XN Project: Mid-Term Presentation

Esha Mulki
Mohammad Movahedi
Ajoy Kumar
Taiye Murtala

College of Professional Studies,
Northeastern University

ALY6080: Integrated Experiential Learning

Instructor: Dr. Matthew Goodwin

Introduction

- Sponsor Danfoss is a multinational corporation with headquarters in Denmark.
- Danfoss produces extensive range of products in various domains to name a few like automotive, buildings, energy and natural resources, food and beverage, marine and offshore etc.
- It provides solutions in various segments like power solutions, climate solutions for heating and cooling and drives.

Executive Summary

- The objective of this project is to improve sales forecasting for Danfoss client.
- Research about the sponsor business industry was performed after receiving the business problem.
- Meeting with the sponsor was conducted and information about dependent and independent variables was gathered.
- The initial analysis like data cleaning, reformatting, and exploratory analysis was carried out using R.
- RMSE and MAPE scores of the model would be calculated and the model with the least RMSE and MAPE values would be chosen for forecasting.

Business Problem

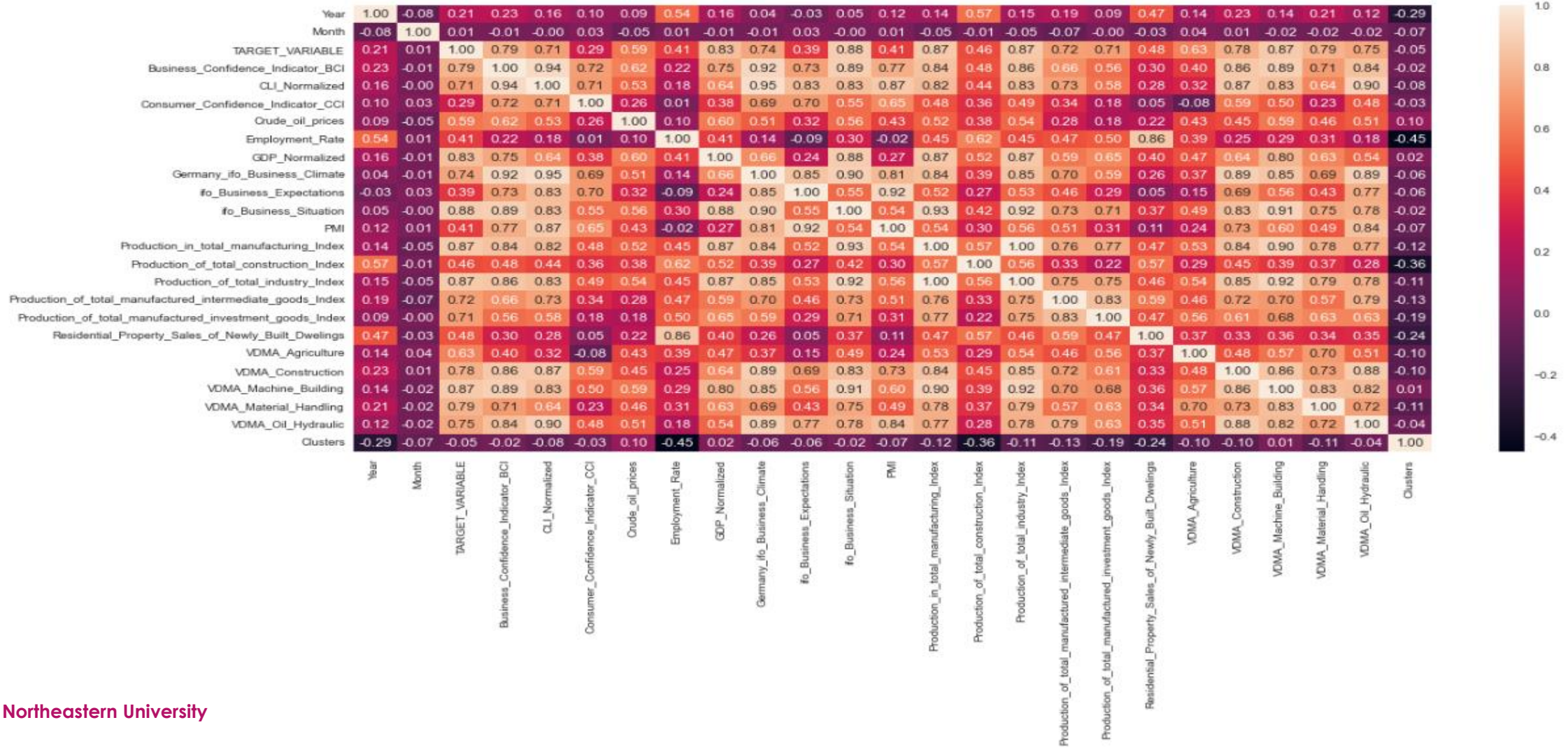
- During the COVID period the company was not able to accurately predict the sales forecast due the uncertainties caused by the pandemic.
- The company's business will be better able to manage its inventory and prevent both overstock and stock-out issues the more accurate the sales forecast is.
- Accurate sales forecasting provides managers with the data they need to forecast revenue and profit.
- The goal of the project is to build an accurate sales forecasting model for Danfoss

