Climate Footprint of Danish Consumption

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Abstract

This research project aims to explore the relationship between variables Financial, Dwellings, and Entertainment and their impact on consumption values of the climate footprint using a linear regression model. The analysis is conducted on the Danish Consumption dataset, which encompasses a diverse range of data related to consumer behavior and environmental factors. The research question driving this project include understanding the extent to which Financial, Dwellings, and Entertainment variables influence consumption, and how accurately a linear regression model can predict consumption values based on these variables. The project also investigates any potential interactions or correlations between the variables and their combined impact on consumption behavior. To address these questions, the study employs a linear regression model in R. The Danish Consumption dataset is preprocessed and cleaned to ensure accurate and reliable results. The variables Financial, Dwellings, and Entertainment are selected as independent variables, and consumption values are treated as the dependent variable. The model is trained on the dataset, allowing for the estimation of coefficients and predictions of consumption values based on the selected variables.The findings of the analysis indicate that the linear regression model effectively predicts consumption values using the Financial, Dwellings, and Entertainment variables. The variable Financial shows a positive and significant effect on consumption, suggesting that individuals with higher financial resources tend to spend more. In contrast, the variable Dwellings displays a negative effect, indicating that owning more properties is associated with reduced consumption levels. The variable Entertainment demonstrates a positive impact on consumption, implying that increased access to entertainment options correlates with higher spending patterns. Policymakers, marketers, and economists who seek to raise awareness of the climate footprint should take these findings seriously. This information may be used by policymakers to create plans that support economic expansion and stimulate consumer spending. Based on their purchasing power and entertainment choices, marketers can target particular customer categories with their marketing initiatives. These factors may be incorporated into models by economists to examine consumption trends and project future patterns. The link between financial, housing, and entertainment characteristics and consumption habits is a key finding of this study effort. The outcomes of the linear regression analysis demonstrate how important these factors are for comprehending and forecasting customer behavior. By including more factors and examining how they interact, future research might build on this work to better understand consumption patterns and guide decision-making across multiple industries.

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1 Introduction

Global climate transformation is an urgent global challenge that needs a complete understanding of the diverse factors contributing to it. These include the consumption customs of different countries and economies. Denmark is no anomaly among developed countries with a high average of living. The climate footprint is the total share of greenhouse gases ejected throughout the life cycle of a product or service, including production, transport, and use. The climate footprint of Danish consumption is an important area of research. Danish consumption patterns are discussed over time, in several countries and economies, in several types of use, and in several industries. Concentrating on the roots of emissions and the causes for emissions in various sectors, this article examines how time, economies, types of use, and industries affect the environmental footprint of Danish consumption. An examination of the climate footprint of Danish consumption can shed light on the relationship between consumption, production, and greenhouse gas emissions. It can also supply insights into the environmental impact of consumption options in Denmark and beyond. In the end, we formulate the research question: "How do types of uses and industries affect the climate footprint of Danish consumption in terms of greenhouse gas emissions? Then, I focused more specifically on articles related to my research question for the project.

1.1 Literature Review

Climate footprint calculations are carried out for different activities such as transportation, energy consumption, water use, production and consumption of products. As a result of climate footprint calculations, people can take steps to reduce their carbon footprints and contribute to the fight against climate change. Studies on climate change and climate footprint and increased awareness make people more sensitive to environmental issues. Individuals and organizations need to take action to solve this problem. For a sustainable future, it is important to reduce greenhouse gas emissions, switch to renewable energy sources and protect natural resources.

Batini et al. (2020) propose a comprehensive package of pricing and sectoral-based mitigation instruments for Denmark and discuss fiscal measures for mitigating agricultural emissions and recommends the use of revenue-neutral feebate schemes to strengthen mitigation incentives, particularly for transportation and agriculture, fisheries and forestry, though these schemes could also be applied more widely. Wackernagel et al. (1999) The Ecological Footprint is one of those indicators that try to capture a broad picture of humanity's demand on natural resources, following the principle of consumer responsibility. Jack & Ivanova (2021) makes an original contribution using storytelling, a step in the direction of increasing empathy and compassion for the various carbon footprint cohorts and working toward socially and environmentally sustainable futures. Antal et al. (2021) different measures, definitions and databases are used. The environmental indicators range from production-based energy and emission accounts to consumption-based carbon-, material- and ecological footprints. Dubois et al. (2019) highlights the need for climate policies that target household consumption and behavioral decisions as key components of low-carbon futures. Salo et al. (2019) authors

found that while carbon footprint calculators can be effective tools for promoting sustainable household consumption practices, there are limitations to their use, such as incomplete data and language barriers. Overall, the research highlights the potential benefits and limitations of carbon footprint calculators in promoting sustainable household consumption practices.

