

جامعة جدة

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By

[Abdulrahman Atif Kalantan] [2140968]

[Suhaib Hayas Alshaikhi] [2140651]

[Mohammed Bakheet Alsaadi] [2140715]

KINGDOM OF SAUDI ARABIA

Ministry of Education

UNIVERSITY OF JEDDAH



جامعة جدة
University of Jeddah

المملكة العربية السعودية
وزارة التعليم
جامعة جدة

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Introduction

The Al Hassan Ghazi Ibrahim Shaker Company has a long and illustrious history that spans over 70 years. Despite the challenges of the business landscape, the company has managed to thrive and become the exclusive agent for LG air conditioners in Saudi Arabia, a highly prestigious achievement. Additionally, the company has expanded its market presence by importing and distributing products from other renowned global brands. One of the key factors behind the company's success is its ability to navigate and excel in a dynamic marketplace. By accurately predicting and meeting the demands of its partners, Al Hassan Ghazi Ibrahim Shaker Company has experienced consistent growth. This success is a result of the company's strategic approach to anticipating market trends and providing responsive solutions to its partners. Not only has this strengthened existing relationships, but it has also facilitated the establishment of new and mutually beneficial connections. In this report, we will explore the importance of the company's forecasting methods, examining how these methods contribute to informed decision-making processes and serve as the foundation for the ongoing success and expansion of Al Hassan Ghazi Ibrahim Shaker Company.



Figure 1 Ibrahim Shaker Company

Company profile

Al Hassan Ghazi Ibrahim Shaker Company is a leading importer, manufacturer, and distributor of air conditioners and home appliances in Saudi Arabia. The company was founded in 1950 and has been listed on the Saudi Exchange since 2010. The company specializes in LG air conditioner spare parts and maintenance, offering a wide range of products to suit different needs and budgets. The company also provides agency services to other home appliances brands, such as Indesit, Ariston, Maytag, Bompani, Midea, and Panasonic. The company has a nationwide footprint through a strong network of exclusive sales outlets, service centres, warehousing facilities, training academies, and an extensive network of distributors. The company is committed to supporting the Kingdom's Vision 2030, by providing energy-efficient solutions and maximizing local content. The company has a unique joint venture with LG for more than 20 years as the sole distributor of LG air conditioners in Saudi Arabia and has recently expanded its partnership with LG to include home appliance and home entertainment products.

The company specializes in LG air conditioner spare parts and maintenance, offering a wide range of products to suit different needs and budgets. **Small Spare Parts:** These are the minor parts that often need to be replaced, such as nuts, screws, fuses, sensors, and other small pieces. They are simple and easy to install and handle. **Medium Spare Parts:** These are the parts that are larger and more important than the small parts, but not as big or complex as the large parts. They include components like fans, motors, PCBs, and other essential parts that make the air conditioner work. **Large Spare Parts:** These are the parts that are the most sizable and sophisticated, such as condensers, compressors, or major frames.



Figure 2 Small Spare Parts



Figure 3 Medium Spare Parts



Figure 4 Large Spare Parts



Methodology

Al Hassan Ghazi Ibrahim Shaker Company faced some challenges throughout the years to determine the right forecast method, as this case study where performed to make a decision, the past year data were used to perform this case study as the data were classified into three types, large, medium and small, the quantitative forecast were used, three forecast method were considered as it will be mention below, and three model performance were used to compare the validity of the forecast method which is mean absolute deviation (MAD), mean squared error (MSE) and mean absolute squared error (MAPE).