Analytics and Visuals

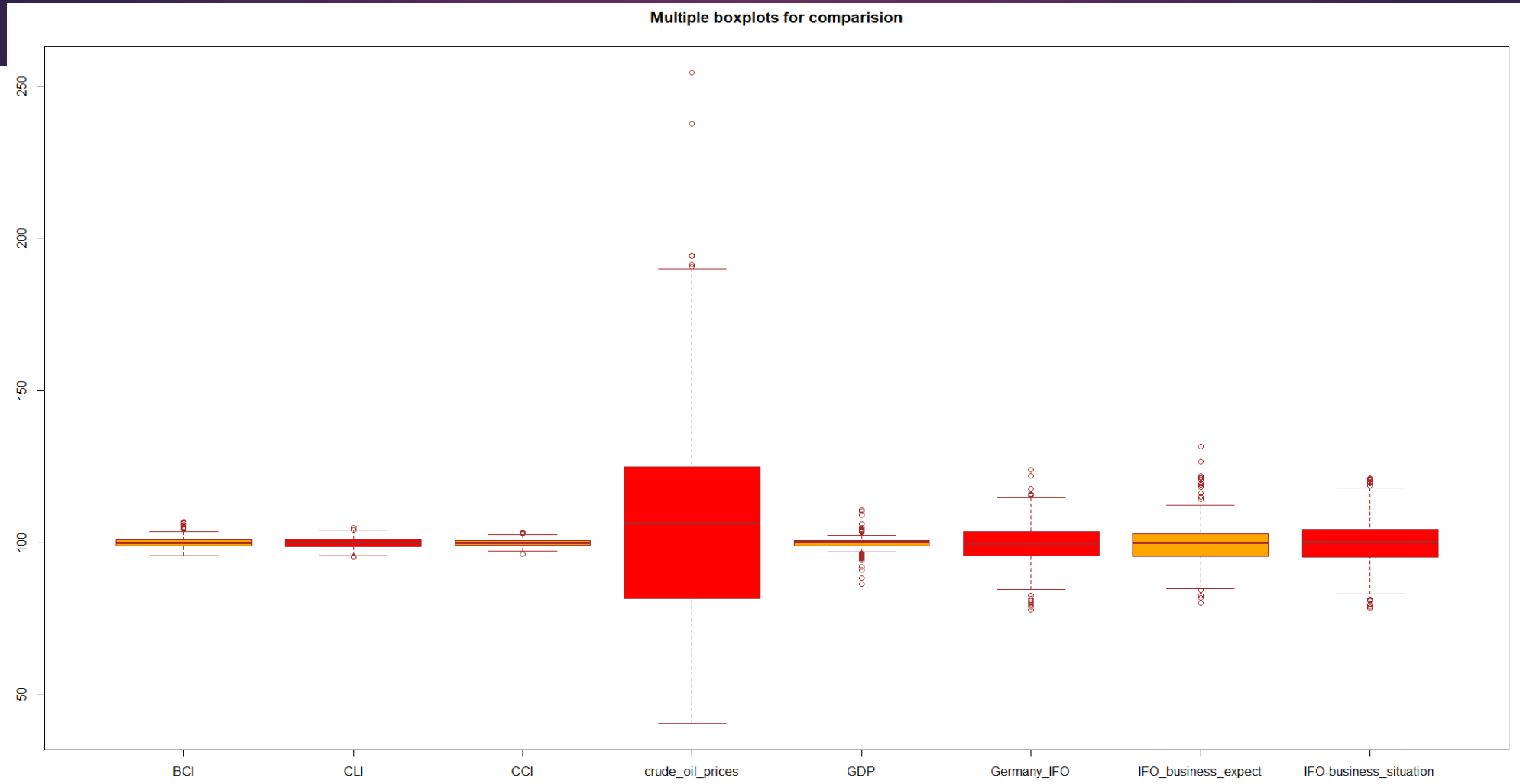
Data Summary

	count	mean	std	min	25%	50%	75%	max
Year	173.0	2014.878613	4.186392	2008.000000	2011.000000	2015.000000	2018.000000	2022.000000
Month	173.0	6.456647	3.429459	1.000000	4.000000	6.000000	9.000000	12.000000
TARGET_VARIABLE	173.0	51.725141	11.779169	20.127824	45.223723	51.405531	57.453146	81.893651
Business_Confidence_Indicator_BCI	173.0	100.165468	2.055684	95.690428	98.867598	100.024729	101.027189	106.939196
CLI_Normalized	173.0	99.911169	1.853292	95.194252	98.779094	99.920269	100.937885	105.027933
Consumer_Confidence_Indicator_CCI	173.0	99.955067	1.466436	93.944354	99.273158	99.928411	100.774643	103.489160
Crude_oil_prices	172.0	108.435237	41.132747	40.647561	82.027291	106.501051	125.504250	254.561356
Employment_Rate	134.0	100.267461	1.088957	97.362329	99.468618	100.404376	101.285165	101.608496
GDP_Normalized	173.0	99.799266	3.153513	86.281709	99.126682	100.190961	100.676776	110.900657
Germany_ifo_Business_Climate	173.0	99.665680	8.265685	78.049565	95.629424	99.665775	103.551278	123.970037
ifo_Business_Expectations	173.0	99.808939	8.376450	80.251660	95.460526	99.928469	102.888209	131.707317
ifo_Business_Situation	173.0	100.403699	9.183025	78.590164	95.393410	100.299501	104.358029	121.230644
