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OPTIMAL FORECASTING OF RESOURCES AND PRODUCTION CAPACITY OF THE LIBYAN IRON AND STEEL COMPANY TO COVER DEMAND FOR ITS PRODUCTS

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ABSTRACT

The Libyan Iron and Steel Company (LISCo) is considered one of the largest industrial companies with capacity is about 1,324,000 tons of liquid steel annually by direct reduction of iron pellets using local natural gas. One of the most difficult problems facing the management is the optimal use of its resources and production capacity needed to cover the volume of demand for its products. In order to meet the needs of its customers in a timely manner and at the lowest possible cost, which requires the use of quantitative techniques as a tool to support and rationalize the economic decision. These problems cannot be solved out of personal judgment. Rather, this requires the use of modern quantitative methods that contribute to making the optimal decision. Among the most important of these are prediction techniques. The importance of the study is represented in forecasting the production capacity and that leads to the optimum utilization of LISC's resources. The study was carried out first by relying on data and information gathering to review previous studies, research and scientific journals. Secondly, through field visits. Third, apply the equations and laws of demand forecasting of simple linear regression to the data obtained. Fourth, using Microsoft Excel on the data collected. We obtained good results with which we can support the senior management of LISC, with 95% & 99% confidence. We recommended LISC does not control costs, and price and securing a fixed profit margin, in addition to the company bearing additional costs resulting from the creation of interests.

Keywords: *linear regression; predicting; Libyan Iron and Steel Company; products*

INTRODUCTION

The issue of production capacity is one of the important issues that have received the attention of institutions due to the scarcity of resources, as the current era is witnessing a gap between consumption and resources, and production capacity decisions are one of the important decisions, in the light of which many decisions are determined such as funds for investment, materials and labor. Also, the change and diversity in the product mix has led to a permanent and continuous change in the amount of production capacity, so it becomes difficult for the organization to maintain the level of its production capacity, especially in the long run, so the

organization predicts the change in energy continuously in order to be able to keep pace with the change in demand and maintain its position competitive.

1. Problem Statements

One of the most difficult problems facing the management of the LISCo is its optimal utilization of its resources and production capacity necessary to cover the volume of demand for its products, in order to meet the needs of its customers in a timely manner and at the lowest possible cost, which requires the need to use quantitative techniques as a tool to support and rationalize the economic decision. This requires the use of modern quantitative methods that contribute to optimal decision-making, the most important of which is forecasting techniques.

2. Importance of Study

The importance of the study is to predict the production capacity, which leads to the optimal exploitation of the resources of the LISCo. The importance of the study can be achieved as follows:

a. Forecasting future events and reducing uncertainty, especially with the development of forecasting methods, which allowed for an improvement in the degree of accuracy.
b. Forecasting the demand for the products of the LISCo will necessarily lead to an increase in production capacity, and planning for it to meet the demand so that the company does not lose some of its sales, incur additional costs and does not lose investment opportunities as a result of freezing part of its capacities.
c. Forecasting the production capacity will lead to linking the efforts of selling, buying, financing, etc., of the various departments in the LISCo, and enabling them to work together to achieve the ultimate goals.

3. Objectives of Study

Through this study, we seek to reach the following objectives:

a. Drafting a model based on information from the sales of the LISCo during the years (2012 to 2019).
b. Through this model, the demand for the company's products for the coming years is predicted through continuous updating of the information on the prepared model.
c. Ensuring the effectiveness and accuracy of the given results by simulating reality.

4. Methodology of Study

In order to achieve the objectives of the study, the process of collecting data and information was relied on the following:

a. Reviewing previous studies, research and relevant scientific journals.
b. Collecting data and recording information and observations through field visits.
c. Apply simple linear regression demand forecasting equations and laws to the obtained data.
d. Using Microsoft Excel on the collected data.

LIBYAN IRON AND STEEL COMPANY

1. Introduction about LISCo

LISCo is one of the largest industrial companies in Libya. It occupies an area of 1,200 hectares in the Qasr Ahmed area in the city of Misurata, located 210 kilometers to the east of Tripoli. The design capacity of the company is about 1,324,000 tons of liquid steel annually by direct reduction of iron pellets using local natural gas. The foundation stone of the company was laid on 09/18/1979, marking the establishment of a heavy manufacturing base in Libya, and the production units were opened on 09/09/1989, thus the company entered the production phase [6]. The production units of the company can be shown as follows [6]

a. Direct Reduction Factory
b. Steel Factory
c. Rolling Bars and Skewers Factories
d. A New Bar Rolling Factory
e. Hot Strip Rolling Factory
f. Cold Rolling Factory
g. Galvanizing and Painting Factory
h. Lime and Dolomite Plant

2. Basic Facilities of LISCo

Company's basic facilities include several stations: [6]

a. Power Station:
b. Desalination Plant:
c. Central Water Station:
d. Sewage Treatment Plant and Purification Plant:
e. Oxygen and Compressed Air Plant:
f. Main Electricity Distribution and Reception Station:

FORECASTING THE DEMAND IN PRODUCTION CAPACITY

Forecasting plays a pivotal role in modern management processes, an important and necessary aid for planning, as planning is the backbone of effective operations, and many organizations have failed due to lack of forecasting; Or the wrong prediction

on which the planning was based. It is important to realize that forecasting not only economic factors, but also political factors, and even cultural values, and societal development, which works to shape and formulate economic policies and economic performance of the enterprise. Demand forecasting is considered one of the most important stages of planning, namely: Estimating the expected activity in the organization in the future in terms of quantity and value during the plan period, and this process often requires expert assessment of the needs in their departments, because managers are the ones who estimate the expected needs of their departments.

