SKF INDIA LTD.

SALES FORECASTING

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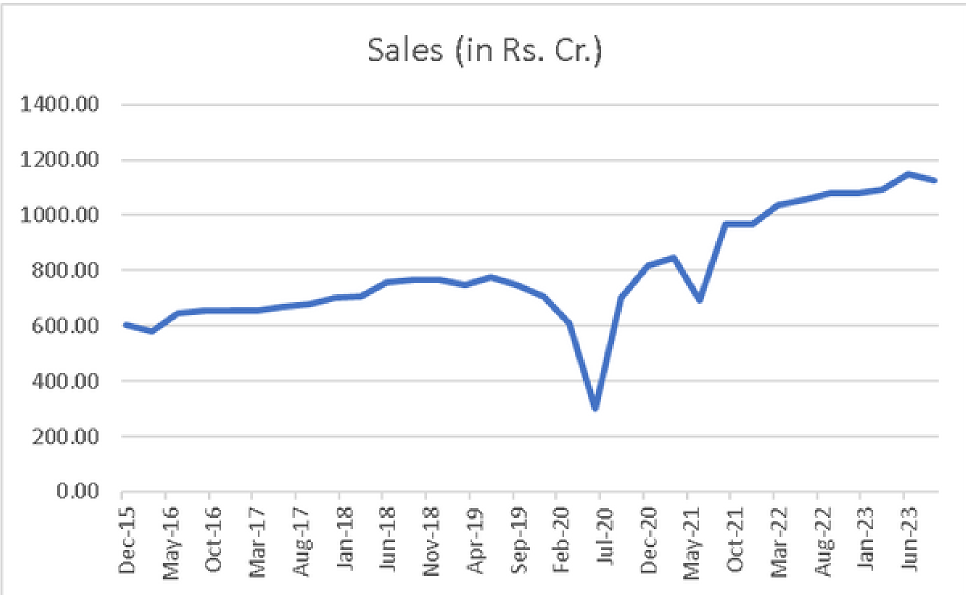
About the Company

SKF India Ltd is a leading global supplier of rolling bearing and seals. The company provides products, solutions and services in the areas of rolling bearings, seals, mechatronics, services and lubrications systems. The company manufactures different types of bearings, seals including roller bearings, bearing units, housings, industrial & hydraulic seals, linear motion products, high precision bearing, spindles, electrical actuators, actuation systems and rolling bearing steel which are used in cars and truck wheels. The company's business is divided into four groups: Automotive business unit, Electrical business unit, Industrial business unit and Service business unit.

Data Overview

The dataset utilized for this sales prediction analysis spans a period from **December 2015 to September 2023**, encompassing a total of 32 quarters. Sourced from Moneycontrol, a reputable financial data platform, the dataset offers a comprehensive view of SKF's sales performance over an extensive time horizon.



Sales Fluctuations Over 32 Quarters

Methodology

Calculating 4 point Moving Average

Sales (in Rs. Cr.)	Mov. Average (MA)
601.87	
579.80	=AVERAGE(E2:E5)
643.61	AVERAGE(number1, [nu
654.55	652.18

The 4-point moving average is computed by taking the average of four consecutive quarters. This moving average helps smooth out short-term fluctuations, providing a clearer representation of the underlying trend in SKF's sales over time.

Calculating Center Moving Average

619.96	
633.69	=AVERAGE(F3:F4)

The center moving average is determined by taking the average of adjacent 4-point moving averages. This approach helps centralize the smoothing process, offering a more balanced view of the overall sales trend.

Calculation of Sales/Center Moving Average

This ratio is derived by dividing actual sales figures by the center moving average. It allows for the identification of variations from the expected trend, highlighting periods of overperformance or underperformance relative to the smoothed average.

Calculation of Seasonality Index

Year	Q1	Q2	Q3	Q4
1		1.03	1.02	1.00
2	0.99	1.00	1.00	1.00
3	0.98	1.02	1.02	1.01
4	0.98	1.03	1.03	1.09
5	1.04	0.51	1.10	1.14
6	1.06	0.82	1.08	1.01
7	1.02	1.01	1.01	0.99
8	0.99	1.03	1.00	
Sea Index	1.01	0.93	1.03	1.03

The seasonality index is computed by analyzing the historical pattern of seasonal fluctuations **(Sales/CMA)** in sales data. It provides a multiplier for each quarter, indicating the degree to which sales typically deviate from the average during that specific period of the year.

Deseasonalized Data Calculation

The deseasonalized data is obtained by **dividing actual sales by the corresponding seasonality index**. This process eliminates the impact of seasonal variations, providing a clearer picture of the underlying sales trend.