- **Naïve Forecast** when performing this type of forecasting the previous period will be taken as forecast, this type of forecasting has some advantages first is its simplicity since it does not require any calculations second is the lack of data it does not require a lot of historical data lastly this naïve forecasting does not put any relationship or time-series in consideration thus making it a risk to use it.
- **Moving Average** in this forecasting method it differs from the naïve since the forecasted value will be calculated by taking the average demand from the previous x periods, there is some similarity between the naïve and moving averages since both of them is easy to calculate and interpret, but one of the major moving average advantage is the that help to smooth out fluctuations and noise in the data since the x period is used as averages. As for this report the $x=3$ because it gives a reasonable result.
- **Exponential Forecasting** In this model, the smoothing factor α exponentially decreasing weights to periods over time, the previous period would have the strongest weight the main advantage of this model that it considers both the previous data and give the rest period a huge weight, it also considers as another weighted-moving-average forecasting method.

As for the model performance the MAD, MSE and MAPE all of them are used to serve different purposes:

- **Mean Absolute Deviation (MAD)** it indicates how much the forecast missed the target.
- **Mean Square Error (MSE)** the square of how much the forecasts missed the target It gives more weight to larger errors compared to MAD.
- **Mean Absolute Percent Error (MAPE)** measures the average percentage difference between the forecasted values and the actual values.

In this report we considered all the performance models to ensure the results were fully accurate.

Software Usage

SAP Ariba is a cutting-edge, cloud-based procurement solution designed to revolutionize and streamline the entire procurement lifecycle for businesses. By leveraging state-of-the-art technology, SAP Ariba is dedicated to optimizing various facets of the procurement process, ranging from sourcing to supplier management. This comprehensive platform empowers companies to make informed decisions, enhance efficiency, and drive cost savings throughout their procurement operations. At its core, SAP Ariba facilitates seamless collaboration between buyers and suppliers in a digital ecosystem. The platform provides a centralized hub where



organizations can efficiently manage their procurement activities, ensuring transparency, compliance, and strategic alignment with business goals. One of the key strengths of SAP Ariba lies in its robust sourcing capabilities. Companies can leverage advanced tools to identify and engage with suppliers, facilitating a more competitive and transparent bidding process. This not only enables organizations to secure the best value for their procurement needs but also fosters healthy supplier relationships.

The screenshot displays the 'ConfigPanel Home' interface for SAP Ariba. On the left, a sidebar lists 'Defined Mobile Applications' with four entries: SAP_WORK_MANAGER_61, SAP_WORK_MANAGER_62 (highlighted), Z_SAP_WORK_MANAGER_61, and Z_SAP_WORK_MANAGER_62. The main area is titled 'Mobile Application (Display Mode)' and includes a toolbar with 'Create', 'Copy', 'Delete', and 'Change' icons. Below the toolbar are four tabs: 'General' (selected), 'Mobile Status Setting', 'Conversion Exit Setting', and 'System Components'. The 'General' tab contains several sections: 'Basic Data' with fields for 'Mobile Application' (SAP_WORK_MANAGER_62), 'Description' (SAP Work Manager 6.2.0 with LAM), and 'Release' (6.2.0); 'User Management Setting' with a checkbox for 'Disable Automatic User Creation'; 'Server Management Setting' with a checkbox for 'Disable Automatic Server Registration'; 'Multi Backend Setting' with a checkbox for 'Multi Backend Enabled' and a 'System Role' dropdown set to 'Host'; and 'Administrative Info' with fields for 'Created By' (YALAMATIS), 'Creation Time Stamp' (21.08.2014 18:15:40), 'Last Changed By' (empty), and 'Changed Time Stamp' (11.06.2015 12:31:52).

Figure 5 SAB software Screenshot

SAB Ariba Snapshot

Formulas

Forecast

$$\text{Moving Averages} = \frac{\sum \text{Demand in Previous } n \text{ Periods}}{n}$$

Where $n = 3$

$$\text{Exponential Forecasting} = \alpha A_{t-1} + (1 - \alpha) F_{t-1}$$

Where:

A_{t-1} = Previous periods actual demand

F_{t-1} = Previous periods forecast demand

$\alpha = 0.1$

Measure Of Forecast Accuracy

$$\text{MAD} = \frac{\sum |\text{Actual} - \text{Forecast}|}{n}$$

$$MSE = \frac{\sum (Forecast Error)^2}{n}$$

$$MAPE = \frac{\sum \frac{|Forecast Error|}{Actual} \times 100}{n}$$

Where n = 12

Results & Calculation

In this report, the applied forecasting methods help Shaker company in determining the right forecast method, budgeting, planning, and estimating growth. Forecasting methods aim to anticipate future outcomes by analysing past events and utilizing management expertise. These methods utilize historical data to make predictions about future events.

months	Part type		
	Large	Medium	Small
Jan	172	343	487
Feb	178	319	540
Mar	175	284	499
Apr	177	270	466
May	173	305	538
Jun	177	279	503
Jul	174	329	470
Aug	174	279	459
Sep	175	289	473
Oct	175	349	539
Nov	180	331	481
Dec	180	313	528
total	2110	3690	5983

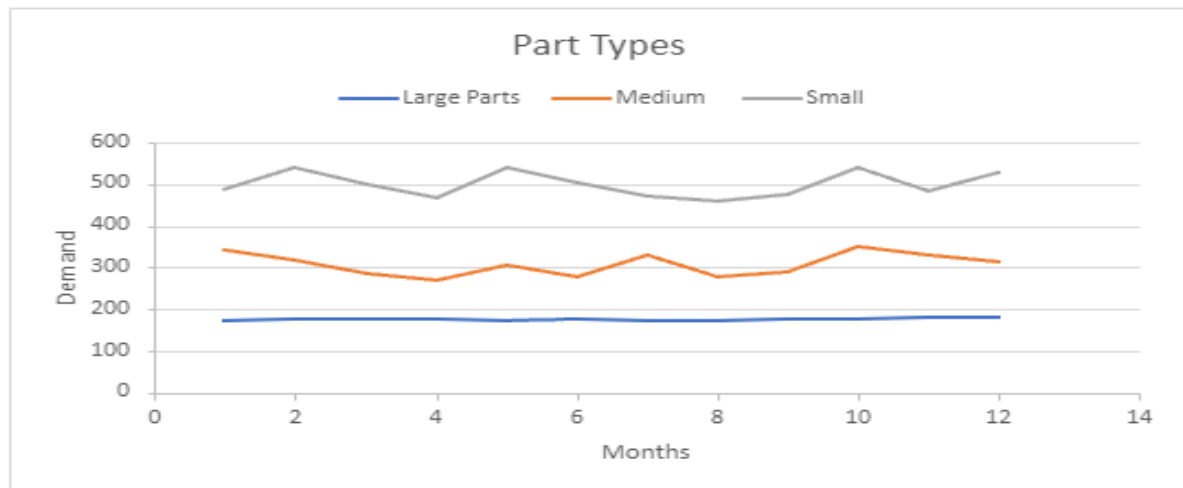


Figure 6 Demand on spare parts

Noting that the X-axis represents the months from January to December and the Y-axis represents the Demand for all part types. It reveals insightful patterns that are crucial for effective inventory management and service planning. The demand for small parts has the highest values across the months. This observation shows the critical nature of small parts within the inventory.

Naïve Forecast

Applying Naïve method that assumes that demand in the next period is equal to demand in the most recent period.

Large Spare Parts

Large							
Period	Actual	Forecasted	Error(a-f)	Abs error	Square error	lerrorl/actual	lerrorl/actual * 100
Jan	172						
Feb	178	172	6	6	36	0.03	3.37
Mar	175	178	-3	3	9	0.02	1.71
Apr	177	175	2	2	4	0.01	1.13
May	173	177	-4	4	16	0.02	2.31
Jun	177	173	4	4	16	0.02	2.26



Jul	174	177	-3	3	9	0.02	1.72
Aug	174	174	0	0	0	0.00	0.00
Sep	175	174	1	1	1	0.01	0.57
Oct	175	175	0	0	0	0.00	0.00
Nov	180	175	5	5	25	0.03	2.78
Dec	180	180	0	0	0	0.00	0.00
Total	2110	1930		2.55	10.55		1.44
				MAD	MSE		MAPE

Calculating the naïve method for the Large spare parts using the MAD, MSE, and finally the MAPE.