1. Prediction Concept

Demand forecasting is defined as an attempt to estimate the market's need for a particular good or service or a mixture of goods during a future period of time. The process of demand forecasting is one of the important activities that precede the production capacity and production planning process, in which the best available data is used in order to analyze it and make correct decisions to The objectives of the production system, such as decisions about total production plans, determining storage levels, and determining the needs of the material, human and financial resources necessary for the production process. Since the forecasting process is a necessary step prior to the planning process for production capacity and production plans, we have to determine: What do we forecast? And how is the prediction going? And the time period covered by the forecast? Forecasting can include various things such as forecasting natural resources and raw materials, forecasting prices, forecasting costs, forecasting demand, and forecasting waiting periods. [1]

2. Importance of Demand Forecasting

The importance of demand forecasting stems from: [1]

a. Finding a process of balance between consumer demand and producers' supply, as it is necessary to identify the expected demand and inform the production department of the quantity to be produced for marketing at the appropriate prices and at the appropriate time.
b. Demand forecasting is the starting point in planning for all departments, as it enables knowledge of the expected revenue, and is also considered the basis for making marketing decisions such as promotion, distribution and pricing, in addition to determining production and distribution costs, and distributing expenses on the basis of the financial capacity of the organization.
c. Its importance also lies in preparing production, inventory and purchasing schedules, estimating the needs of manpower, financial needs and the work of economic feasibility to determine profits.

3. Elements of the Demand Forecasting Process

Before performing the demand forecasting process, the following should be studied and taken into consideration: [2]

a. The ability of the institution to produce different types of goods, that is, to determine the production capabilities available to the institution in terms of the availability of various machines, equipment and supplies.
b. It is necessary to ensure that there is a demand in the market for the types of goods expected to be sold by the institution. In this context, the following matters must be studied:
    1) Studying the tastes and desires of consumers.
    2) Studying income levels and their differences.
    3) Understand the basic elements that make up the request.
    4) Attempting to understand and isolate the forces that affect the order number to take a certain value.
    5) If possible, each of these components can be estimated, and by combining them together, a better estimate of demand as a whole can be obtained.

4. Time Dimensions of Demand Forecasting

The chronological age of the application can be divided into three periods as in Table (1):

Table (1) Time Dimensions for Demand Forecast

No	Forecast Period	Time	Forecast Use
1	short	No more than a year	in procurement and manpower
2	medium	Three future years	In planning sales, budget, production and revenue
3	long	more than three years	Planning for ongoing or new goods or services

5. Factors Affecting Demand Forecasting Process

There are many factors that can affect the accuracy of forecasting, some of which are factors outside the control of the organization and are called external factors, and some of them are within the control of the organization and are called internal factors. [2]

a. External Factors: This type of factor cannot be controlled because it is subject to the environment in which the institution is located. These factors may affect the general trend of the demand line. A sales program must be adapted to these factors, by monitoring them periodically and making adjustments to them when needed. Among these factors are: [2]
    1) Political factors.
    2) Economic factors

3) Legal factors.
4) Competitive social factors.
5) In addition to these factors, there are other external factors such as technical changes used in the manufacture of the commodity, and fluctuations in prices of materials used in the industry, especially if they are imported from other countries.

b. Internal Factors: They are the factors that are under the control of the institution, but the degree of control over these factors depends on the ability of the institution to control the management process and the extent of the coherence of functional relationships within its organizational structure, and among these factors: [2]

1) The occurrence of a development in the commodity.
2) A change in the distribution methods used.

Demand forecasting is a difficult process, because reaching a number for the expected demand that approximates the actual demand is extremely difficult, but it is possible to reach numbers that are somewhat close to the actual demand using different quantitative methods. In general, the difficulty of forecasting demand is due to several considerations, including: [1]

a) Time range: The more the forecast is for short periods of time, the easier it is than forecasting for long periods of time, because the probability of changing the conditions that affect the forecast number is greater the longer the time period, and on the contrary, it is relatively easy to anticipate changes in the near future.
b) Stability: It means the extent of political, social and economic stability in the society, as these factors affect the demand for a particular commodity, and often the prediction of demand in stable societies is easier than in unstable societies, and for example if the institution depends on the export of a commodity to a particular country, it must be taken Bearing in mind that the demand for that commodity is greatly affected by the political relations between the two exporting and importing countries.

6. Multiple Factors Affecting Demand:

Those factors mean the set of influences on the demand for a particular commodity, such as price levels, commodity quality, advertising, packaging, and outlets. It is clear from the previous narrative that the forecasting process is difficult because it takes place under changing conditions governed by the element of time, the stability of society and the extent of overlapping factors affecting demand.

7. Demand Forecasting Methods

The methods used in the preparation of demand forecasting are classified into two main types. The first type is non-quantitative methods and they are also called

personal, qualitative, descriptive or qualitative methods, and they depend mainly on the experience and skill of individuals, while the second type is quantitative methods and is based mainly on the analysis of historical data, and the two types are:

a. **Descriptive Forecasting Methods:** Descriptive forecasting methods are usually used when historical data on demand is not available, and therefore they are suitable for preparing a long-term forecast when introducing new products or providing new services, or when making modifications to existing products, and descriptive forecasting is performed in multiple ways such as knowledge of experiences opinions, salesman estimates and market studies and Delphi method. [3]
b. **Quantitative Forecasting Methods:** They are the ways in which forecasts are measured using specific mathematical methods and time tables, and based on data from past years. A comparison can be made between descriptive and quantitative forecasting methods as shown in Table (2):

Table (2) Comparison between Descriptive and Quantitative Forecasting Methods

No	Type	Descriptive Forecasting Methods	It depends on mathematical calculations
1	Property	Depends on personal opinions and experiences	It depends on mathematical calculations
2	Advantages	You can easily include the latest changes (environmental or informational changes)	You can enter a lot of data and variables at once
3	Defects	Biased, reduce prediction accuracy	Some data not available