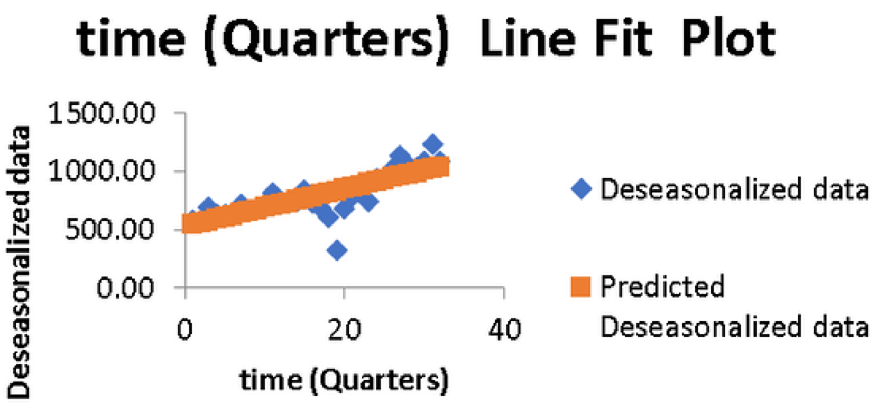
Linear Regression

The p-values for both the intercept and slope are very low (4.32e-12 and 4.34e-07), indicating they are highly statistically significant. The t-statistics are high, also suggesting the coefficients are meaningful.

The model implies that on average, the dependent variable increases by 16.15 units for every 1 unit increase in 'time' (likely quarters in this case). So there is a clear positive association between 'time' and the dependent variable.

With an R-squared of 0.58, this model explains 58% of the variance in the dependent variable.

Overall, the intercept, slope, and R-squared imply a moderately good fitting model that shows a positive trend between the dependent variable and time over a period of 32 quarters.



Regression Statistics	
Multiple R	0.76075066
R Square	0.57874156
Adjusted R Square	0.56469961
Standard Error	131.398051
Observations	32

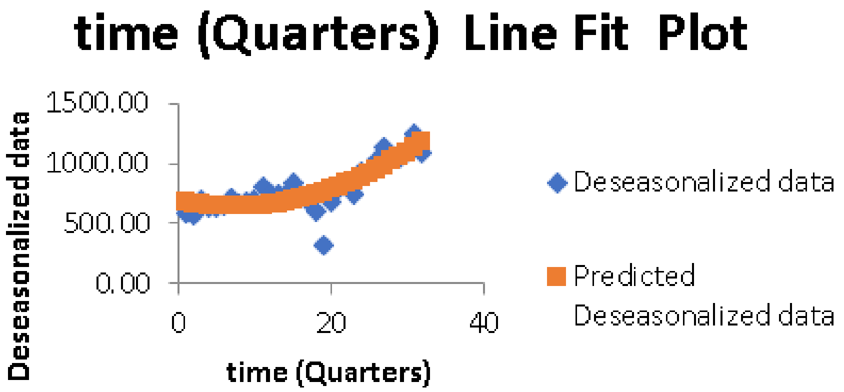
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	525.307598	47.56689056	11.04355554	4.3163E-12
time	16.1508504	2.515745702	6.419905796	4.3386E-07

Quadratic Regression

The intercept and time^2 coefficient are statistically significant with very low p-values (1.44e-11 and 0.0026). However, the linear time coefficient has a high p-value (0.17), indicating it is not statistically significant.

With an R-squared of 0.69, this quadratic model explains 69% of the variance in the dependent variable. This is higher than the 58% in the previous linear model, indicating that the quadratic model provides a better fit and explains more of the variability compared to the linear model.

The increase in R-squared from **0.58 to 0.69** shows that the quadratic term improves the model - capturing more of the non-linear relationship versus fitting just a straight line.

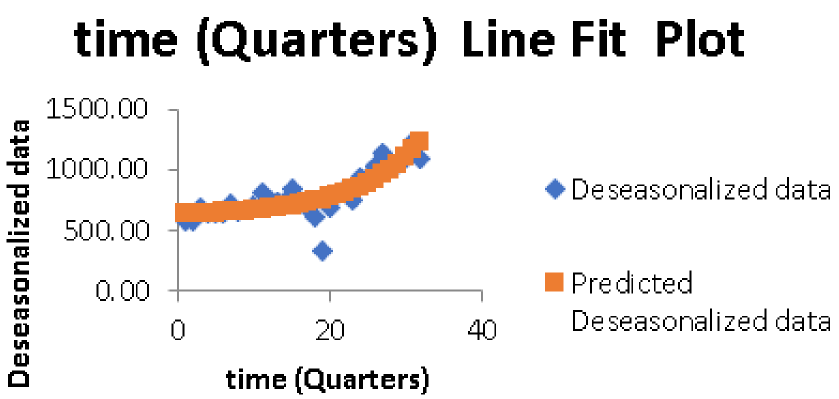


Regression Statistics	
Multiple R	0.832824609
R Square	0.693596829
Adjusted R Square	0.672465576
Standard Error	113.9784827
Observations	32

