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.

$(2002-1961)$

(CFE)

(MAD) (MSE)

$.(MAPE)$

.

An Improvement Single Exponential Smoothing Method for Forecasting in Time Series

Abstract:

In this paper we describe single exponential smoothing method, which is used in time series forecasting, and suggest an improving to the single exponential smoothing method through adding the mean of the first differences for the time series for all predicting values of the single exponential smoothing. The improved method was compared with single exponential smoothing method by using real time series data for wheat national production for the period (1961-2002) through depending on Cumulative Forecasting Error (CFE), Mean Absolute Deviation (MAD), Mean Square Error (MSE), and Mean Absolute Percentage Error (MAPE) as criteria for comparison. It is clear that the improv method was more efficient than the single exponential smoothing method for forecasting in time series.

* مدرس مساعد/كلية علوم الحاسوب والرياضيات ـ قسم الاحصاء والمعلوماتية

1– :

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(   )

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Holt C. C. (1958)

.

.

.

1961)-

(α)   (WINQSB)   .(2002

.

2- :

.

- : (initial value)

.

.

- : (Parameters)

(0 ≤α ≤ 0.3)

.

- : (Differences)

. …

3- :

:**[7][2]** .

- : (**Cumulative Forecasting Error**)

. :

$$CFE = \sum e_t$$
… (1)

$$e_t = x_t - F_t$$
… (2)

:

x_t : .

F_t: .

e_t: ( ) .

- : (**Mean Absolute deviation**)

. :

$$MAD = \frac{\sum |x_t - F_t|}{n}$$ … (3)

- : (**Mean Square Error**)

. :

$$MSE = \frac{\sum (x_t - F_t)^2}{n}$$ … (4)

‑   (Mean Absolute Percentage :

Error)

.

:

$$MAPE = 100 * \frac{\sum \left[|e_i|/x_t\right]}{n} \qquad \dots (5)$$

3‑   : **(Exponential Smoothing)**

.

(Naïve)

.

:

$$F(t+1)=\alpha\, X(t)+(1-\alpha)\, F(t) \qquad \dots (6)$$

:

X(t) :   .t

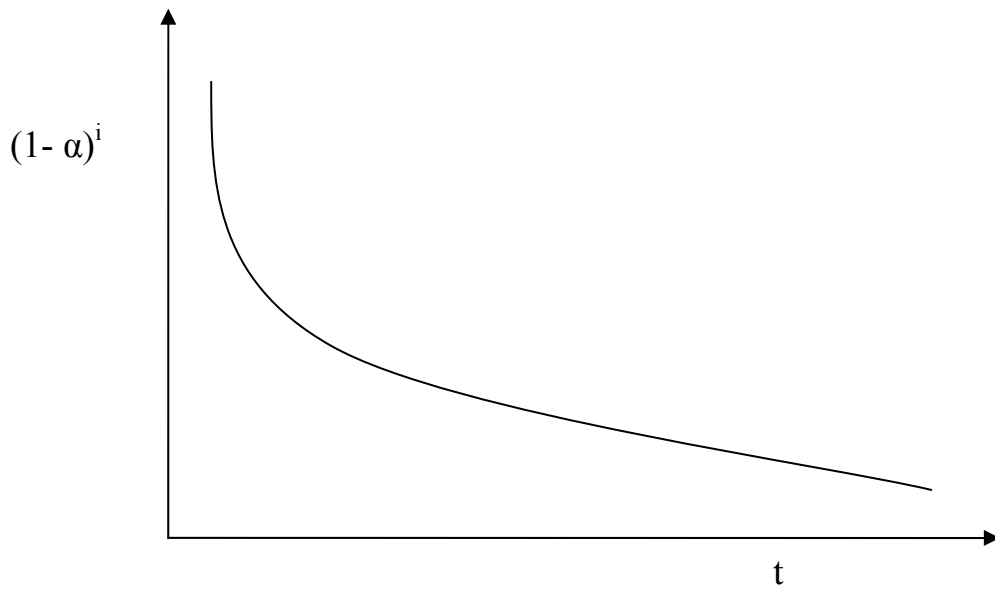F(t):   t.

F(t+1) :   (t+1).

α : $(0 \leq \alpha \leq 1)$.

[4]:

$$s_i = \alpha\, x_i + (1-\alpha)s_{i-1} \qquad \dots (7)$$

:

x_i: (i).

s_{i-1}:   (i-1).

s_i: (i).

α : $(0 \leq \alpha \leq 1)$.