8. Paradoxes of Forecasting Methods

The paradoxes between descriptive and quantitative forecasting methods can be illustrated in Figure (1):

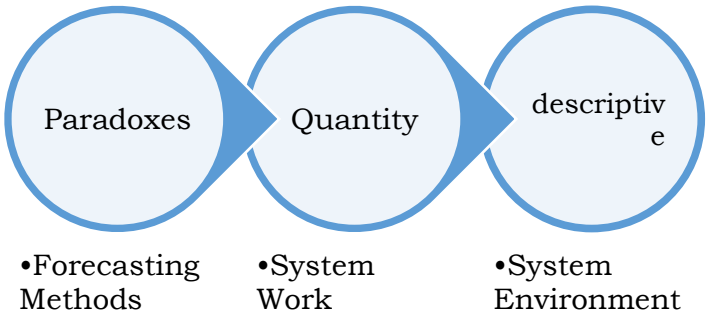

Figure (1) Paradoxes between Forecasting Methods (Al-Idrisi et al., 2015)

9. Factors for Selecting a Forecasting Method

One of the most important factors for choosing the forecast method can be listed as follows and can be expressed briefly as in Figure (2) showing the factors for choosing the forecast method:

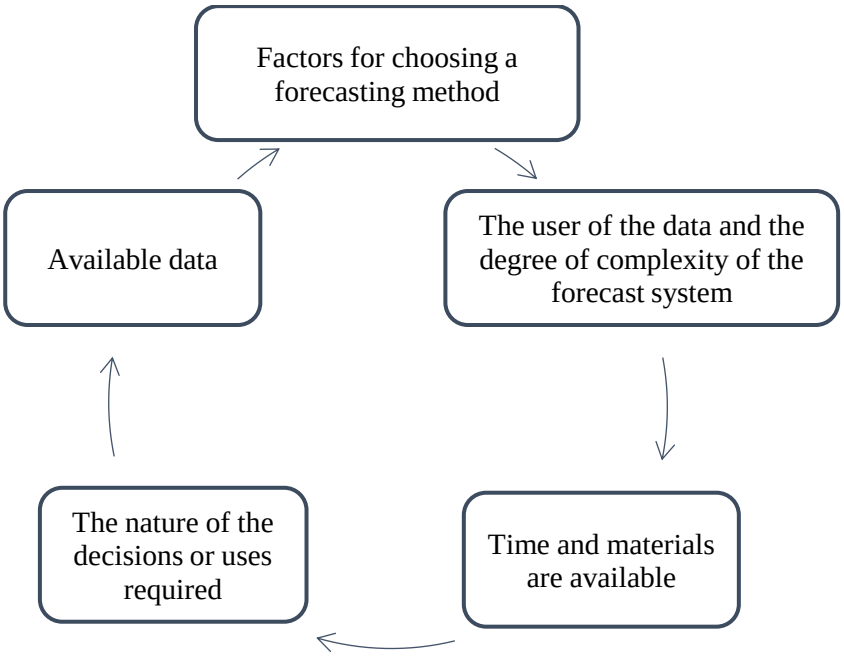

Figure (2) Factors for Choosing Forecast Method (Al-Idrisi et al., 2015)

a. The user of data and the degree of complexity of the forecast system:

The choice of the forecast method depends on the scientific and cultural level and the experience of managers, and they are the category that will benefit from the results of demand forecasting. Therefore, the methods used to forecast demand must correspond to those levels, for managers to refrain from using the forecast extracted by methods they do not understand. One of the important points preferred by users of the results; It is the use of common forecasting methods, and the trend currently tends to use forecasting methods that rely more on the use of complex mathematical methods. The use of these methods directly is a surprising move for managers, and therefore the choice of forecasting method must be taken into account not to be too advanced or too complex; Because the information of users of prediction results is usually much less than the level of those complex systems, and more than that, the use of simple systems is sometimes more feasible, that is, the end goal is not to use complex methods of forecasting as much as those methods are appropriate and consistent with the level of information users of the results. [3]

b. Time and materials available:

Choosing the forecast method depends on the time allowed to collect data, and preparing the forecast requires a period of time for data collectors and forecast

preparers. For example, preparing for a complex forecasting method requires collecting data for several months at a high cost, and the use of an electronic computer reduces the cost and time required to make a forecast. [3]

c. Nature of Decisions or Uses Required:

The association of the purpose prediction method has already been mentioned; of the procedures and nature of the decisions based on it, and these purposes are related to the required qualities such as the time period during which the signature is required and the scope and number of points required to be expected. [3]

d. Available data:

The choice of forecasting method often depends on the available data. It requires the use of an econometric model for forecasting, for example, certain data that are not easily available in a short time, and therefore another method must be chosen because it is not suitable for forecasting in the short time. The quality of the available data also affects the forecast. If the available data are few or inaccurate use led to inaccurate predictions. [3]

10. Forecasting Methods:

It can be classified into two groups:

a. Quality Methods: It is a set of objective methods that are used to make a forecast of demand when historical data on demand is not available and which depends on methods that invest the wisdom and experience possessed by management, as well as a group of other factors and information possessed by individuals such as intuition, personal experience and expectations, including the following four that are used at the time: [4]

1) Estimates of salesmen: This method is characterized by the accuracy of the contact of salesmen due to their constant contact with customers, and the spread of salesmen in geographical areas to facilitate the division of demand according to regions. And the inability of salesmen sometimes to distinguish between the desires of customers and the needs of customers, and the possibility of salesmen providing low estimates of the volume of demand in the future in order to appear in a good appearance in front of the company when their actual sales exceed the estimates they previously provided.
2) The expert committee method, and this method is sometimes used to modify forecasts made in the face of exceptional circumstances such as the promotion of new products or the occurrence of a global event that destabilizes the forecasts made by the company, and its disadvantages are the high cost associated with forecasting and the possibility of exaggerating or underestimating the demand due to the varying experiences possessed by the experts.
3) Marketing research: It is considered a systematic approach to formulating and testing hypotheses about the market, and it is in the short, medium and

long term, and its accuracy is in the short term, and it requires the following steps: [4]

