**SALES FORECASTING OF MARUTI SUZUKI MINI CARS USING DIFFERENT MODELS**

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**SUPPLY CHAIN PROJECT**

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**Introduction**

* Demand forecasting is the most important task is designing a supply chain
* Efficient forecasting can reduce costs across the supply chain
* Demand forecasting is the basis for each supply chain activity
* Inventory levels, production capacity, workforce level is decided by demand forecasting
* Better forecasting is achieved when there is no information distortion between the different supply stages
* The basic models used are

1. Moving average
2. Exponential smoothing
3. Static
4. Holt
5. Winter

**Company**

* Maruti Suzuki is the largest car manufacturer of India by sales volume
* It has plants located in Gurgaon and Manesar
* Its mini car segment forms the largest contribution to the total sales
* This includes the cars-Alto and WagonR
* Both of these vehicles have been quite popular among the Indians due to its lower costs and Maruti’s efficient after sales services

**DATA**

* The data has been procured online using web scraping in python (references have been provided)
* Data from 2020 has been deliberately excluded because of the covid pandemic which has led to unstable demand
* Monthly data of the sales have been converted to quarterly data

**Observations**

* Average=32283,max=42310, min=10123

**FORECASTING MODELS**

* The different models have been used in excel
* The errors have been calculated to find out which is the best among the models
* All standard values of alpha and beta have been chosen here
* MAPE (mean absolute percentage error) has been used for comparisons

|  |  |
| --- | --- |
|  | MAPE |
| Moving Average | 17.3425 |
| Exponential | 15.70375 |
| Static | 17.29467 |
| Holt | **13.95643** |
| Winter | 15.86117 |

**INFERENCES**

* The lowest MAPE is for the Holt’s model
* This shows it is the best model
* The highest MAPE is for moving average – this is because it doesn’t take into account the trend and the seasonality factors
* Exponential smoothing is better than moving average because it gives higher weightage to the most recent sales data
* Holts and Winter models take into account the trend and seasonality hence tend to be more accurate

**OPTIMIZATION OF THE MODELS**

* The models can be further optimized by minimizing MAPE by changing alpha beta gamma values
* This has been carried out for Holt and Winter models
* The results have been stored in what if analysis>scenario manager>optimized in the basic demand forecasting sheet-holt and winter tab

|  |  |  |
| --- | --- | --- |
|  |  | MAPE |
| HOLT | ALPHA-0.86  BETA-0 | 2.283441 |
| WINTER | ALPHA-0.91  BETA-0  GAMMA-0.143 | 1.975 |

* This shows that there is no trend since beta=0

**REGRESSION**

* The independent variables chosen here for regression are gdp and interest rates
* Both are macroeconomic indicators-hence have been chosen as predictor variables
* The correlation between the sales data and gdp turns out to be 0.7 which is high and shows that gdp and sales have a high correlation
* The correlation between the sales data and intertest rates is 0.34 which is low
* The MAPE values have been used to compare both regression models

|  |  |  |
| --- | --- | --- |
|  | MAPE | R^2 |
| GDP | 11.15999 | 0.60106936 |
| INTEREST RATES | 15.1592 | 0.117989 |

* **INFERENCES**
* Mape and R^2 value is higher for gdp regression
* This proves that it is more efficient model and at the same time it explains the variance more than the interest rates model

**MULTIPLE REGRESSION**

* Multiple regression has been run with both interest rates and gdp as the predictor variables
* While the R^2 value increased from the other two models to **0.67**, the MAPE value turned out to be **13%**
* This shows that as we increase the variables the explained variance proportion increases and the model becomes more accurate
* Some part of the model will always be unexplained due to the randomness of events

**REFERENCES**

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