PMI	173.0	101.850675	17.830181	63.466334	89.626289	99.555273	109.754522	161.612284
Production_in_total_manufacturing_Index	171.0	100.135106	7.105157	77.753304	97.807387	101.195922	103.230958	125.050587
Production_of_total_construction_Index	171.0	99.110029	4.844012	81.492718	95.921830	99.268112	102.015713	123.641102
Production_of_total_industry_Index	171.0	99.998665	6.651863	80.244924	97.915707	100.968188	102.973053	124.529812
Production_of_total_manufactured_intermediate_goods_Index	139.0	99.514440	7.532978	73.384132	98.053737	100.863572	103.007853	113.718002
Production_of_total_manufactured_investment_goods_Index	138.0	100.782788	8.088812	75.120385	98.570519	102.100331	105.431430	114.601585
Residential_Property_Sales_of_Newly_Built_Dwelings	134.0	100.995202	2.515453	96.432692	98.705175	101.116503	103.456908	105.760494
VDMA_Agriculture	171.0	104.581690	22.335711	52.173913	91.913967	99.567100	119.743590	167.452077
VDMA_Construction	171.0	105.038129	33.182226	38.325282	89.015152	102.601156	116.931156	236.158192
VDMA_Machine_Building	171.0	102.127317	20.095164	49.435347	93.725156	100.911002	107.602311	156.682028
VDMA_Material_Handling	171.0	102.876076	19.591777	48.908297	93.814882	102.091633	113.114878	175.103734
VDMA_Oil_Hydraulic	171.0	107.216767	41.531314	25.925129	85.104796	98.219788	123.806617	266.117065