- Designing a questionnaire to collect the necessary data
- Determining how the questionnaire will be administered
- Choosing a representative sample of the research community
- Analyzing the results of the questionnaire

4) Delphi method: It is the process of obtaining agreement among a group of experts about the prediction of an event in the future; While maintaining the confidentiality of the identity of each member of the group, the procedure for this method requires three types of participants: [4]

- The prediction decision makers are 5-10
- The assistants of the forecast decision-makers who prepare a series of questionnaires, distribute them to the members of the secret committee, collect and summarize the results and present them to the decision-makers.
- Experts, who are the individuals who receive the questionnaire and answer it, and their answers are considered inputs to decision makers in preparation for the prediction.

b. Quantitative Methods: Quantitative methods can be divided into several methods, including: [5]

1) **Time series analysis:** The series represents a set of observations arranged chronologically according to the sequence of their occurrence, and that the time series may include one or more of the following elements: average, trend, seasonal effect, periodic effect, random factors, and perhaps autocorrelation as well. Time series aims to identify and isolate each of the previous elements, and on this basis, the prediction for a specific period is expressed as a function of the previous factors, and as follows. [7]:

$$Y = T * C * S * R$$

Whereas:

Y is forecast for a future period

T is direction

C is periodic effect

S is seasonal effect

R is random variables.

2) Causal Methods: Including linear regression and multiple regression, and it is one of the most effective ways to predict demand, and is used when there is a lot of information available about the relationship between demand and a set of internal and external factors that can affect demand, namely [7]: Linear regression method: This method assumes that demand occurs because of one reason. One or more variables, and the demand is called the dependent

variable, and the factor or factors that cause demand are called the independent factors, and the following equation is used to describe the relationship between two variables, one independent and the other dependent: [8]

$$Y = a + b X$$

As for the constants a, and b, they are calculated using the least squares method, as follows [8].

$$\boldsymbol{b} = \frac{\sum \boldsymbol{XY} - \boldsymbol{n}\,\overline{\boldsymbol{X}}\,\overline{\boldsymbol{Y}}}{\sum \boldsymbol{X^2} - \boldsymbol{n}\overline{\boldsymbol{X}}^{\boldsymbol{2}}}$$

$$a = \overline{Y} - b\,\overline{X}$$

$$\overline{\boldsymbol{X}} = \frac{\sum \mathbf{X}}{\mathbf{n}}$$

$$\overline{\boldsymbol{Y}} = \frac{\sum \boldsymbol{Y}}{\boldsymbol{n}}$$

A is called the regression constant, and its value means the value of the dependent variable when the value of the independent variable is zero, and it represents the point of intersection of the regression line with the vertical axis (which represents the dependent variable), as shown in Figure (3).

$$\boldsymbol{r} = \frac{\sqrt{\mathbf{n}\sum \boldsymbol{x^2} - (\sum \boldsymbol{x})^{\,2}}}{\sqrt{\mathbf{n}\sum \boldsymbol{y^2} - (\sum \boldsymbol{y})^{\,2}}}$$

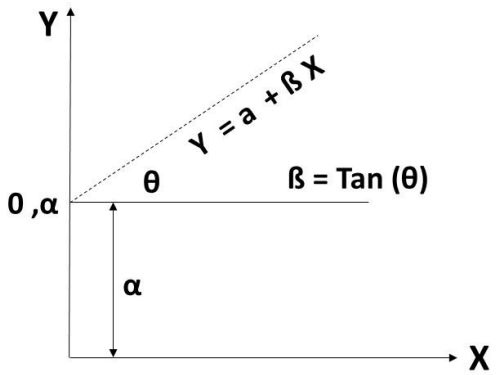

Figure (3) Linear Regression Equation (Boufenesh., 2009)

The type of relationship is determined by the sign of the correlation coefficient, if the sign is positive, this indicates that the relationship is direct, and if the sign is negative, this indicates that the relationship is inverse. When interpreting the value of the linear correlation coefficient calculated from the sample data, there are no fixed rules, but rather subject to the approximation process, which depends mainly on the field of study, and it is customary to

judge the correlation coefficient in a way that approaches as mentioned in Table (3).

Table (3) Relationship between two Variables (Boufenesh., 2009)

Value of Correlation Coefficient between Two Variables	Relationship between Two Variables (Independent and Dependent)
$\|0.00\| \leq r < \|0.25\|$	There is No Relationship
$\|0.25\| \leq r < \|0.50\|$	Weak
$\|0.50\| \leq r < \|0.75\|$	Medium
$\|0.75\| \leq r < \|0.90\|$	Strong
$\|0.90\| \leq r < \|1.00\|$	Very Strong

PREDICTION MODELS

The linear regression analysis method was used because it is relatively simple and provides an easy-to-interpret mathematical formula that can make predictions and linear regression can be applied to different areas of business. Linear regression analysis is used to predict the value of a variable based on the value of another variable. The variable you want to predict is called the dependent variable, and the variable you use to predict the value of the other variable is called the independent variable. This analysis model estimates the coefficients of a linear equation, which includes one or more independent variables that best predict the value of the dependent variable. Linear regression fits the straight line method or surface that minimizes discrepancies between expected and actual output values. Make predictions more easily we can apply linear regression in Microsoft Excel which greatly simplifies the process of using linear regression equations, linear regression models and linear regression formula. Organizational leaders can make better decisions using linear regression techniques, where organizations collect large amounts of data, and linear regression helps them use that data to better manage reality instead of relying on experience and intuition, and we can take large amounts of raw data and turn it into actionable information, and Table (4) shows the sales volume of the Iron and Steel Company, i.e. the data on which forecasts are made.