	Coefficients	Standard Error	t Stat	P-value
Intercept	688.4683392	64.43126624	10.68531443	1.4365E-11
time	-12.6422216	9.00145908	-1.404463598	0.17080133
timesq	0.872517334	0.26463436	3.297067448	0.00258641

Cubic Regression

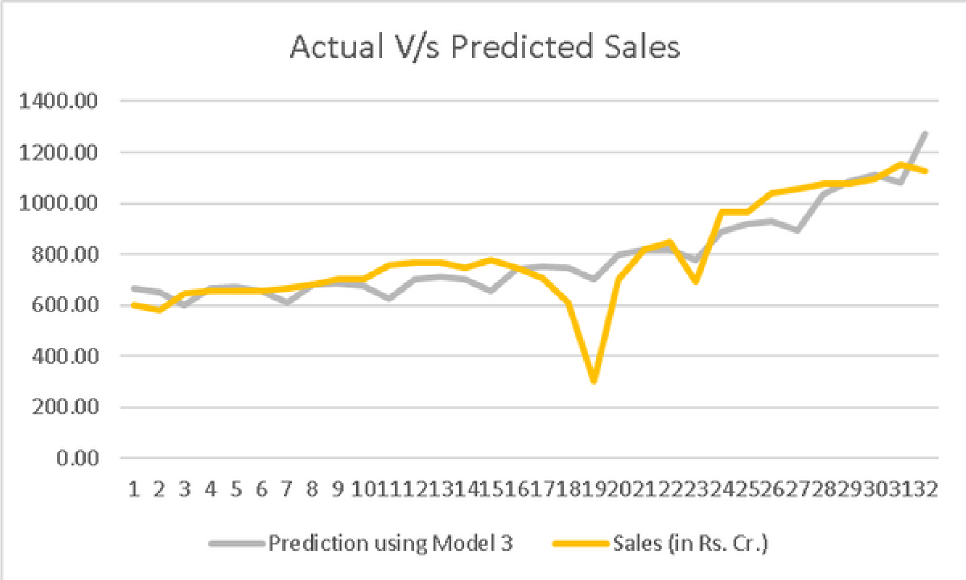
The intercept term is statistically significant with a p-value of 4.24e-09. However, the linear and quadratic terms have very high p-values, indicating they are not statistically significant. Only the cubic term is significant with a p-value of 2.66e-07. With an R-squared of 0.70, this cubic regression explains 70% of the variance in the dependent variable. This is higher than the previous linear and quadratic models, suggesting the cubic model provides the best fit.



Regression Statistics	
Multiple R	0.838937018
R Square	0.703815321
Adjusted R Square	0.672081248
Standard Error	114.045334
Observations	32

Coefficients	Standard Error	t Stat	P-value
646.5525143	77.29820511	8.364392335	4.23932E-09
-1.188090617	14.72869842	-0.080665011	0.936282181
0.336235144	0.606490813	0.554394455	0.583710343
2.61543E-07	2.66104E-07	0.982858797	0.334093965

Results



Quarters	Prediction Sales (in Rs. Cr.)
33	1355.721639
34	1410.387633
35	1391.375382
36	1658.720011

The cubic regression model for sales predictions is:
Sales = 646.55 - 1.19 * time + 0.34 * time^2 + 2.62*10^(-7) * time^3
Where:

- 646.55 is the intercept
- -1.19 is the coefficient for the linear time term
- 0.34 is the coefficient for the quadratic time^2 term
- 2.62*10^(-7) is the coefficient for the cubic time^3 term

This equation models the nonlinear S-shaped association between sales and time, with the cubic term capturing the curve. To make final sales predictions, this model output is multiplied by a seasonality index factor. This incorporates seasonal fluctuations into the final sales forecasts.
In summary, the cubic model with an intercept, linear, quadratic and cubic time terms fits the nonlinear trend in sales over time. It is tuned further by applying a seasonality index to account for periodic seasonal effects. This results in sophisticated data-driven sales predictions from the regression.

Conclusion

In conclusion, this sales forecasting analysis for SKF India Ltd leveraged historical quarterly sales data from December 2015 to September 2023. Multiple techniques were employed, including moving averages, seasonality indexing, and linear, quadratic, and cubic regressions.

The cubic model with seasonal adjustment provided the best fit with an R-squared of 0.70. This model captured the S-shaped nonlinear sales trend over time. The final regression equation incorporated intercept, linear, quadratic, and cubic terms for time, as well as a seasonality index multiplier.

In summary, this advanced forecasting methodology enabled data-driven sales predictions that account for long-term trends, cyclical seasonal effects, and nonlinear relationships. The robust modelling provides actionable insights for SKF India Ltd's business planning and strategy.