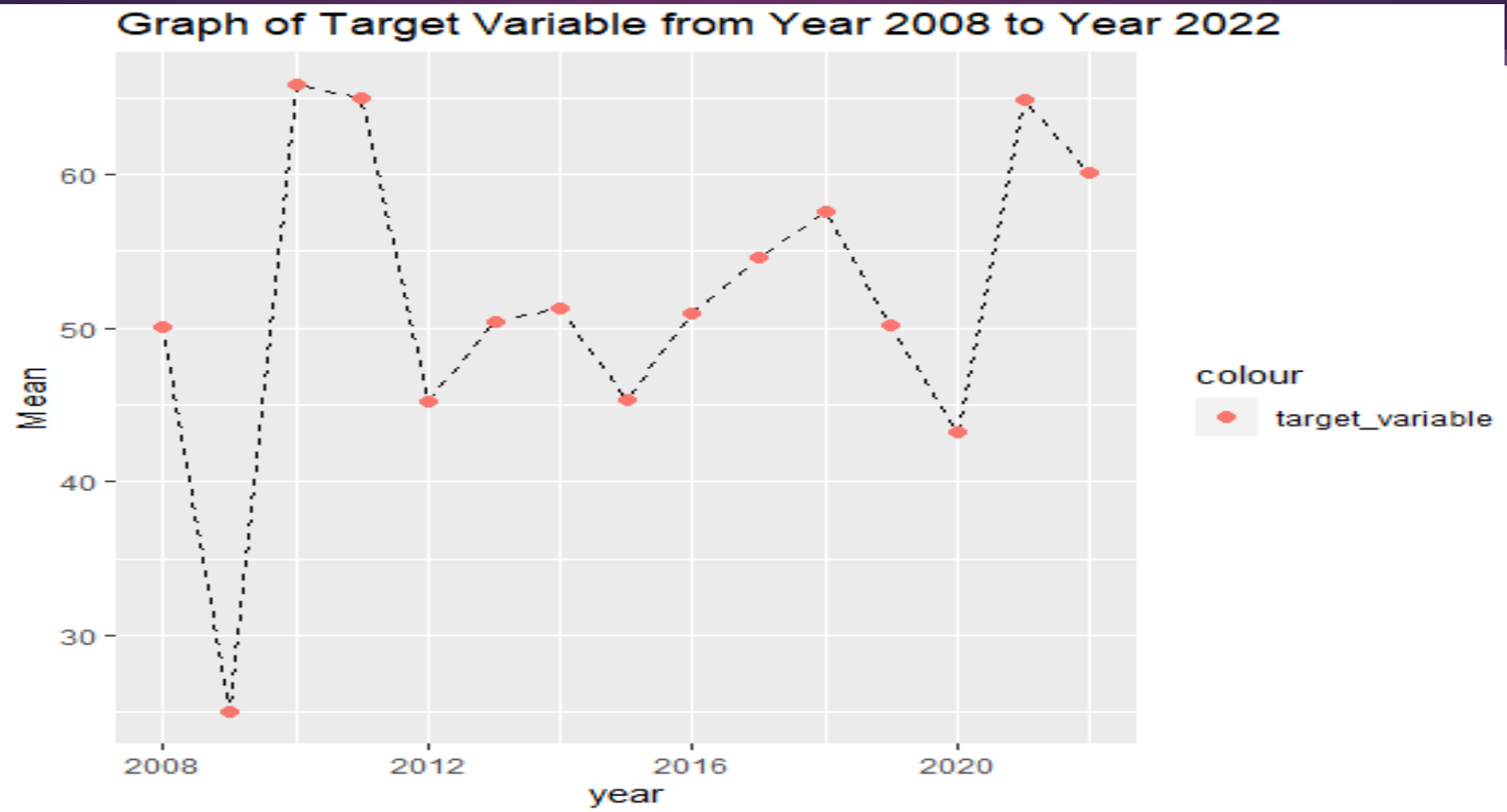
Correlation Plots