1. Demand Forecasting of the Firm

The main purpose of demand forecasting is used to study the economic feasibility. It requires access to accurate measurements of the expected volume of sales for future periods, and it is to review the actual sales data of the product in previous periods, which are being expanded or a new product is added to the product mix for the purpose of determining the general level of sales and knowing their seasonal trends of increase or decrease. The volume of sales in its value in a certain period of

the year and at its lowest level in another period, By reviewing the sales data during a certain period of time, the company becomes in a better position to understand the trend of previous sales and thus increases its capabilities to forecast future sales, and to forecast the sales demand for the Iron and Steel Company, 96 months, i.e. for 8 years, were taken from (2012 to 2019) and the linear regression method was applied about it by the following equation.

$$Y = a + b\,x$$

Where:

Expected demand: Y

$$b = \sum xy - n\,\bar{x}\bar{y}$$

$$\mathrm{a} = \overline{\mathrm{Y}} - \mathrm{b}\,\overline{\mathrm{X}}$$

$$\bar{X} = \frac{\sum \mathrm{X}}{\mathrm{n}}$$

$\bar{Y} = \frac{\sum Y}{n}$ Time is months

Y is Sales

n is Number of samples

$\bar{X}$ is Average time

$\bar{y}$ is Average sales

E is Error rate

F is Actual demand

Y is Expected demand

The data was entered from Table (4) on the program (Microsoft Excel) and using the previous equations, the prediction and error rate were obtained as shown in Table (5)

Table (4) Sales Data For 8 Years

Year	Quantity sold during the months for each year in tons												Total (tons)
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
2012	32,450	32,450	32,450	32,450	32,931	32,481	21,161	18,476	43,360	23,248	31,941	37,518	370,916
2013	37,476	35,884	46,432	48,029	46,034	44,347	22,821	29,154	44,983	41,437	53,454	61,154	511,205
2014	55,612	48,571	61,484	60,787	56,768	47,356	10,689	14,992	21,413	26,045	31,929	37,606	473,252
2015	39,783	39,649	15,723	30,143	30,941	23,856	19,685	34,221	32,450	39,252	41,281	32,419	379,403
2016	29,733	34,922	45,322	30,391	31,748	16,246	34,906	45,778	29,141	32,942	17,507	37,407	386,043
2017	32,450	28,458	43,106	48,560	38,905	21,168	16,905	19,533	32,562	36,358	23,314	37,707	379,026
2018	33,990	33,005	28,346	19,481	23,613	23,653	39,592	31,759	39,369	26,957	27,233	33,819	360,817
2019	40,074	30,095	53,038	41,816	24,304	29,211	44,930	33,194	44,606	46,340	44,369	32,450	464,427

Table (5) Expected Demand and Error Rate

Months	**Month**	**Actual Demand**	**Expected Demand**	**Error Rate**
Year	X	F	Y = a + b*x	E = Y- F
1	1	32450	36247.10309	3797.10309-
2	2	32450	36207.52263	3757.52263-
3	3	32450	36167.94217	3717.94217-
4	4	32450	36128.36171	3678.36171-
5	5	32931	36088.78125	3157.78125-
6	6	32481	36049.20079	3568.20079-
7	7	21161	36009.62033	14848.62033-
8	8	18476	35970.03987	17494.03987-
9	9	43360	35930.45941	7429.54059
10	10	23248	35890.87895	12642.87895-
11	11	31941	35851.29849	3910.29849-
12	12	37518	35811.71803	1706.28197
1	13	37476	35772.13757	1703.86243
2	14	35884	35732.55711	151.44289
3	15	46432	35692.97665	10739.02335
4	16	48029	35653.3962	12375.6038
5	17	46034	35613.81574	10420.18426
6	18	44347	35574.23528	8772.76472
7	19	22821	35534.65482	12713.65482-
8	20	29154	35495.07436	6341.07436-
9	21	44983	35455.4939	9527.5061
10	22	41437	35415.91344	6021.08656
11	23	53454	35376.33298	18077.66702
12	24	61154	35336.75252	25817.24748
1	25	55612	35297.17206	20314.82794
2	26	48571	35257.5916	13313.4084
3	27	61484	35218.01114	26265.98886
4	28	60787	35178.43068	25608.56932
5	29	56768	35138.85022	21629.14978
6	30	47356	35099.26976	12256.73024
7	31	10689	35059.6893	24370.6893-
8	32	14992	35020.10884	20028.10884-
9	33	21413	34980.52838	13567.52838-
10	34	26045	34940.94792	8895.94792-
11	35	31929	34901.36746	2972.36746-
12	36	37606	34861.787	2744.213
1	37	39783	34822.20654	4960.79346
2	38	39649	34782.62608	4866.37392
3	39	15723	34743.04562	19020.04562-
4	40	30143	34703.46516	4560.46516-
5	41	30941	34663.8847	3722.8847-

