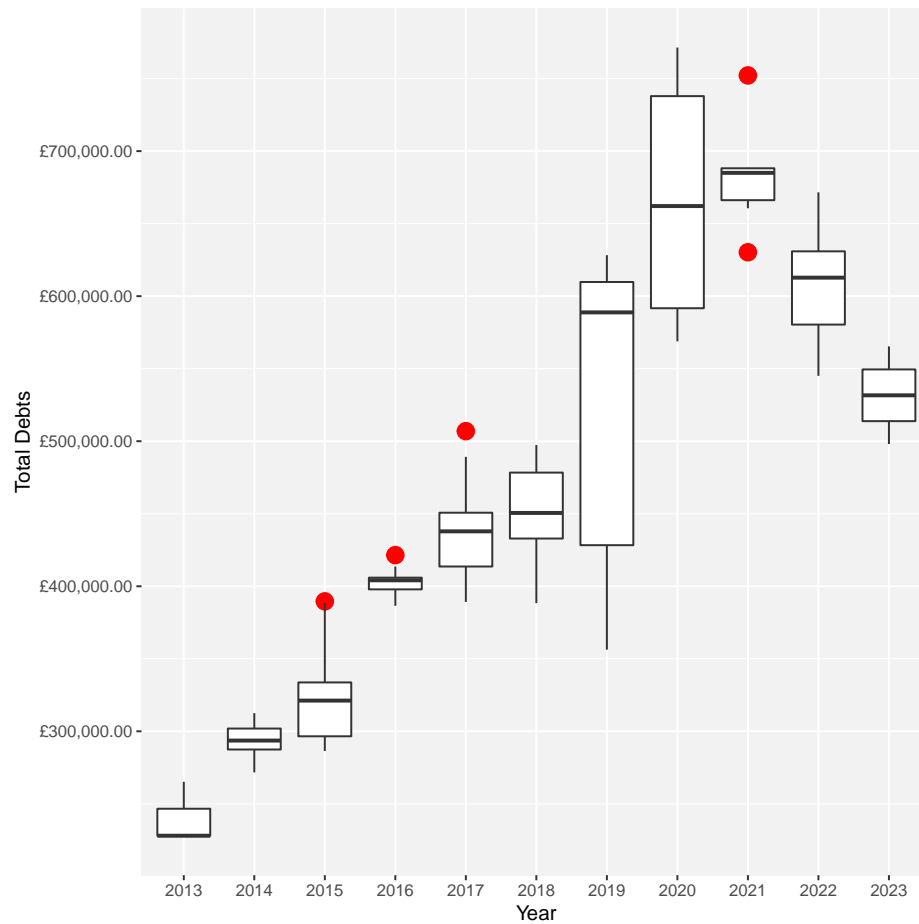


Figure 1: Average debts over years

Then you need to show the actual total debts (from all lenders) on every month of the year over the past 10 years. In other words you should write a code that reproduce Figure 2.

