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Statistical Methods to Predict the FDI in Jordan by using Winter's Exponential Smoothing Technique

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Abstract: *This study aims to apply the statistical methods for prediction of the FDI in Jordan by using Winter's Exponential Smoothing Technique. To achieve the objectives, the study is mainly based on the secondary data related to FDI in Jordan selected from the annual reports for Multi-years of the Jordanian Investment Board for the period (2003-2014). The study reached to a number of results, including the following:*

a. *The results of forecasting explained that the Foreign Direct Investment (FDI) in Jordan will see a rise in the nearest future.*

b. *The Winter's Exponential Smoothing Multiplicative model is adequate to forecast the FDI in Jordan.*

Keywords: *Time series, Prediction, Winters Technique, Exponential Smoothing, Multiplicative Seasonal Model.*

1. Introduction

The foreign investment is constitute focus of the attention for governments in many countries of the world, especially the Arab countries, Jordan has sought to pay attention to attracting and attracting such investments through the facilities and legislation, and work to enhance the attraction of investments, including Arab investments investment environment. For that successive Jordanian government have sought, through the promotion of investment to improve the investment climate and attract investment, and marketing of the Jordanian investment environment Foundation, through the restructuring of many of the laws, regulations and legislative reforms to achieve greater economic freedom, and the removal of restrictions on Arab capital movement and foreign (Touama, 2015). The Foreign direct investment has increased dramatically in Jordan since 1980. Jordan has offered special programs and incentives to promote FDI and attract foreign capital. Most FDI in Jordan depend upon privatizing major public owned companies, and facilitating partnership-based companies which unite domestic and foreign investors. Hence, the most important is to consider which type of FDI is to be attracted and into which sector need to be promoted (Yaseen, 2014: 127).

2. Methodology

2.1. The Study Problem

The study problem involves on the weakness of some of the traditional ways to predict, so the researcher using modern method for forecasting purposes as Winter's exponential smoothing technique, which is proved the quality of the results of this technical by many studies.

2.2. The Study Objectives

The study objectives are to apply of the statistical methods to predict the FDI in Jordan by using Winter's Exponential Smoothing Technique. This main objective will be achieved through achievement of the following sub-objectives:

1. To identify the concept of the FDI in Jordan.
2. To identify the concept of Exponential Smoothing and its types.

3. To identify Winter's Exponential Smoothing Technique**.**
4. To predict FDI in Jordan by using Winter's Exponential Smoothing Technique for the years (2015 and 2016).

3. METHODS OF SOLUTION

3.1. Winter's Exponential Smoothing Technique

The exponential smoothing is a procedure for continually revising a forecast in the light of more recent experience. Exponential smoothing assigns exponentially decreasing weights as the observation get older. In other words, recent observations are given relatively more weight in forecasting than the older observations. And the exponential smoothing be on three types are (Single Exponential Smoothing, Holt's Exponential Smoothing, Winter's Exponential Smoothing) (Prajakta, 2004: 3-4).

In Single Exponential Smoothing, the forecast function is simply the latest estimate of the level. If the trend and seasonal components are added which itself is updated by Winter's Exponential Smoothing.

Based on the above, Winter's Exponential Smoothing method is a three parameter model that is an extension of Holt's Exponential Smoothing method.

3.2. Multiplicative Seasonal Model

We can explain the necessary equations of **Multiplicative Seasonal Model** for Winter's Exponential Smoothing Series, which are given as follows:

- The Level of series estimate, is given by:

  $$L_t = \alpha \ (У_t / S_{t-m}) + (1-\alpha)(L_{t-1} + T_{t-1}) \quad (1)$$

  Where $(0< \alpha <1)$ is a smoothing constant of the data.

- The Trend estimate, is given by:

  $$T_t = \beta \ (L_t - L_{t-1}) + (1-\beta) \ T_{t-1} \quad (2)$$

  Where $(0< \beta <1)$ is the smoothing constant for the trend.

- The Seasonality estimate, is given by:

  $$S_t = \gamma \ (У_t / L_t) + (1-\gamma) \ S_{t-m} \quad (3)$$

  Where $(0< \gamma <1)$ is the smoothing constant for the seasonality.

- The value of forecast n periods in the future, is given by:

  $$F_{t+n} = (L_t + n \ T_t) \ S_{t+n-m} \quad (4)$$

Whereas:

L_t: Level of series estimate.

α : Smoothing constant of data.

$У_t$: Actual value in period t.

β : Smoothing constant for trend.

T_t: Trend estimate.

γ : Smoothing constant for seasonality.

S_t: Seasonality estimate.

n: Number of periods in the forecast lead period.

m: Number of periods in the season.

F_{t+n}: Forecast n Period in the future.

The Winter's exponential smoothing parameters (α , β and γ) can be selected in order to minimize the measure of **forecast** error, such as (RMSE and MAD).