6	42	23856	34624.30424	10768.30424-
7	43	19685	34584.72378	14899.72378-
8	44	34221	34545.14332	324.14332-
9	45	32450	34505.56286	2055.56286-
10	46	39252	34465.9824	4786.0176
11	47	41281	34426.40194	6854.59806
12	48	32419	34386.82148	1967.82148-
1	49	29733	34347.24102	4614.24102-
2	50	34922	34307.66056	614.33944
3	51	45322	34268.0801	11053.9199
4	52	30391	34228.49964	3837.49964-
5	53	31748	34188.91918	2440.91918-
6	54	16246	34149.33872	17903.33872-
7	55	34906	34109.75826	796.24174
8	56	45778	34070.1778	11707.8222
9	57	29141	34030.59734	4889.59734-
10	58	32942	33991.01688	1049.01688-
11	59	17507	33951.43642	16444.43642-
12	60	37407	33911.85596	3495.14404
1	61	6596	33872.2755	27276.2755-
2	62	28458	33832.69504	5374.69504-
3	63	43106	33793.11458	9312.88542
4	64	48560	33753.53412	14806.46588
5	65	38905	33713.95366	5191.04634
6	66	21168	33674.3732	12506.3732-
7	67	16905	33634.79274	16729.79274-
8	68	19533	33595.21228	14062.21228-
9	69	32562	33555.63182	993.63182-
10	70	36358	33516.05136	2841.94864
11	71	23314	33476.4709	10162.4709-
12	72	37707	33436.89044	4270.10956
1	73	33990	33397.30998	592.69002
2	74	33005	33357.72952	352.72952-
3	75	28346	33318.14906	4972.14906-
4	76	19481	33278.5686	13797.5686-
5	77	23613	33238.98814	9625.98814-
6	78	23653	33199.40768	9546.40768-
7	79	39592	33159.82722	6432.17278
8	80	31759	33120.24676	1361.24676-
9	81	39369	33080.6663	6288.3337
10	82	26957	33041.08585	6084.08585-
11	83	27233	33001.50539	5768.50539-
12	84	33819	32961.92493	857.07507
1	85	40074	32922.34447	7151.65553

2	86	30095	32882.76401	2787.76401-
3	87	53038	32843.18355	20194.81645
4	88	41816	32803.60309	9012.39691
5	89	24304	32764.02263	8460.02263-
6	90	29211	32724.44217	3513.44217-
7	91	44930	32684.86171	12245.13829
8	92	33194	32645.28125	548.71875
9	93	44606	32605.70079	12000.29921
10	94	46340	32566.12033	13773.87967
11	95	44369	32526.53987	11842.46013
12	96	32450	32486.95941	36.95941-

2. Seasonal Index

Time series is an advanced quantitative forecasting tool in the field of future foresight. It is also considered one of the basic topics that are widely used in various sciences, especially in statistics and analysis, and statistical analytical procedures resulting from the use of time series, and it has a prominent and important role in making decisions in major Global institutions that are useful in forecasting the future. The seasonality index method is one of the statistical methods worthy of attention, which has developed a lot and can be used for the purpose of forecasting the future of supply and demand for a service or a commodity. The seasonal index method depends on tracking the phenomenon (or the variable) over a certain time range (several years, for example), and then it is expected for the future based on the different values that appeared in the indicator and on the pattern of growth in values.

It means a set of observed values connected to each other, generated in succession with the continuation of time, and it contains a seasonal phenomenon, which refers to the symmetric pattern of the movement of the time series in the opposite months during the successive years. It is a year, a season or a month, and the seasonality index of the iron and steel company can be calculated for the previous 8 years, and through Table (6) the seasonality index is calculated and can be expressed by the following equations:

Seasonality Index = Expected Demand / Actual Demand

Adjusted Seasonality Index = Sum of Seasonality Index for Same Month / Number of Years

Final Adjusted Seasonality Index = Adjusted Seasonality Index / (12 / Total Adjusted Seasonality Index)

The data was entered from Table (5), on the (Microsoft Excel) program, and using the previous equations, the seasonality index was obtained as shown in Table (6).

Table (6) Seasonality Index

No	1	2	3	4	5	6	7	8	9	10	11	12
1	0.90	0.90	0.90	0.90	0.91	0.90	0.59	0.51	1.21	0.65	0.89	1.05
2	1.05	1.00	1.30	1.35	1.29	1.25	0.64	0.82	1.27	1.17	1.51	1.73
3	1.58	1.38	1.75	1.73	1.62	1.35	0.30	0.43	0.61	0.75	0.91	1.08
4	1.14	1.14	0.45	0.87	0.89	0.69	0.57	0.99	0.94	1.14	1.20	0.94
5	0.87	1.02	1.32	0.89	0.93	0.48	1.02	1.34	0.86	0.97	0.52	1.10
6	0.19	0.84	1.28	1.44	1.15	0.63	0.50	0.58	0.97	1.08	0.70	1.13
7	1.02	0.99	0.85	0.59	0.71	0.71	1.19	0.96	1.19	0.82	0.83	1.03
8	1.22	0.92	1.61	1.27	0.74	0.89	1.37	1.02	1.37	1.42	1.36	1.00
	12 / Total Seasonal Index Adjusted						Total Seasonal Index Adjusted					
	1.00557						11.9335					
	Total Seasonality Index Final Average						12					

Linear regression method was used to forecast the demand and it was implemented over a period of 96 months. It determines the planning of business, sales and marketing strategies for the Iron and Steel Company, and Table (7) shows the expected demand, seasonality and rate.

Table (7) Expected Demand and Adjusted Demand

Months	Expected Demand	Adjusted Expected Demand	Seasonal
1	32447	32449	1
2	32408	33328	1.02
3	32368	38489	1.18
4	32329	36688	1.13
5	32289	32736	1.03
6	32249	27950	0.86
7	32210	25095	0.77
8	32170	26908	0.83
9	32131	33637	1.04
10	32091	31164	0.97
11	32052	31896	0.99
12	32012	36437	1.13
Forecasting	Expected Average Demand	Adjusted Average Demand	Difference
	386756	386783	27

3. Demand forecasting confidence level (95% - 99%)

The demand that comes from outside the company for its final goods, which governs to a large extent the company's ability to achieve the expected rates of return on the invested funds, and the estimate of the expected demand and the possibility of its continuation in the future represents the cornerstone of the efficiency of carrying out the transformational process, but this estimate demand needs To a high level of confidence, in order for the company to prepare production, inventory and purchase

schedules, estimate the needs of manpower, financial needs and work on economic feasibility to determine profits.

a. 95% confidence level: The data was extracted from Table (7) on the (Microsoft Excel) program, and the statistical estimates shown in Table (8) were obtained, which shows the statistical estimates for the 95% confidence level.