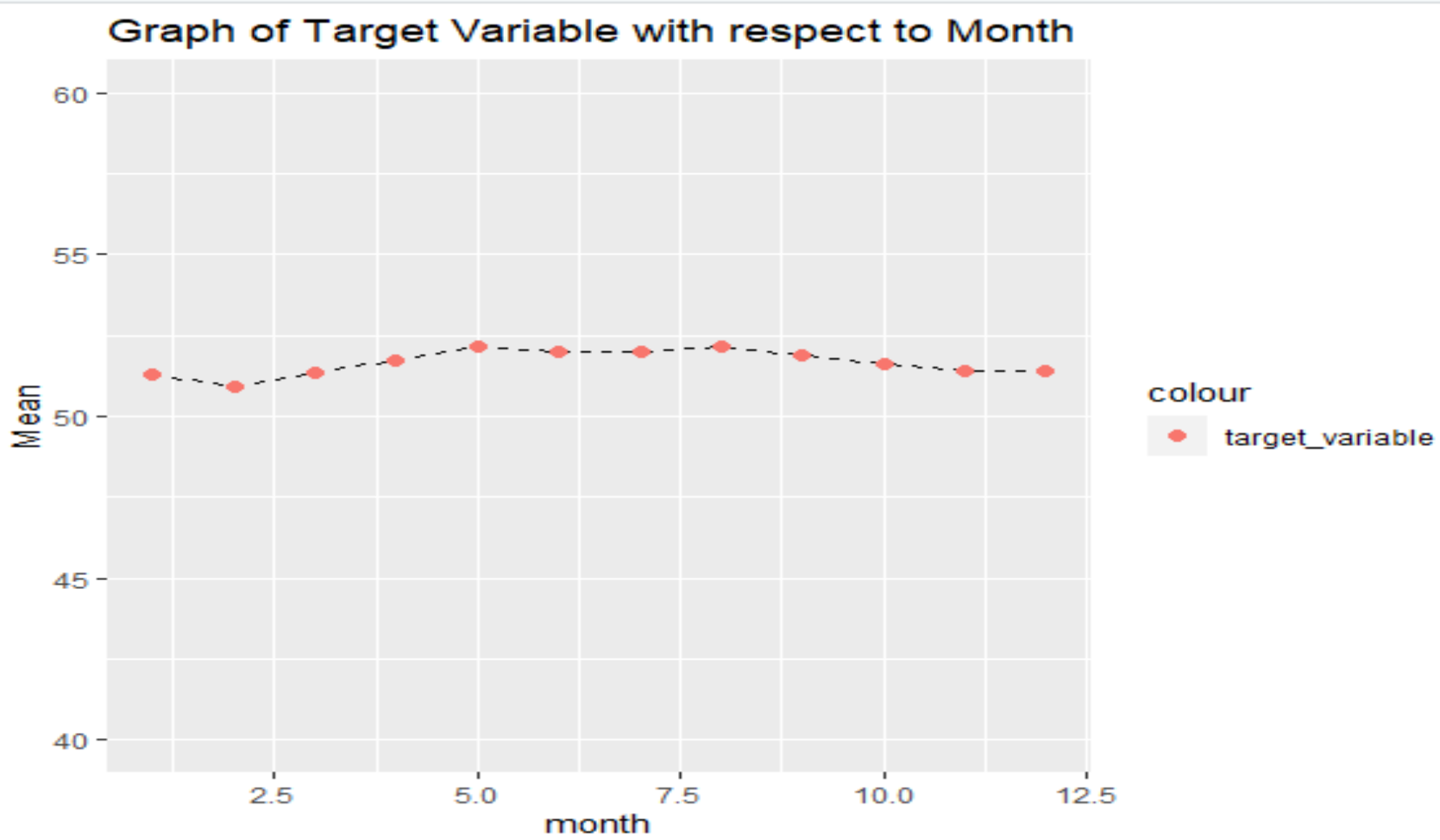
Boxplots to check the outliers



