08/05/2020

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	y	y'
2018		
1	10.1	
2	12.3	
3	15.6	12.66
2019		
1	12.4	13.43
2	11.8	13.26
3	12	12.06
2020		
1	14.2	12.66

$$y'_t = \frac{y_t + y_{t-1} + y_{t-2} + \dots + y_{t-(k-1)}}{k}$$

$$y''_t = \frac{y'_t + y'_{t-1} + y'_{t-2} + \dots + y'_{t-(k-1)}}{k}$$

$$a_t = 2y'_t - y''_t \qquad \hat{y}_{t+M} = a_t + b_t M$$

$$b_t = \frac{2}{k-1}(y'_t - y''_t)$$

formüllerini kullanarak 2020 yılının 2ci dönemini tahmin edin

Çözüm $k=3$

$y_{t-2} = y_1$ olması için $t-2=1 \quad t=3$

$$y'_t = \frac{y_t + y_{t-1} + y_{t-2}}{3}$$

$$y'_3 = \frac{y_3 + y_2 + y_1}{3} = 12.66$$

$$y'_4 = \frac{y_4 + y_3 + y_2}{3} = 13.43$$

$$y'_5 = \frac{y_5 + y_4 + y_3}{3} = 13.26$$

$$y'_6 = \frac{y_6 + y_5 + y_4}{3} = 12.06$$

$$y'_7 = \frac{y_7 + y_6 + y_5}{3} = 12.66$$

$$y''_t = \frac{y'_t + y'_{t-1} + y'_{t-2}}{3}$$

$t-2=3$ $t=5$ olmalı

$$y''_5 = \frac{y'_5 + y'_4 + y'_3}{3} = 13.11$$

$$y''_6 = \frac{y'_6 + y'_5 + y'_4}{3} = 12.91$$

$$y''_7 = \frac{y'_7 + y'_6 + y'_5}{3} = 12.66$$

$$a_5 = 2y'_5 - y''_5 = 2 \times 13.26 - 13.11 = 13.41$$

$$a_6 = 2y'_6 - y''_6 = 2 \times 12.06 - 12.91 = 11.21$$

$$a_7 = 2y'_7 - y''_7 = 2 \times 12.66 - 12.66 = 12.66$$

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$b_t = \frac{2}{k-1}(y'_t - y''_t)$ idi

$k = 3$

$b_t = \frac{2}{2}(y'_t - y''_t)$

$b_t = y'_t - y''_t = 13.26 - 13.11$

$b_5 = y'_5 - y''_5 = 13.26 - 13.11 = 0.15$

$b_6 = y'_6 - y''_6 = 12.06 - 12.21 = -0.84$

$b_7 = y'_7 - y''_7 = 12.66 - 12.66 = 0$

$\hat{y}_{6+1} = a_6 + b_6 \cdot 1$

$= 11.21 - 0.84 \cdot 1$

$= 10.37$ dur.

Brownun tek parametreli üstel düzgünləşdirmə

$y'_t = \alpha y_t + (1-\alpha) y'_{t-1}$

$y''_t = \alpha y'_t + (1-\alpha) y''_{t-1}$

$a_t = 2y'_t - y''_t$

$b_t = \frac{\alpha}{1-\alpha}(y'_t - y''_t)$

$y_{t+m} = a_t + b_t \cdot m$

$\alpha = 0.4$ alınsın

$t-1=1$, $t=2$

$y'_2 = 0.4\, y_2 + 0.6\, y'_1$

$= 0.4 \cdot 33 + 0.6 \cdot 36 = 34.8$

$y''_2 = \alpha y'_2 + (1-\alpha) y''_1$

$y''_2 = 0.4 \cdot 34.8 + 0.6 \cdot 36$

$= 35.52$

$a_2 = 2y'_2 - y''_2 = 2 \times 34.8 - 35.52 = 34.08$

X	y_t	y'_t	y''_t	a_t	b_t	y_{t+m}
1	36	36	36			
2	33	(34.8)	35.52	34.08	-0.48	
3	34	34.48	35.1	33,86	-0.41	
4	41	37.09	35.9	38.28	0.79	
5	39	37.85	36.68	39.02	0.77	
6	42	39.51	37.81	41.21	1.12	
7	44	41.32	39,21	43.41	1.39	
8	46	43,19	40.81	45.57	1.57	
9	45	43.91	42.05	45.77	1.23	
10	41	42.75	42.33	43.17	0.28	
11	46	44.05	43.02	45.08	068	
12	45	44.43	43.58	45.28	0.56	
13						
14						
15						

$y_{13} = a_{12} + b_{12} \cdot 1 = 45.84$

$y_{14} = a_{12} + b_{12} \cdot 2 = 46.4$

$y_{15} = a_{12} + b_2 \cdot 3 = 46.96$ olur.

$b_2 = \frac{0.4}{0.6}(y'_2 - y''_2)$

$= \frac{2}{3}(34,8 - 35.52) = -0.48$

3 Doğrusal olmayan düzgünleştirme Brown'un 2.ci derece üstel düzgünleştirmesi

$$y'_t = \alpha y_t + (1-\alpha) y'_{t-1}$$

$$y''_t = \alpha y'_t + (1-\alpha) y''_{t-1}$$

$$y'''_t = \alpha y''_t + (1-\alpha) y'''_{t-1}$$

$$a_t = 3y'_t - 3y''_t + y'''_t$$

$$b_t = \frac{\alpha}{2(1-\alpha)^2}\left[(6-5\alpha)y'_t - (10-8\alpha)y''_t + (4-3\alpha)y'''_t\right]$$

$$c_t = \frac{\alpha^2}{(1-\alpha)^2}\left(y'_t - 2y''_t + y'''_t\right)$$

$\alpha = 0.2$

$$\hat{y}_{t+M} = a_t + b_t M + \frac{1}{2} c_t M^2$$

X	y	y'_t	y''_t	y'''_t	a	b	c
2015	63.6	63.6	63.6	63.6	63.6	0	
16	68.4	64.56	63.79	63.64	65.95	0.522	0.039
			63.88	63.68	64.15	0.041	0.0022
17	61.7	63.99					
			63.80	63.54	53.55	-2.31	-0.178
18	42.4	59.67	61.58	63.15	46.05	-3.619	-0.258
19	40.7	55.88					
20	42.8 elde edilir.						