In order to apply the **Multiplicative Seasonal Model** should be calculate the **initial values** for each of (L_m , T_m and S_m), as follows:

- The initial value of the level $\mathbf{L_m}$, is given by:

  $L_m = (y_1+y_2+\ldots y_m) / m$ (5)
- The initial value of the Trend $\mathbf{T_m}$, is given by:

  $T_m = (y_{m+1} - y_1) / m$ (6)
- The initial value of the Seasonal indicators **(S_1, S_2,..., S_m),** is given by:

$$\left.\begin{aligned} S_1 &= y_1 / Lm \\ S_2 &= y_2 / Lm \\ &\ldots\ldots\ldots\ldots \\ S_m &= y_m / L_m \end{aligned}\right] \quad (7)$$

3.3. Forecasting Accuracy Tests

There are two important criterions to test the **accuracy** of the forecasting, and to test the **adequate** of Winter's Exponential Smoothing Multiplicative Model, as follows:

a. Mean Absolute Deviation (MAD):

$$MAD = \sqrt{\sum |e_t| / n} \quad (8)$$

b. Root Mean Square Error (RMSE):

$$RMSE = \sqrt{\sum e_t^2 / n} \quad (9)$$

c. Ljung - Box Statistic (Q*)**:**

$$Q^* = N(N+2)\sum_{j=1}^{n} r_i^2/(N-j) \quad (10)$$

Whereas:

N**:** Number of observations**.**

r_i^2: Square of the autocorrelation of residuals.

Q*: Is distributed as a Chi-square (χ^2) distribution with (df = N-2)

4. Results and Discussion

4.1. Estimation the (L_t, T_t and S_t) of Winter's Exponential Smoothing Technique

The study is mainly depending on the secondary data related to Foreign Direct Investment (FDI) selected from the annual reports for Multi-years of the Jordanian Investment Board. To achieve the study objects, the researcher select the data of FDI during the period (2003-2014), as shown in Table (1). The results in Table (1), refers to estimate the (Level, Trend, and seasonal) of Winter's Exponential Smoothing Multiplicative model, as follows:

Table1. *Estimation the (L_t, T_t and S_t) of Winter's Exponential Smoothing Technique*

Years	t	FDI	L_t	T_t	S_t	F_{t+n}
2003	1	8865	-	-	0.8829	-
2004	2	9624	-	-	0.9585	-
2005	3	10409	-	-	1.0367	-
2006	4	11265	10040.75	843.250	1.1219	-
2007	5	12238	11777.14	932.564	0.9141	9609.48
2008	6	13187	13024.18	964.012	0.9693	12182.25
2009	7	15135	18367.95	1401.988	0.9942	14501.56
2010	8	16324	18204.05	1245.399	1.0768	22179.89
2011	9	17521	19364.86	2281.669	0.9122	17778.74
2012	10	16193	20164.33	2133.449	0.9361	20981.98
2013	11	16875	20700.48	1973.719	0.9584	22168.45
2014	12	17928	20866.74	1792.973	1.0332	24415.58

The results in Table (1), refers to the following:

a. The estimation values of (L_4, T_4) and (S_1, S_2, S_3, S_4 and S_5), calculated by the relations (5), (6) and (7) respectively.

b. The estimation values of (L_t , T_t and S_t) for (t = 5,6,…12), calculated by the relations (1), (2) and (3) respectively, at the parameters ($\alpha = 0.3$, $\beta = 0.1$ and $\gamma = 0.2$).

c. The estimation forecasting values of (F_{t+n}) calculated by the relation No. (4).

4.2. Test the adequate of Winter's Exponential Smoothing Multiplicative Model

The results in Table (2), explained the criterions (RMSE and MAD) for testing the forecasting accuracy, and the statistic (Q*) to test the adequate of Winter's Exponential Smoothing Multiplicative model, as follows:

Table2. *Test the Forecasting Accuracy & the Adequate of Winter's Exponential Smoothing Multiplicative Model*

Model	Criterions		Ljung - Box Statistic (Q*)		
	RMSE	MAD	Q*	df.	Sig.
FDI - model	0.2097	5.8041	2.451	10	0.248

[Critical value of (χ^2) with (df = 10), at the significant level ($\alpha = 0.05$)] = 18.307

The results of the criterions for testing the forecasting accuracy, and to test the adequate of Winter's Exponential Smoothing Multiplicative model, incoming in Table (2), indicates to:

a. The **forecasting accuracy** by the Winter's Exponential Smoothing Multiplicative model is very high**,** because the values of the accuracy criterions (RMSE and MAD) were low, and equals to (0.2097 and 5.8041) respectively.

b. The Winter's Exponential Smoothing Multiplicative model is **adequate** to forecast the FDI in Jordan, because the value of the Ljung - Box (Q*) statistic which is equals to (2.451) is less than the critical value of Chi-square (χ^2) (18.307) at the significant level ($\alpha = 0.05$), and the statistical significant (p-value) (0.248) is greater than ($\alpha = 0.05$).

4.3. Forecasting of the FDI in Jordan by Winter's Exponential Smoothing model

The results in Table (3), refers to the forecasting values of FDI by Winter's Exponential Smoothing Multiplicative model for the years (2015 and 2016), as follows:

Table3. *Forecasting values of FDI in Jordan by Winter's Exponential Smoothing Multiplicative model*

Years	t	L_t	T_t	S_t	Forecasting (F_{t+n})
2015	13	21016.96	1628.698	0.8790	20670.19
2016	14	-	-	-	21198.61

The results incoming in Table (3), explained that the forecasting of the Foreign Direct Investment (FDI) in Jordan will see a rise in the nearest future.

5. CONCLUSIONS

This section includes the most important conclusions in light of the results, as follows:

a. The results of forecasting explained that the Foreign Direct Investment (FDI) in Jordan will see a rise in the nearest future.

b. The results indicates to the forecasting accuracy of the Winter's Exponential Smoothing Multiplicative model was very high**.**

c. The Winter's Exponential Smoothing Multiplicative model is adequate to forecast the FDI in Jordan.

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