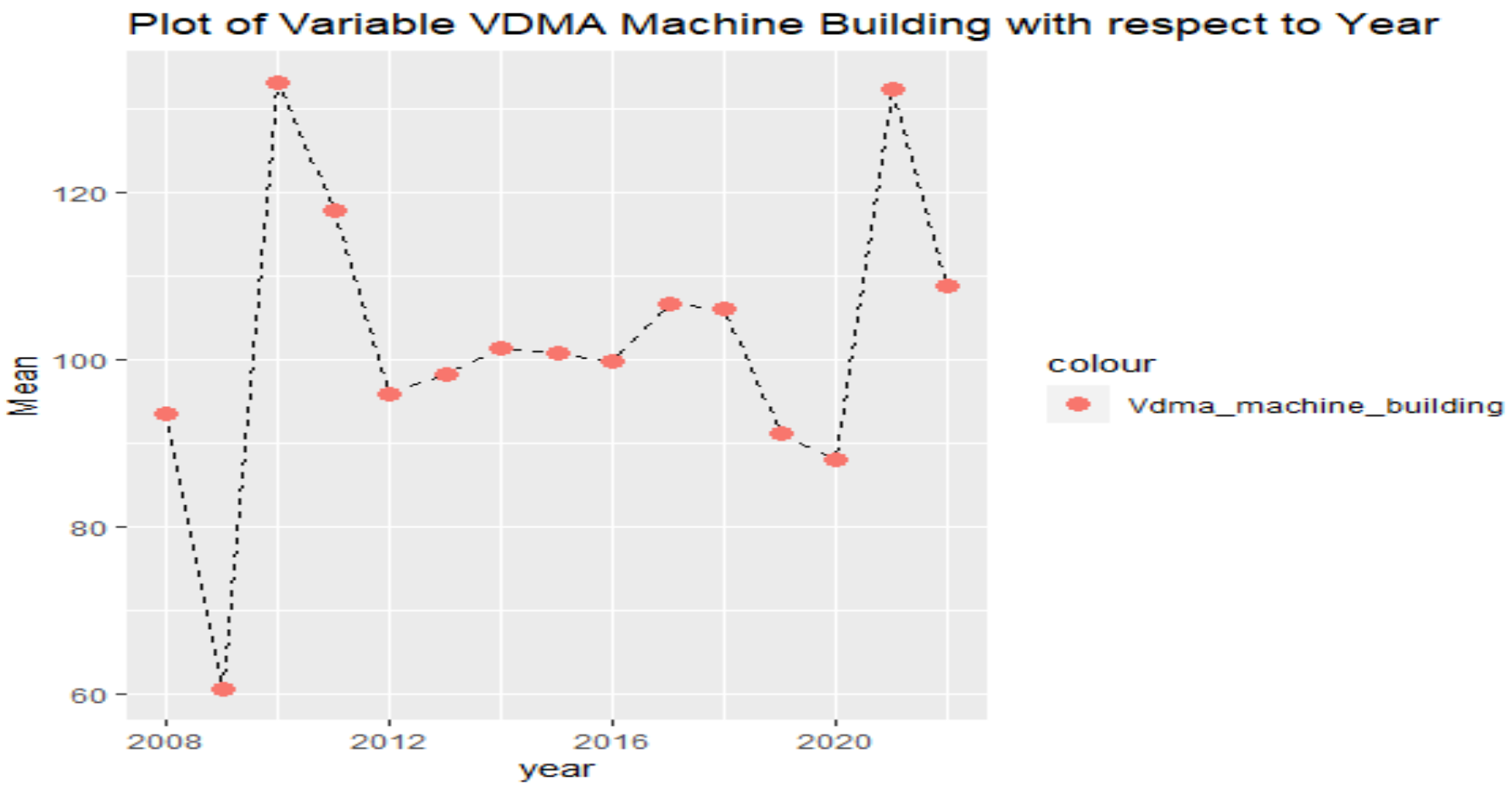
Graph of Target variable with respect to the year