$$y'_2 = 0.2\, y_2 + 0.8\, y'_1$$
$$= 0.2\ 68.4 + 0.8\ 63.6 = 64.56$$

$$y''_2 = 0.2\, y'_2 + 0.8\, y''_1$$
$$= 0.2\ 64.56 + 0.8\ 63.6 = 63.79$$

$$y'''_2 = 0.2\, y''_2 + (0.8)\, y'''_1$$
$$= 0.2\ 63.79 + 0.8\ 63.6 = 63.64$$

$$a_2 = 3y'_2 - 3y''_2 + y'''_2 = 65.95$$

$$b_2 = \frac{0.2}{2(0.8)^2}\underbrace{\left[5y'_2 - 8.4\, y''_2 + 3.4\, y'''_2\right)}_{33.4} = 0.522$$

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$$c_2 = \frac{(0.2)^2}{(0.8)^2}\left[y'_2 - 2y''_2 + y'''_2\right]$$

$$c_2 = \frac{0.04}{0.64}\left[64.56 - 2\times 63.79 + 63.64\right] = 0.039$$

$$\hat{y}_{2020} = a_{2019} + b_{2019}\cdot 1 + \frac{1}{2}c_{2019}\cdot 1^2$$

$$= 46.05 - 3.619 + \frac{1}{2}(-0.258)$$

$$= 42.3$$

Örnek	y			
2018				
1	9.2			
2	11.6	→ 9,375		
3	9.3	→ 9.3125	99.86	
		→ 9,25		
4	7.4	→ 9.35	79.14	
2019		→ 9.45		
1	8.7	→ 9.55	91.09	
		→ 9.65		
2	12.4	→ 9.8375	126.04	
		→ 10.025		
3	10.1			
4	8.9			

$y_t/y_t' \times 100$ yandaki veriye göre 2020 yılının 1. çeyrek dönemini tahmin edin. s=4

$$y^*_{t+0.5} = \frac{\sum_{j=-1}^{2} y_{t+j}}{4}$$

$$y^*_{t+0.5} = \frac{y_{t-1} + y_t + y_{t+1} + y_{t+2}}{4}$$

$t-1=1 \Rightarrow t=2$

$$y^*_{2+0.5} = \frac{y_1 + y_2 + y_3 + y_4}{4}$$

$$y^*_{3,5} = \frac{y_2 + y_3 + y_4 + y_5}{4}$$

$$y^*_{4,5} \quad \frac{y_3 + y_4 + y_5 + y_6}{4}$$

$$y^*_{5,5} = \frac{y_4 + y_5 + y_6 + y_7}{4}$$

$$y^*_{6,5} = \frac{y_5 + y_6 + y_7 + y_8}{4}$$

$$y^*_{t+0.5} = \frac{\sum_{j=-s/2+1}^{s/2} y_{t+j}}{s}$$

$$y^*_t = \frac{y^*_{t-0.5} + y^*_{t+0.5}}{2}$$

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Mevsim indeksi

	2018	2019	ort	Düzeltme
1		91.09	91.09	91.98
2		126.04	126.04	127.27
3	99.86		99.86	100.84
4	79.14		79.14	79.91
			396.13	400

Konjonktür Artı oklar indeksi

y	$y'_{ort} = T$	M	TM	$y/TM \times 10000 = I \times A$
$y_3 = 9.3$	$y'_3 = 9.3125$	91.98	856.56	108.71
$y_4 = 7.4$	$y'_4 = 9.35$	127.27	1189.97	62.186
$y_5 = 8.7$	$y'_5 = 9.55$	100.84	963.022	90.34
$y_6 = 12.4$	$y'_6 = 9.8375$	79.91	786.11	157.73

konjonktür indeksi

	2018	2019	ort	Düzeltme
1			90.34	86.25
2			157.73	150.59
3	108.71		108.71	103.80
4	62.186		62.186	59.37
			418.96	400.01

Seri yarısı ile trend hesaplıyalım

x	y	
1	9.2	
2	11.6	$5/2$ → 9.375
3	9.3	
4	7.4	
5	8.7	
6	12.4	$13/2$ → 10.025
7	10.1	
8	8.9	

$\left(\frac{5}{2}, 9.375\right)$ $\left(\frac{13}{2}, 10.025\right)$

$m = \frac{0.65}{4} = 0.1625$

$y - 9.375 = 0.1625\left(x - \frac{5}{2}\right)$

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$$y = 0.1625X - 0.1625\frac{5}{2} + 9.375$$

$$y = 0.1625X + 8.969$$

2020 1 dönemi olduğu için $X = 9$ konur

$$y = 0.1625 \times 9 + 8.969$$

$$y = 10.43.15$$

Zaman Serisi 2020'nin 1 dönemi $= y_{Trend} \times$ Mevsim indeksi $\times$ konjonktür

$$= 10.4315 \times \frac{91.98}{100} \times \frac{8625}{100}$$

$$= 8.275$$