(s_{i-1}) (s_i) :

$$s_i = \alpha\, x_i + (1- \alpha)[\, \alpha\, x_{i-1} + (1- \alpha)s_{i-2}] \qquad ...(8)$$

(s_{i-2}) (s_i) :

$$s_i = \alpha\, x_i + (1- \alpha)[\, \alpha\, x_{i-1} + (1- \alpha)[\, \alpha\, x_{i-2} + (1- \alpha)s_{i-3}]] \quad ...(9)$$

:

$$s_i = \alpha\, x_i + \alpha(1-\alpha)x_{i-1} + \alpha(1-\alpha)^2 x_{i-2} + \alpha(1- \alpha)^3 x_{i-3} + ... + (1- \alpha)^i s ...(10)$$

:

$$s_i = \alpha \sum_{j=0}^{i} (1- \alpha)^j x_{i-j} + (1- \alpha)^i s_0 \qquad\qquad ...(11)$$

s_0

$(1- \alpha)$

(1)

$(\alpha=1)$

$(\alpha=0)$

(α) .[5]

(α)

.

$(1- \alpha)^i$

t

(1)

4– : **(Proposition Method)**

.

:

1- :

F(t+1)=α X(t)+(1- α) F(t)   … (12)

2 -

.   :

F*(t+1)= F(t+1)+$\overline{d}$ …(13)

:

F(t+1): .(t+1)

$\overline{d}$:

F*(t+1) :   .(t+1)

.

.

6-   :

.[1] (2002-1961)

(2)

(2)

(   ):

1-   (α)
(CFE)   (WINQSB)

.

:
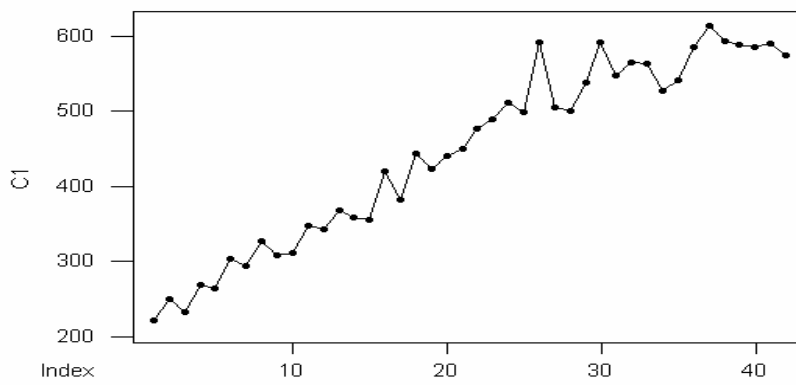
(1)

(CFE)

1961	222	*	*	1982	477	450.000	458.585

1962	250	222.000	230.585	1983	490	477.000	485.585
1963	233	250.000	258.585	1984	512	490.000	498.585
1964	269	233.000	241.585	1985	499	512.000	520.585
1965	264	269.000	277.585	1986	592	499.000	507.585
1966	304	264.000	272.585	1987	505	592.000	600.585
1967	294	304.000	312.585	1988	501	505.000	513.586
1968	327	294.000	302.585	1989	538	501.000	509.585
1969	309	327.000	335.585	1990	592	538.000	546.585
1970	311	309.000	317.585	1991	547	592.000	600.585
1971	348	311.000	319.585	1992	565	547.000	555.585
1972	343	348.000	356.585	1993	564	565.000	573.585
1973	369	343.000	351.585	1994	527	564.000	572.585
1974	359	369.000	377.585	1995	542	527.000	535.585
1975	356	359.000	367.585	1996	585	542.000	550.585
1976	420	356.000	364.585	1997	613	585.000	593.585
1977	382	420.000	428.585	1998	593	613.000	621.585
1978	444	382.000	390.585	1999	588	593.000	601.585
1979	423	444.000	452.585	2000	586	588.000	596.585
1980	440	423.000	431.585	2001	590	586.000	594.585
1981	450	440.000	448.585	2002	574	590.000	598.585

2-   (α)

(MAD)   (WINQSB)

.   :

(2)

(MAD)

1961	222	*	*	1982	477	443.976	452.562
1962	250	222.000	230.585	1983	490	464.781	473.367

... —————————————— [268]