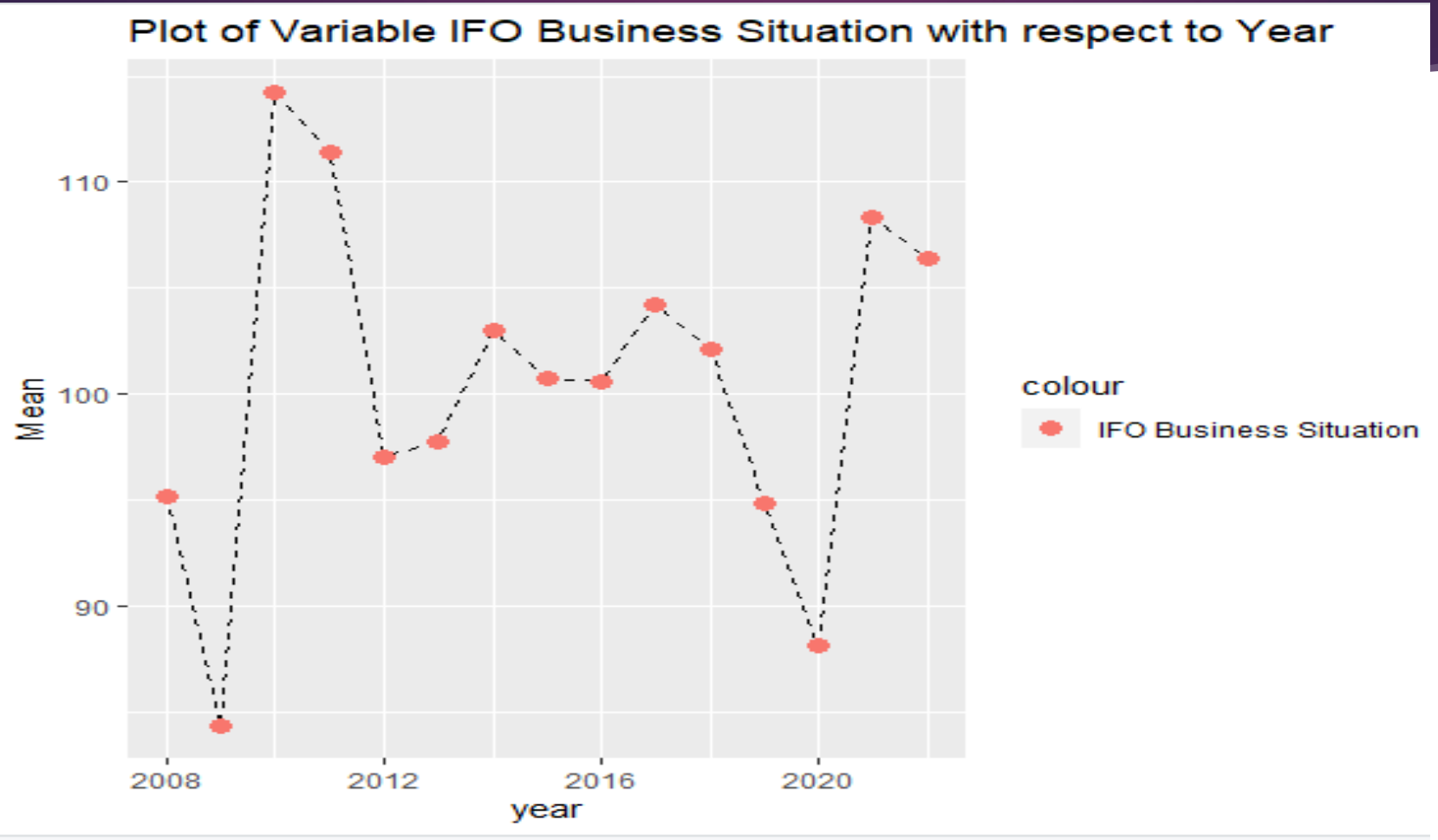
Graph of Target variable with respect to the month