Using the formulas above in the methodology MAD = 2.55, MSE = 10.55, and MAPE about = 1.44

Medium Spare Parts

Medium							
Period	Actual	Forecasted	Error(a-f)	Abs error	Square error	lerrorl/actual	lerrorl/actual * 100
Jan	343						
Feb	319	343	-24	24	576	0.08	7.52
Mar	284	319	-35	35	1225	0.12	12.32
Apr	270	284	-14	14	196	0.05	5.19
May	305	270	35	35	1225	0.11	11.48
Jun	279	305	-26	26	676	0.09	9.32
Jul	329	279	50	50	2500	0.15	15.20
Aug	279	329	-50	50	2500	0.18	17.92
Sep	289	279	10	10	100	0.03	3.46
Oct	349	289	60	60	3600	0.17	17.19
Nov	331	349	-18	18	324	0.05	5.44
Dec	313	331	-18	18	324	0.06	5.75
Total	3690	3377		30.91	1204.18		10.07
				MAD	MSE		MAPE

After we calculated the large spare parts now, we have to calculate medium and small spare parts.

The medium spare parts are calculated using MAD, MSE, and MAPE formulas.

The MAD = 30.91, MSE= 1204.18, MAPE = 10.07



Small Spare Parts

Small							
Period	Actual	Forecasted	Error(a-f)	Abs error	Square error	lerrorl/actual	lerrorl/actual * 100
Jan	487						
Feb	540	487	53	53	2809	0.10	9.81
Mar	499	540	-41	41	1681	0.08	8.22
Apr	466	499	-33	33	1089	0.07	7.08
May	538	466	72	72	5184	0.13	13.38
Jun	503	538	-35	35	1225	0.07	6.96
Jul	470	503	-33	33	1089	0.07	7.02
Aug	459	470	-11	11	121	0.02	2.40
Sep	473	459	14	14	196	0.03	2.96
Oct	539	473	66	66	4356	0.12	12.24
Nov	481	539	-58	58	3364	0.12	12.06
Dec	528	481	47	47	2209	0.09	8.90
Total	5983	5455		42.09	2120.27		8.28
				MAD	MSE		MAPE

Calculating MAD, MSE, and MAPE for small spare parts

MAD = 42.09, MSE = 2120.27, MAPE = 8.27

The naïve tells us that Small Spare parts have the highest demand followed by the medium spare parts, and last but not least the Large Spare Parts.

Moving average

The moving average uses an average of the n most recent periods of data to forecast the next period.

Large Spare Parts

Large

Period	Actual	Forecasted	Error(a-f)	Abs error	Square error	lerrorl/actual	lerrorl/actual * 100
Jan	172						
Feb	178						
Mar	175						
Apr	177	175	2	2	4	0.01	1.13
May	173	177	-3.67	3.667	13.44	0.02	2.12
Jun	177	175	2.00	2.00	4.00	0.01	1.13
Jul	174	176	-1.67	1.67	2.78	0.01	0.96



Aug	174	175	-0.67	0.67	0.44	0.00	0.38
Sep	175	175	0.00	0.00	0.00	0.00	0.00
Oct	175	174	0.67	0.67	0.44	0.00	0.38
Nov	180	175	5.33	5.33	28.44	0.03	2.96
Dec	180	177	3.33	3.33	11.11	0.02	1.85
Total	2110	1577.67		2.15	7.19		1.21
				MAD	MSE		MAPE

It is three months moving average is found by summing the demand during the past 3 months and dividing by 3.

April forecasted was found by summing all the demand from January and February and lastly March and divide by 3 we get 175. We do the same for May and all the rest.

