Product Sales Analysis

MATERIALS AND METHODS

- Three selected cosmetic products from the selected company consist of Moisturizer (P1), Perfume (P2), and Sun Cream (P3).
- Thirteen effective variables on sales were classified into three groups: Marketing, Purchasing Power, and Time-Effect.
- Based on a survey during a 5-year period (2012-2016) at this study that was conducted as cross-sectional, 20 experts in the fields of marketing and corporate sales were asked in polling about the impact of each of 13 effective factors on sales of Company's products within the Likert 5-scale spectrum.
- The rounded value of mean responses from interviewees was considered as a criterion score about pricing for sales of products per year.

Table 1: Classification of effective factors on sales

Characteristics	Category
Marketing	Product elements
	Place
	Promotion
	People
	Price
	Process
	Physical environment
Purchasing power	Tax (GST)
	Inflation rate
	Currency exchange
	Interest rate
Time effect	Seasonal factor
	Time pressure

- To determine validity through the Delphi technique, the aforesaid tools were given to 20 experts in marketing and sales and their comments were implemented at the first turn, and then the results were returned to them for their reconfirmation.
- To analyze Delphi's results at the first round, content analysis was done to identify the main themes in the initial questionnaire and the results of the given questionnaire were converted into the final questionnaire.
- Cronbach alpha coefficient was utilized to measure the reliability of research variables.
- The reliability value was $\alpha = 0.88$; therefore, research variables are highly reliable and one could ensure from internal consistency of these variables.
- Similarly, the rate of sales of three products was measured within a 9-year period and during years (2012-2020).
- Spline Smooth Prediction was used in the first round of analysis for the prediction of values of 13 variables within years (2017- 2020).
- In the second round, Friedman's nonparametric test was employed for ranking 13 variables in terms of impact on sales of each of selected products using mean rank and based on the predicted value at the first round of analysis.
- As a result, when the hypothesis of the Mean Rank equality for variables is rejected, this criterion will be used to rank the variables.
- By fitting of appropriate ARIMA model at the third round, sale values are forecasted for either of the selected products in a 5-year period (2021-2025). Statistical analyses were done in R-software.

Table 3: Mean rank of factors for moisturizer cream (P1)

Variable	Mean rank
×1	5.299
×2	2.999
×3	3.000
×4	4.399
×5	5.700
×6	4.800
×7	3.999
×8	4.172
×9	4.599
×10	5.299
×11	4.2693
×12	4.978
×13	4.299

Table 4: Mean rank of factors for perfume (P2)

Variable	Mean rank
×1	2.700
×2	2.599
×3	4.699
×4	2.700
×5	4.100
×6	2.000
×7	3.899
×8	3.554
×9	4.299
×10	4.100
×11	3.925
×12	3.831
×13	4.000

- Concerning the forecast of sales, the rate of sales is predicted in 5-year period (2021-2025) based on sales at an interval of years (2012-2016).
- To this end, the ARIMA model is fitted automatically by suitable parameters on data using the forecast package in R-software.
- Whereas the diagram of sales includes increasing trend, therefore, the logarithmic transform was used for obtaining stationary time series.
- Time series diagram is shown for data relating to three products along with confidence interval concerning the forecast values in Figure 2.
- In Figure 2, for forecast points over a 5-year period between 2021 and 2025, two confidence intervals are shown, one 80% in bright blue and the other 95% in light blue.
- It can be seen that the forecasted values also have an increasing trend and the width of the confidence interval in Figure 1a and 1b is less than Figure 1c.
- This may indicate a slight increase in forecast accuracy.
- In order to determine the goodness of the fitting model, autocorrelation function (acf) and partial autocorrelation function (pacf) diagrams were used for the rest of the models. Diagrams related to time series model are shown in Figure 3.
- It is seen in acf diagram the values are placed within the confidence interval after the first lag and pacf diagram is also included in the confidence interval.
- Usually, acf and pacf graphs are plotted for different lags for the data, and by comparing the graphs, the auto regressive order (AR), moving average (MA) and a combination of auto regressive and moving average are identified and the model order will be determined.
- It is clear from Figure 2 that ARIMA (0, 1, 0) is the best choice for the goodness of fit of time series belong P1 and P2, and ARIMA (0, 2, 0) is the best choice for the goodness of fit of time series belong P3.
- In order to analyze the hypothesis of independence of residuals, the Ljung-Box test is used. Results are shown in Table 5.
- It is observed from the results of all three tests that there is no reason to reject the hypothesis of independence of residuals with $P > 0.05$ at the significance level of 0.05.
- Table 6 shows the forecast values for sales of the product in a 5-year period.