Table (8) Statistical Estimates of 95% Confidence Level

item	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 99.0%	Upper 99.0%
Intercept	36286.68	2316.38	15.67	0.00	31687.45	40885.91	30196.57	42376.79
t	-39.58	41.47	-0.95	0.34	-121.92	42.76	-148.61	69.45

The expected demand for the minimum and the maximum can be expressed by the following equations:

Expected Minimum Order = Minimum Intersection + (Minimum T Value X Month)

Expected Demand Upper Bound = Upper Bound Intersection + (Maximum T Value X Month)

The data was entered on Microsoft Excel through Table (4) and Table (8) and the expected demand for the minimum and maximum confidence level of 95% shown in Table (9) was obtained.

Table (9):
Expected Demand for Lower and Upper Bound for 95% Confidence Level

Months	Expected Average Demand	Expected Minimum Demand	Expected Maximum Demand
97	32447	19861	45033
98	32408	19739	45076
99	32368	19617	45118
100	32329	19495	45161
101	32289	19373	45204
102	32249	19251	45247
103	32210	19129	45289
104	32170	19008	45332
105	32131	18886	45375
106	32091	18764	45418
107	32052	18642	45460
108	32012	18520	45503

b. Confidence level of 99%: The data was extracted from Table (7) on the (Microsoft Excel) program, and the statistical estimates shown in Table (10)

were obtained, which shows the statistical estimates for the 99% confidence level.

Table (10) Statistical Estimates of 99% Confidence Level

item	Coefficients	Standard Error	t Stat	P-value	Lower 99.0%	Upper 99.0%
Intercept	36286.68	2316.38	15.67	0.00	30196.57	42376
t	-39.58	41.47	-0.95	0.34	-148.61	69.44

The expected demand for the minimum and the maximum can be expressed by the following equations:

Expected Minimum Order = Minimum Intersection + (Minimum T Value X Month)

Expected Demand Upper Bound = Upper Bound Intersection + (Maximum T Value X Month)

The data was entered on (Microsoft Excel) through Table (7) and Table (8), and the expected demand for the minimum and maximum confidence level of 99% shown in Table (11) was obtained.

Table (11) Expected Demand for Minimum and Maximum Confidence Level 99%

Months	Expected Average Demand	Expected Minimum Demand	Expected Maximum Demand
97	32447	15781	49113
98	32408	15632	49182
99	32368	15484	49252
100	32329	15335	49321
101	32289	15187	49390
102	32249	15038	49460
103	32210	14889	49529
104	32170	14741	49599
105	32131	14592	49668
106	32091	14444	49738
107	32052	14295	49807
108	32012	14146	49877

4. Forecasting Demand for Average Months of the Firm

Demand was also predicted in the same way as a linear regression for 96 months of sales for the Iron and Steel Company, but it was worked on the basis of average totals for the months, i.e. for 8 years from (2012 - 2019). Table (12) shows sales data, average months and totals.

Table (12) Sales Data, Average Months and Totals

No	Year	Quantity Sold												Total
		1	2	3	4	5	6	7	8	9	10	11	12	Ton
1	2012	32450	32450	32450	32450	32931	32481	21161	18476	43360	23248	31941	37518	370916
2	2013	37476	35884	46432	48029	46034	44347	22821	29154	44983	41437	53454	61154	511205
3	2014	55612	48571	61484	60787	56768	47356	10689	14992	21413	26045	31929	37606	473252
4	2015	39783	39649	15723	30143	30941	23856	19685	34221	32450	39252	41281	32419	379403
5	2016	29733	34922	45322	30391	31748	16246	34906	45778	29141	32942	17507	37407	386043
6	2017	32450	28458	43106	48560	38905	21168	16905	19533	32562	36358	23314	37707	379026
7	2018	33990	33005	28346	19481	23613	23653	39592	31759	39369	26957	27233	33819	360817
8	2019	40074	30095	53038	41816	24304	29211	44930	33194	44606	46340	44369	32450	464427
Total Monthly Demand		301568	283034	325901	311657	285244	238318	210689	227107	287884	272579	271028	310080	3325089
Average Monthly Demand		37696	35379	40738	38957	35656	29790	26336	28388	35986	34072	33879	38760	34636

The data was entered from Table (12) on Microsoft Excel and using the previous equations related to expect demand, error rate and seasonality index, the expected demand, error rate and seasonality index for the average months were obtained as shown in Table (13).

Table (13) Expected Demand, Error Rate and Seasonality Index for Average Months

Month	Average Demand	Expected Demand	Error A-F	Modified Request	Seasonal Indicator	Adjusted Seasonality Index	Expected And Average Demand
1	37696	36339.66346	1356.337	36339.66	1.037324	1.037262	37693.74
2	35379.25	36029.96897	-650.719	36029.97	0.98194	0.981881	35377.13
3	40737.625	35720.27448	5017.351	35720.27	1.140462	1.140394	40735.18
4	38957.125	35410.57998	3546.545	35410.58	1.100155	1.100089	38954.79
5	35655.5	35100.88549	554.6145	35100.89	1.015801	1.01574	35653.36
6	29789.75	34791.191	-5001.44	34791.19	0.856244	0.856193	29787.97
7	26336.125	34481.4965	-8145.37	34481.5	0.763776	0.76373	26334.55
8	28388.375	34171.80201	-5783.43	34171.8	0.830754	0.830705	28386.67
9	35985.5	33862.10752	2123.392	33862.11	1.062707	1.062643	35983.34
10	34072.375	33552.41302	519.962	33552.41	1.015497	1.015436	34070.33
11	33878.5	33242.71853	635.7815	33242.72	1.019125	1.019064	33876.47
12	38760	32933.02404	5826.976	32933.02	1.176934	1.176864	38757.68