MAD, MSE, and MAPE is calculated using the same formula above, we got MAD = 2.15, MSE = 7.19, and MAPE = 1.21

Medium Spare Parts

Medium							
Period	Actual	Forecasted	Error(a-f)	Abs error	Square error	error /actual	error /actual * 100
Jan	343						
Feb	319						
Mar	284						
Apr	270	315.33	-45.33	45.33	2055.11	0.17	16.79
May	305	291.00	14.00	14.00	196.00	0.05	4.59
Jun	279	286.33	-7.33	7.33	53.78	0.03	2.63
Jul	329	284.67	44.33	44.33	1965.44	0.13	13.48
Aug	279	304.33	-25.33	25.33	641.78	0.09	9.08
Sep	289	295.67	-6.67	6.67	44.44	0.02	2.31
Oct	349	299.00	50.00	50.00	2500.00	0.14	14.33
Nov	331	305.67	25.33	25.33	641.78	0.08	7.65
Dec	313	323.00	-10.00	10.00	100.00	0.03	3.19
Total	3690	2705.00		25.37	910.93		8.23
				MAD	MSE		MAPE

Doing the same thing we did in Large Spare parts, However, this time with medium spare parts. MAD = 25.37, MSE = 910.93, and MAPE = 8.21

Small Spare Parts

small							
Period	Actual	Forecasted	Error(a-f)	Abs error	Square error	error /actual	error /actual * 100



Jan	487						
Feb	540						
Mar	499						
Apr	466	508.67	-42.67	42.67	1820.44	9.16%	9.16
May	538	501.67	36.33	36.33	1320.11	6.75%	6.75
Jun	503	501.00	2.00	2.00	4.00	0.40%	0.40
Jul	470	502.33	-32.33	32.33	1045.44	6.88%	6.88
Aug	459	503.67	-44.67	44.67	1995.11	9.73%	9.73
Sep	473	477.33	-4.33	4.33	18.78	0.92%	0.92
Oct	539	467.33	71.67	71.67	5136.11	13.30%	13.30
Nov	481	490.33	-9.33	9.33	87.11	1.94%	1.94
Dec	528	497.67	30.33	30.33	920.11	5.74%	5.74
Total	5983	4450		30.41	1371.91		6.09
				MAD	MSE		MAPE

Calculating MAD, MSE, and MAPE for Small spare parts.

MAD = 30.41, MSE= 1371.91, MAPE = 6.09.

Exponential Method

Large spare Parts

Large

Period	Actual	Forecasted	Error(a-f)	Abs error	Square error	lerrorl/actual	lerrorl/actual * 100
Jan	172	181					
Feb	178	180.1	-2.10	2.10	4.41	0.01	1.18
Mar	175	179.89	-4.89	4.89	23.91	0.03	2.79
Apr	177	179	-2.40	2.40	5.76	0.01	1.36
May	173	179	-6.16	6.16	37.96	0.04	3.56
Jun	177	179	-1.54	1.54	2.39	0.01	0.87
Jul	174	178	-4.39	4.39	19.27	0.03	2.52
Aug	174	178	-3.95	3.95	15.61	0.02	2.27
Sep	175	178	-2.56	2.56	6.53	0.01	1.46
Oct	175	177	-2.30	2.30	5.29	0.01	1.31
Nov	180	177	2.93	2.93	8.58	0.02	1.63
Dec	180	177	2.64	2.64	6.95	0.01	1.46
Total	2110	2143.73		2.99	11.39		1.70
				MAD	MSE		MAPE

Exponential Method is a weighted moving average. The alpha α is 0.1.

January Forecasted with respect to Previous Forecast and previous actual demand we got 181. The other months was calculated using the same formula. Now we can calculate MAD, MSE, and MAPE.