2 Dataset

We will analyze the climate footprint of Danish Consumption by industries and type of use by general consumption. The Data set used in the research was taken from Statistics Denmark website. Statistics Denmark is a Danish governmental organization under the Ministry of the Interior and Housing and which reports to the Minister of Economic and Internal Affairs. The organization is responsible for creating statistics on the Danish society, for example employment statistics, trade balance, and demographics. Data set that has 144 observations with 14 variables including categorical industries (Origin of emissions) Agriculture , Mining , Manufacturing , Utility services , Construction , Trade , Information , Financial , Real estate , Dwellings , Other business services, Public administration, Entertainment and Consumption.

2.1 Data Summary Statistics

(Table 1) summarizes the key statistics derived from our dataset, which includes information on the various consumption categories based on tonnes of CO2 emitted. The mean Agriculture value is 1,110,368.24, with a significant standard deviation of 2,190,280.92. Dwellings show a mean of 11,524.81 and a standard deviation of 28,155.06. Entertainment has a mean of 29,606.35 and a standard deviation of 52,132.34. Financial has a mean of 13,879.33 and a standard deviation of 25,301.07. Consumption has a mean of 6,415,264.99 and a high standard deviation of 11,440,660.73.The range varies for each category, with Agriculture having the widest range (-345,549.00 to 9,416,203.00) and Dwellings having the narrowest (0.00 to 96,670.00). These statistics provide insights into the average values and variability within each consumption category, facilitating a better understanding of the data.

Table 1: Summary Statistics

	Mean	Std.Dev	Min	Median	Max
Agriculture	1110368.24	2190280.92	-345549.00	157802.50	9416203.00
Consumption	6415264.99	11440660.73	102345.00	2043940.50	62459078.00
Dwellings	11524.81	28155.06	0.00	358.00	96670.00
Entertainment	29606.35	52132.34	48.00	7536.50	288140.00
Financial	13879.33	25301.07	85.00	3132.00	130399.00

3 Methods and Data Analysis

3.1 Predictor Variable Analysis: Identifying Key Factors Affecting Consumption

Understanding the factors that influence consumption patterns is essential for decision-making and policy formulation. In this analysis, we examine three predictor variables - Financial, Dwellings, and Entertainment - to identify their impact on Consumption. The analysis utilizes a multiple linear regression model to uncover the relationships between these variables.

(Figure 1) presents the results of the multiple linear regression model. The bar plot illustrates the regression coefficients of the predictor variables.The coefficient values show the strength and direction of each predictor variable's association to consumption. A positive coefficient means that rising levels of the predictor variable are linked to rising levels of consumption, whereas a negative coefficient suggests the opposite. Based on the coefficients, Financial appears to be the most influential predictor variable, with the highest absolute coefficient value. It suggests that changes in Financial have a significant impact on Consumption. Entertainment also exhibit notable coefficients, indicating their relevance in understanding consumption patterns. Interestingly, the Dwellings showed a negative coefficient , meaning that an increase in the Dwelling is associated with a decrease in Consumption. (Figure 1)

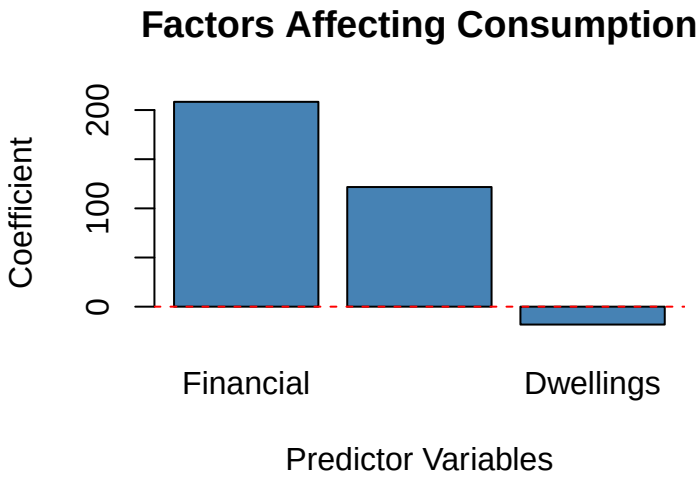

Figure 1: Predictor Variables

We created a scatter plot (Figure 2) further explore the relationship between Consumption and Financial. The plot visualizes the data points and the fitted line generated by the regression model. It helps us understand the nature of the relationship between Consumption and Financial. As pictured in the plot,If the data points tend to cluster around the line, it indicates a strong correlation between the variables (Consumption and Financial) , so further supporting the finding from the regression analysis.