5. Demand forecast for average months confidence level (95% - 99%)

Demand forecasting is the starting point in planning for all departments, as it enables knowledge of the expected revenue, and is also considered the basis for making marketing decisions such as promotion, distribution and pricing, in addition to determining production and distribution costs, and distributing expenses on the basis of the company's financial ability. The confidence level of (95% - 99%) is as follows:

a. 95% confidence level for the average month: The data was extracted from Table (13) on the (Microsoft Excel) program, and the statistical estimates shown

in Table (14) were obtained, which shows the statistical estimates for the average months of the 95% confidence level.

Table (14) Statistical Estimates of Average Months for 95% Confidence Level

item	Coefficients	Standard Error	Test	P-value	Lower 95.0%	Upper 95.0%
Intercept	36649	36649	13.17	1.20 E-07	30541	42847
t	-309.69	377.94	-0.81	0.34	-1151	532.42

The expected demand for the minimum and the maximum can be expressed by the following equations:

Expected Minimum Order = Minimum Intersection + (Minimum T Value X Month)

Expected Demand Upper Bound = Upper Bound Intersection + (Maximum T Value X Month)

The data was entered on the Microsoft Excel program through Table (13) and Table (14) and the expected demand for the minimum and upper average of the 95% confidence level shown in Table (15) was obtained.

Table (15) Expected Demand for Minimum and Upper Average Months for The 95% Confidence Level

Months	Expected Average Demand	Expected Minimum Demand	Expected Maximum Demand
13	32623	15477	49769
14	32314	14326	50301
15	32004	13174	50834
16	31694	12022	51366
17	31385	10870	51898
18	31075	9718	52431
19	30765	8566	52963
20	30455	7415	53496
21	30146	6263	54028
22	29836	5111	54561
23	29526	3959	55093
24	29217	2807	55625

b. 99% confidence level for the average month: The data was extracted from Table (13) on the (Microsoft Excel) program, and the statistical estimates shown in Table (16) were obtained, which shows the statistical estimates for the average months of the 99% confidence level.

Table (16) Statistical Estimates of Average Months for 99% Confidence Level

item	Coefficients	Standard Error	Test	P-value	Lower 99.0%	Upper 99.0%
Intercept	36649	2781	13.17	1.20 E-07	27833	45465
t	-309.69	377.94	-0.81	0.34	-1507	888

The expected demand for the minimum and the maximum can be expressed by the following equations:

Expected Minimum Order = Minimum Intersection + (Minimum T Value X Month)

Expected Demand Upper Bound = Upper Bound Intersection + (Maximum T Value X Month)

The data was entered on (Microsoft Excel) through Table (13) and Table (16) and the expected demand for the minimum and maximum average months for the 99% confidence level shown in Table (17) was obtained.

Table (17) Expected Demand for Minimum and Upper Average Months for 99% Confidence Level

Months	Expected Average Demand	Expected Minimum Demand	Expected Maximum Demand
13	32623	8235.882	57010.78
14	32314	6728.364	57898.91
15	32004	5220.846	58787.04
16	31694	3713.328	59675.16
17	31385	2205.81	60563.29
18	31075	698.2919	61451.42
19	30765	-809.226	62339.55
20	30455	-2316.74	63227.68
21	30146	-3824.26	64115.81
22	29836	-5331.78	65003.94
23	29526	-6839.3	65892.07
24	29217	-8346.82	66780.2

CONCLUSION

Several results have emerged from the study, including the following:

1. Using this model, we have obtained good results, with which we can support the senior management of the Libyan Iron and Steel Company with a confidence of 95% & 99%.
2. The average error between the expected demand and the actual demand is very small, and this indicates the accuracy of the results obtained. The average error for the first method was (1.12777 E-10) and for the second method (-1.81899 E-12) and this does not represent a difference in the results.

3. The officials' lack of awareness of the importance and feasibility of forecasting models and their application despite studies and research confirming the positive results achieved by these models and the attention they received for their effectiveness in the management process.
4. The scarcity of competencies capable of using these scientific methods that keep pace with global development in forecasting production capacity.
5. The absence of a real study of the market, and the gap between the Libyan Iron and Steel Company and its customers is constantly expanding and this has led to idle production capacity and the company bearing additional costs due to excess production sometimes and due to the inability to meet demand at other times.
6. The Libyan Iron and Steel Company does not control costs, and therefore does not control the price and secure a fixed profit margin, in addition to the company bearing additional costs resulting from the creation of irrelevant interests that can be combined into one interest.

RECOMMENDATIONS

After presenting all the findings of the study, some recommendations can be made as follows:

1. The necessity of relying on the quantitative methods of forecasting models in the management of the various functions of the Libyan Iron and Steel Company and choosing among these techniques, especially with the development of the computer, which provided the decision maker with great capabilities in the speed of calculations and the enormous ability to store and retrieve information.
2. Finding a department or body specialized in the field of forecasting, or at least seeking the help of specialists in the field of forecasting, because the majority of economic data are random in nature.
3. Carry out a forecasting process within a limited period of time and review this forecast in light of changes related to the general economic conditions and problems specific to the Libyan Iron and Steel Company.
4. Choosing an appropriate method for forecasting by balancing the accuracy of the results provided by the chosen method and the cost of applying the latter, and using methods that rely on statistical foundations such as significance tests and confidence intervals.

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