MAD = 2.99, MSE = 11.39, MAPE = 1.70

Medium spare parts

Medium							
Period	Actual	Forecasted	Error(a-f)	Abs error	Square error	lerrorl/actual	lerrorl/actual * 100
Jan	343	322					
Feb	319	324.1	-5.10	5.10	26.01	1.60%	1.60
Mar	284	323.59	-39.59	39.59	1567.37	13.94%	13.94
Apr	270	319.63	-49.63	49.63	2463.24	18.38%	18.38
May	305	314.67	-9.67	9.67	93.47	3.17%	3.17
Jun	279	313.70	-34.70	34.70	1204.17	12.44%	12.44
Jul	329	310.23	18.77	18.77	352.28	5.70%	5.70
Aug	279	312.11	-33.11	33.11	1096.13	11.87%	11.87
Sep	289	308.80	-19.80	19.80	391.93	6.85%	6.85
Oct	349	306.82	42.18	42.18	1779.37	12.09%	12.09
Nov	331	311.04	19.96	19.96	398.57	6.03%	6.03
Dec	313	313.03	-0.03	0.03	0.00	0.01%	0.01
Total	3690	3779.71		22.71	781.04		7.67
				MAD	MSE		MAPE

Using the same formula for Medium spare parts

MAD = 22.71, MSE = 781.04, MAPE = 7.67

Small Spare Parts

small							
Period	Actual	Forecasted	Error(a-f)	Abs error	Square error	lerrorl/actual	lerrorl/actual * 100
Jan	487	503					
Feb	540	501.4	38.60	38.60	1489.96	7.15%	7.15
Mar	499	505.26	-6.26	6.26	39.19	1.25%	1.25
Apr	466	504.63	-38.63	38.63	1492.59	8.29%	8.29
May	538	500.77	37.23	37.23	1386.03	6.92%	6.92
Jun	503	504.49	-1.49	1.49	2.23	0.30%	0.30
Jul	470	504.34	-34.34	34.34	1179.52	7.31%	7.31
Aug	459	500.91	-41.91	41.91	1756.43	9.13%	9.13
Sep	473	496.72	-23.72	23.72	562.58	5.01%	5.01



Oct	539	494.35	44.65	44.65	1993.90	8.28%	8.28
Nov	481	498.81	-17.81	17.81	317.28	3.70%	3.70
Dec	528	497.03	30.97	30.97	959.08	5.87%	5.87
Total	5983	6011.72		26.30	931.56		5.27
				MAD	MSE		MAPE

Using the same formula for Small spare parts

MAD = 26.30, MSE = 931.56, MAPE = 5.26

	Large			Medium			Small		
	MAD	MSE	MAPE	MAD	MSE	MAPE	MAD	MSE	MAPE
Naïve Forecasting	2.55	10.55	1.44	30.91	1204.18	10.07	42.09	2120.27	8.28
Moving Average Forecasting	2.15	7.19	1.21	25.37	910.93	8.23	30.41	1371.91	6.09
Exponential Forecasting	2.99	11.39	1.70	22.71	781.04	7.67	26.30	931.56	5.27

Recommendation

After conducting the calculation and performing the measure of forecast accuracy it's possible to determine the right forecasting method for each the large, medium, and small spare part. Judging by the performance accuracy of the forecast (MAD, MSE, MAPE). It is highly recommended for the large parts to use the moving averages forecast methods, as for the medium and small parts its recommended to use the exponential forecast, thus these results is based on the lower summation of (MAD,MSE,MAPE), it is logically for the medium and small parts to use these type of forecast because the exponential forecasting put the previous actual value and the past forecasted value and give each one of them a specified weight.

Conclusion

After visiting the shaker group and perform the forecast for the three parts, there are some interesting information that to be mentioned they have two kind of storages one for full devices that they directly sells, and the other for the spare parts, the study was conducted in the second type of storages, there is some storages they had to shut down due to high cost and stack for some unnecessary parts, as in this study it refined recommendations as a result of this first-hand experience and further optimized the strategic use of forecasting methods tailored to the air conditioning and home appliances industries.