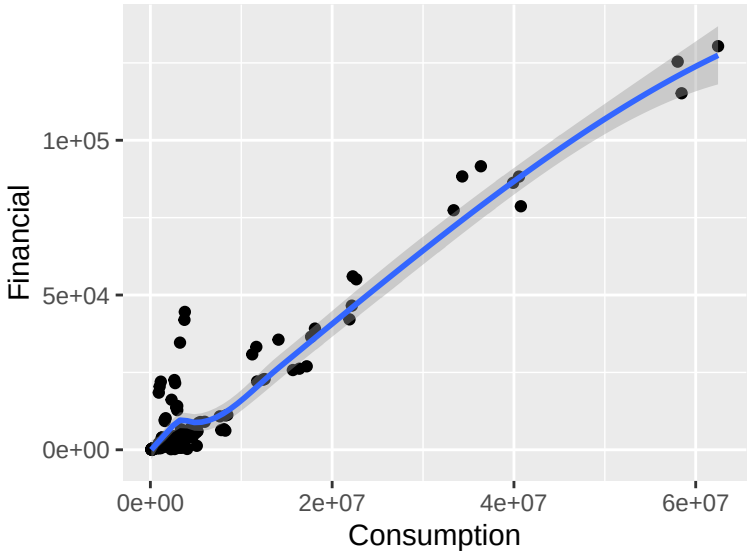

Figure 2: Scatter Plot: Financial VS. Consumption

3.2 Prediction

We employed a linear regression model to predict consumption patterns based on the "Danish_Consumption.csv" Data set. The regression equation can be expressed as follows:

$$Consumption = \beta_0 + \beta_1 Financial + \beta_2 Dwellings + \beta_3 Entertainment + \varepsilon$$

In the this equation, Consumption represents the predicted consumption levels. The constant term β_0 and the estimated coefficients $\beta_1, \beta_2, \beta_3$ are associated with the independent variables Financial, Dwellings, and Entertainment, respectively. These coefficients provide insights into the magnitude and direction of the impact that each variable has on the predicted consumption patterns. Additionally, the error term ε accounts for any unexplained variability in the model. By analyzing these coefficients, we can understand how changes in Financial, Dwellings, and Entertainment affect the predicted consumption levels.

By fitting the linear regression model in R using the Danish Consumption Data set, we were able to estimate the values of the coefficients and utilize them to make predictions on new observations.

3.3 Results

We present a line plot (Figure 3) comparing predicted consumption values and actual consumption values using the "Danish_Consumption.csv" Data set. This plot provides valuable insights into the performance of the linear regression model in predicting consumption values accurately based on the variables Financial, Dwellings, and Entertainment from the "Danish_Consumption.csv" Data set. With each sample acting as a separate identifier, this

graphic shows the connection between the samples and their related consumption levels. The dark red line indicates consumption numbers predicted by a linear regression model, while the blue line reflects actual consumption values. We may evaluate the accuracy of the model's consumption estimation by visually observing how close the blue line is to the dark red line. This visualization helps us understand the nature of the impact that Financial has on the climate footprint of Danish consumption. (Figure 3)

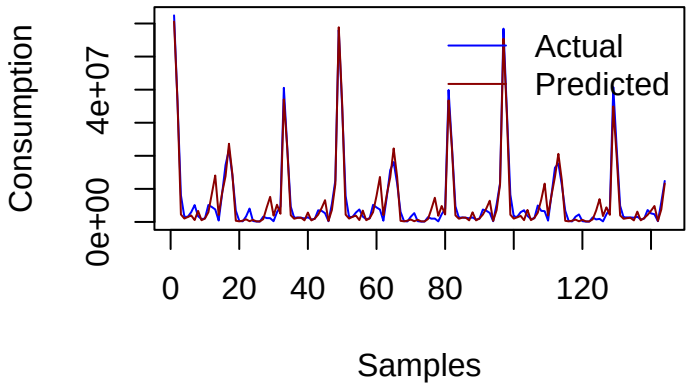

Figure 3: Predicted Consumption VS. Actual Consumption

4 Conclusion

In conclusion, this academic paper explored to assess the accuracy of a linear regression model in predicting consumption values based on the variables Financial, Dwellings, and Entertainment using the "Danish_Consumption.csv" Data set.

The results revealed that the variable Financial had a significant positive effect on consumption, indicating that an increase in financial resources was associated with higher levels of consumption. The variable Entertainment also displayed a positive effect on consumption, indicating that increased opportunities for entertainment activities were linked to higher consumption levels. On the other hand, the variable Dwellings showed a negative impact on consumption, suggesting that a higher number of dwellings led to decreased consumption. The model showed some degree of accuracy in estimating consumption levels, but more research and statistical analysis are required to determine the model's overall usefulness because a bigger sample size might improve the model's accuracy. By fitting the linear regression model in R and calculating the coefficients, we can forecast fresh observations. Policymakers, marketers, and economists are just a few of the stakeholders involved in consumption analysis who can benefit from this method.

Overall, our analyzes findings highlight the importance of considering specific variables, especially Financial and other variables such as Entertainment , when predicting consumption patterns for climate footprint. Future research can further expand the Data set and incorporate additional variables to enhance the model's accuracy and provide more comprehensive insights into consumption behavior.

5 References

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