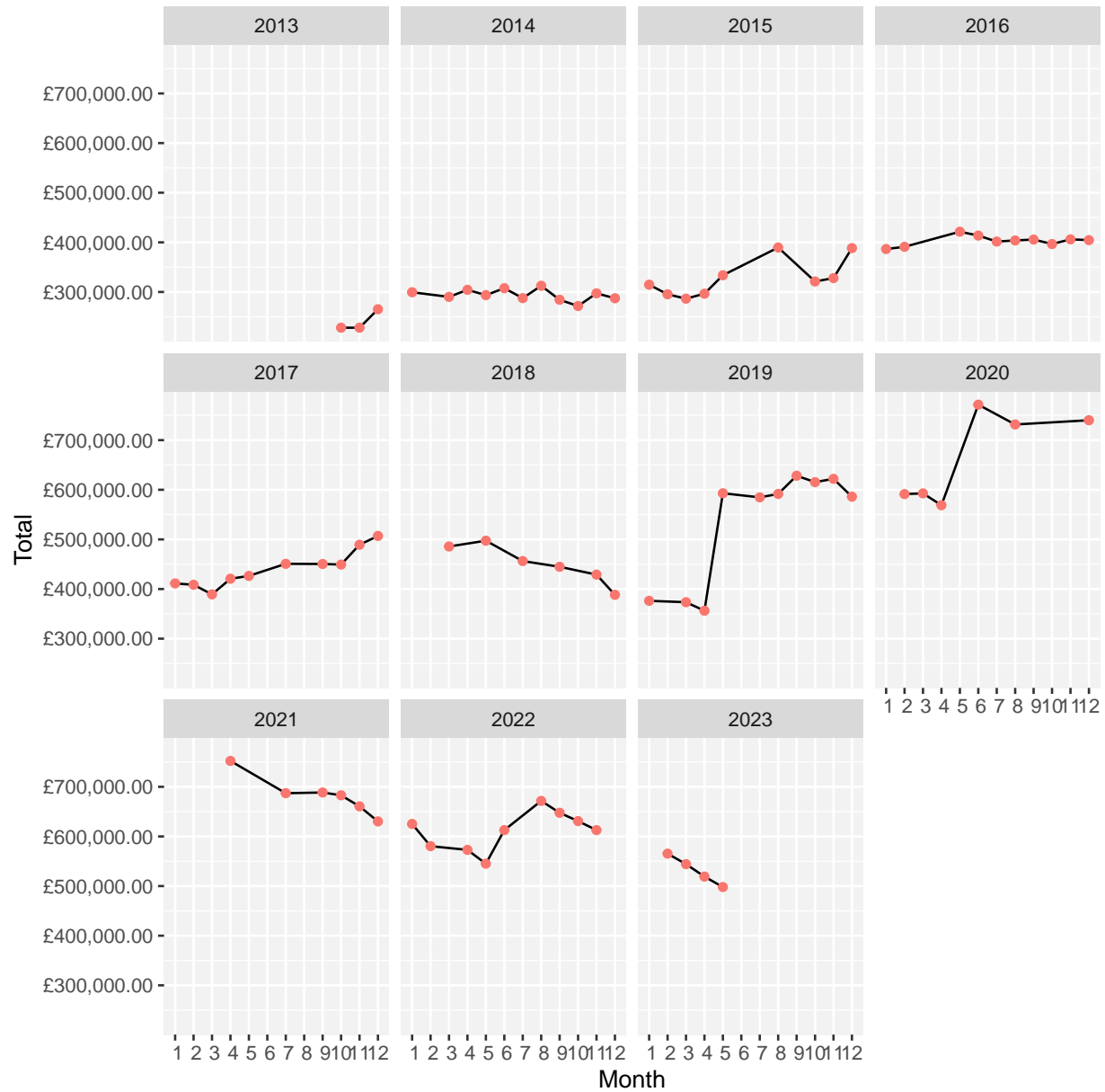


Figure 2: The total debts from all lenders over months and years

## 2.2 Predictive Model

This task involves **creating a time series model** to forecast the total debts from all lenders over time. We understand that this may be a challenging given the limited size of the dataset; however, the primary objective is to demonstrate how you would approach the problem. To simplify matters, you may focus solely on the month of the year and the total debts, which can be computed for each row by adding the debts from all lenders in that row, as illustrated in Figure 3.

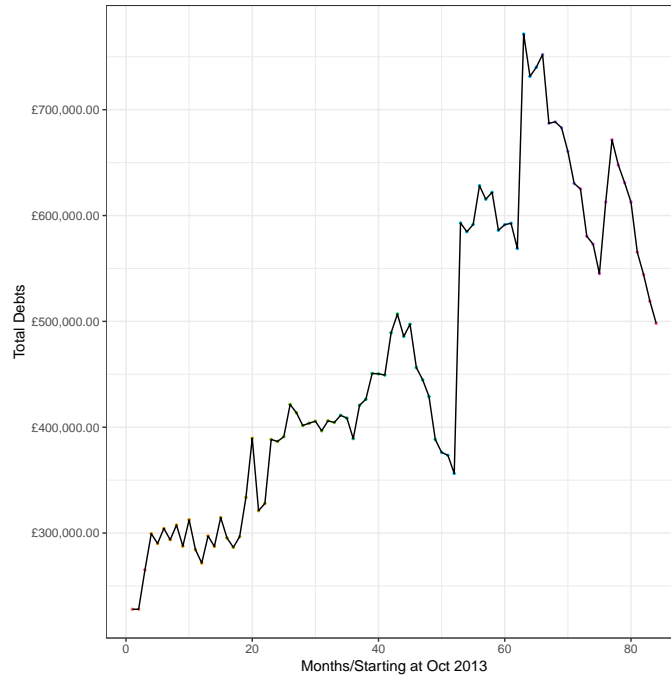


Figure 3: Total monthly debts from all lenders starting from October 2013

### 3 Final Thoughts

This task is your chance to show your problem solving skills, present your approach in a structured and easy-to-follow/reproduce format. You are not restricted to the tasks above, so feel free to extend your work to provide more insights/ suggestions, etc... That can help the SME plan/ manage their debts.