Graph of VDMA Machine Building with respect to the year



Graph of IFO Business Situation with respect to the years



Flow of the Project

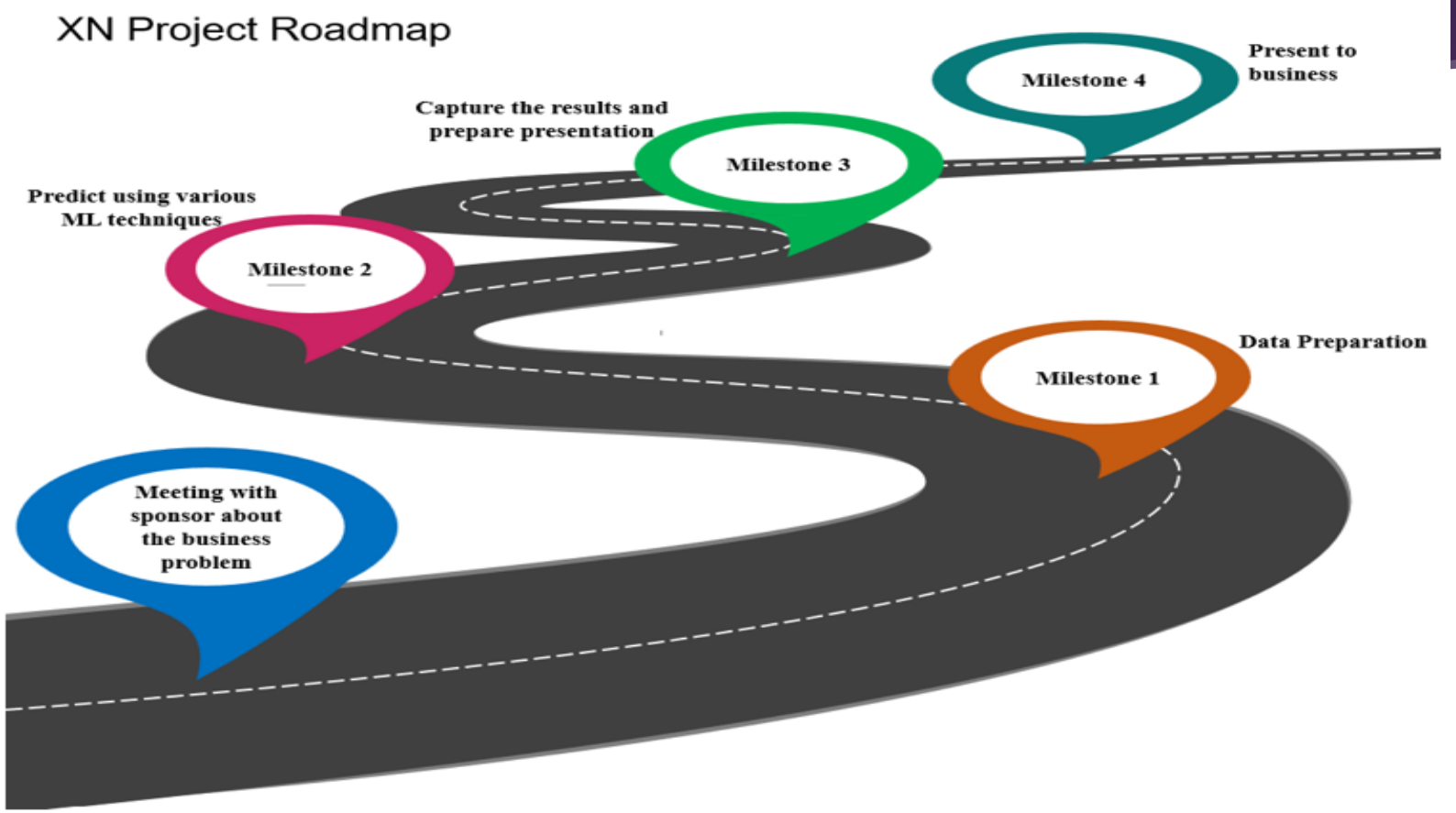


Fig 1: Milestones for the project

Analysis and Findings

- Some variables like IFO_business_situation, VDMA_Machine_Building, Production_in_total_manufacturing_index and VDMA_Material_Building are highly correlated with the target variable.
- Also, some of the variables are highly colinear with each other leading to multicollinearity.
- It was observed from the value of crude oil prices with respect to the years that there has been high fluctuation in the value of crude oil prices over the years.
- It was observed that the mean IFO business situation value is fluctuating between the year 2008 till 2012 however after 2012 the values is more less constant till 2018 post which the values are again fluctuating.

Analysis and Findings(contd)

- It was observed that the mean target variable values is fluctuating between the year 2008 till 2012 however after 2012 the values is more less constant till 2018 post which the values are again fluctuating.
- It was observed that the target variable with respect to the months does not show much variance. The value is more or less constant in different months of a particular year.

- Overall, it can be seen that in the years 2008 and 2009 when there was global recession and the year 2020 and 2022 when there was pandemic. there was major impact on the sales of Danfoss.

Future Research

- Some of the external variables might be considered for the analysis like for instance the consideration of the "pandemic year" variable. This might have some better performance with the sales prediction.
- There could be quarterly analysis of sales from the year 2020 to 2022.
- Also there could be grouping of four years for the analysis to understand the change from the four year period.

References

- Kelwig,D.(2022, June 24).*The definitive guide to sales forecasting methodologies.* Zendesk. Retrieved from https://www.zendesk.com/blog/5-essential-sales-forecasting-techniques/
- GeeksforGeeks. (2021). *Design a Learning System in Machine Learning*. GeeksforGeeks. Retrieved from https://www.geeksforgeeks.org/design-a-learning-system-in-machine-learning/
- Logallo, N. (2019, December). *Data Science Methodology 101*. Towards Data Science. https://towardsdatascience.com/data-science-methodology-101-ce9f0d660336

Thank You