1963	233	239.640	248.225	1984	512	480.669	489.254
1964	269	235.457	244.042	1985	499	500.408	508.993
1965	264	256.589	265.174	1986	592	499.521	508.106
1966	304	261.258	269.843	1987	505	557.783	566.368
1967	294	288.185	296.771	1988	501	524.530	533.115
1968	327	291.849	300.434	1989	538	509.706	518.291
1969	309	313.994	322.579	1990	592	527.531	536.117
1970	311	310.848	319.433	1991	547	568.146	576.732
1971	348	310.944	319.529	1992	565	554.824	563.410
1972	343	334.289	342.875	1993	564	561.235	569.820
1973	369	339.777	348.362	1994	527	562.977	571.562
1974	359	358.188	366.773	1995	542	540.312	548.897
1975	356	358.699	367.285	1996	585	541.375	549.961
1976	420	356.999	365.584	1997	613	568.859	577.444
1977	382	396.690	405.275	1998	593	596.668	605.253
1978	444	387.435	396.020	1999	588	594.357	602.942
1979	423	423.071	431.656	2000	586	590.352	598.937
1980	440	423.026	431.612	2001	590	587.610	596.196
1981	450	433.720	442.305	2002	574	589.116	597.701

3-   (α)

(MSE)   (WINQSB)

.   :

(3)

(MSE)

1961	222	*	*	1982	477	444.935	453.521
1962	250	222.000	230.585	1983	490	466.419	475.004

1963	233	240.760	249.345	1984	512	482.218	490.804
1964	269	235.561	244.146	1985	499	502.172	510.757
1965	264	257.965	266.550	1986	592	500.047	508.632
1966	304	262.009	270.594	1987	505	561.655	570.241
1967	294	290.143	298.728	1988	501	523.696	532.282
1968	327	292.727	301.312	1989	538	508.490	517.075
1969	309	315.690	324.275	1990	592	528.262	536.847
1970	311	311.208	319.793	1991	547	570.966	579.552
1971	348	311.068	319.654	1992	565	554.909	563.494
1972	343	335.813	344.398	1993	564	561.670	570.255
1973	369	340.628	349.213	1994	527	563.231	571.816
1974	359	359.637	368.223	1995	542	538.956	547.542
1975	356	359.210	367.796	1996	585	540.996	549.581
1976	420	357.059	365.645	1997	613	570.479	579.064
1977	382	399.230	407.815	1998	593	598.968	607.553
1978	444	387.686	396.271	1999	588	594.969	603.555
1979	423	425.416	434.002	2000	586	590.300	598.885
1980	440	423.797	432.383	2001	590	587.419	596.004
1981	450	434.653	443.238	2002	574	589.148	597.734

(α) -4

(WINQSB)   (MAPE)

:   .

(4)

(MAPE)

1961	222	*	*	1982	477	443.976	452.562
1962	250	222.000	230.585	1983	490	464.781	473.367
1963	233	239.640	248.225	1984	512	480.669	489.254
1964	269	235.457	244.042	1985	499	500.408	508.993
1965	264	256.589	265.174	1986	592	499.521	508.106
1966	304	261.258	269.843	1987	505	557.783	566.368
1967	294	288.185	296.771	1988	501	524.530	533.115
1968	327	291.849	300.434	1989	538	509.706	518.291
1969	309	313.994	322.579	1990	592	527.531	536.117
1970	311	310.848	319.433	1991	547	568.146	576.732
1971	348	310.944	319.529	1992	565	554.824	563.410

1972	343	334.289	342.875	1993	564	561.235	569.820
1973	369	339.777	348.362	1994	527	562.977	571.562
1974	359	358.188	366.773	1995	542	540.312	548.897
1975	356	358.699	367.285	1996	585	541.375	549.961
1976	420	356.999	365.584	1997	613	568.859	577.444
1977	382	396.690	405.275	1998	593	596.668	605.253
1978	444	387.435	396.020	1999	588	594.357	602.943
1979	423	423.071	431.656	2000	586	590.352	598.938
1980	440	423.026	431.612	2001	590	587.610	596.196
1981	450	433.720	442.305	2002	574	589.116	597.701

$(\alpha):$

(5)

			215.61	22.46	834.81	5.05	0.63
			CFE	MAD	MSE	MAPE	α
CFE			352.00	26.00	1152.48	6.00	1.00
			0.00	25.91	1078.78	6.03	1.00
MAD			567.61	23.28	998.81	5.31	0.63
			215.61	22.46	834.81	5.05	0.63
MSE			532.83	23.40	996.17	5.33	0.67
			180.83	22.80	846.73	5.15	0.67
MAPE			567.61	23.28	998.81	5.31	0.63

$(α)$.

7- :

1-

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2-

.

3- WINQSB

$(α)$

(CFE,MAD,MSE,MAPE)

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8- :

1- . (2005)

(1961-2002)

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2-

(2009) " WINQSB"

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3- (1992) "

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