

PAST CAS AND SoA EXAMINATION QUESTIONS

$$\hat{y}_{100}^{(10)} = \frac{1}{5} (7.9 + 8.2 + 5.5 + 8.9 + 7.1) = 7.4$$

A. Smoothing Techniques

A1. You are given the following information about a series of observations, $Y_t, t = 1, 2, 3, \dots, 100$:

$|y_t| < 10$ for all t $y_{96} = 7.1$ $y_{97} = 8.9$ $y_{98} = 5.5$ $y_{99} = 8.2$ $y_{100} = 7.3$

You are to use simple exponential smoothing, with $\alpha = .9$, to forecast values beyond the end of the observation period. Calculate the forecasted value of y_{101} . (Answer to the nearest .1.)

- A. 7.1 B. 7.2 C. 7.3 D. 7.4 E. 7.5 (85F-120-14)

A2. According to Pindyck and Rubinfeld, larger values of alpha in exponential smoothing produce smoother forecasted values. (87-10-31-MC) **F**

A3. Effective 1/1/85, California residential property policyholders were required to receive an offer for earthquake coverage from their insurer. The table below shows (in hundreds) the number of such policyholders who accepted the offer of Company X in each policy month. In November 1985, your company's property reinsurer wants an immediate estimate of the total number of policyholders with earthquake coverage for the 1986 contract year. The reinsurer will accept a reasonable projection of the year end 1985 in-force as the 1986 estimate for negotiating with its retrocessionaires.

Policy Month	Policies (00s)	Policy Month	Policies (00s)
Jan	21	Jun	18
Feb	14	Jul	15
Mar	19	Aug	14
Apr	20	Sep	22
May	29	Oct	28
		10 month total	200

Use single exponential smoothing to estimate the year end 1985 in-force assuming all annual policies, no cancellations, no additional acceptances from a policy month after it ends, and an alpha factor of .25. State any additional assumptions you must make. Round interim results to nearest hundred with .5 and up to next higher hundred. (86-10-54a-3)

A4. In January 1990, you join a department that forecasts your company's policies in force (PIF). You find the following information left from your predecessor's forecast of one year earlier:

1989 PIF forecast at year end 1988	1,000
Credibility of the most recent observation (alpha)	.6

- a. Assuming that your department has used single exponential smoothing for 10 years, and that the actual year end 1989 PIF is now known to be 1,000, what is your forecast for year end 1990 PIF?
- b. In your forecast in a., how much weight is being given to the 1987 actual PIF? (90-10-39a&b-.5/5)

A5. In simple exponential smoothing, $\hat{y}_N(2) = \hat{y}_N(1)$. (90F-120-13-MC)

A6. In simple exponential smoothing, $\hat{y}_{N+1}(1)$ is a weighted average of y_{N+1} and y_N . (90F-120-13-MC)

A7. Given the following data series, which is known to have no seasonality:

Time	1	2	3	4	5
y_t	2,000	3,000	1,000	6,000	1,500

And assume $\tilde{y}_1 = 2,000$

- a. Compute two forecasts for periods 2 through 5 based on exponential smoothing; the first with $\alpha = .1$; the second with $\alpha = .9$.
- b. Which value of α would you choose in order to forecast future values? Why? *0,1 car^t valeurs connues*
- c. In the forecast for period 5, how much weight is given to the second observation of 3,000 in each of the two forecasts above? (91-10-45-1/.5/.5)

A8. According to Pindyck and Rubinfeld, larger values of alpha in exponential smoothing produce smoother forecasted values. (92-10-9-MC)

A9. According to Pindyck and Rubinfeld, with single exponential smoothing, if $\alpha > 0$ then all of the prior observations receive some weight in computing the most recent forecast. (92-10-9-MC)

A10. You use simple exponential smoothing with $\alpha = .1$ and $\tilde{y}_0 = 27$ to forecast the following time series:

$\hat{y}_5 = 0,1 \times 15 + 0,9(\hat{y}_4)$

t	1	2	3	4	5
y_t	20	30	10	60	15

Determine \tilde{y}_5 .

avec $\hat{y}_4 = \frac{1}{2} \times (20 + 30 + 10)$

- A. 16 B. 19 C. 22 D. 26 E. 27 (Sample-120-13)

A11. You use exponential smoothing with $\alpha = .1$ to calculate \tilde{y}_{20} . Determine the change in \tilde{y}_{20} if the starting value y_0 is changed from 10 to 20.

- A. 1.0 B. 1.2 C. 2.4 D. 9.0 E. 10.0 (95F-120-11)

A12. You use simple exponential smoothing with $\alpha = .6$ and $\tilde{y}_0 = 103$ to forecast the following time series:

t	1	2	3	4
y_t	95	119	109	126

Determine the sum of squared one-step-ahead forecast errors.

- A. 123 B. 133 C. 272 D. 758 E. 766 (96S-120-11)

A13. You are smoothing the annual claims rate for an insurance company using double exponential smoothing. The values of the single-smoothed statistic and double-smoothed statistic are, respectively, $\tilde{y}_t = 2.73$ and $\tilde{\tilde{y}}_{t-1} = 2.41$. The smoothing constant α is .2. Determine the smoothed value at time T, that is $\tilde{\tilde{y}}_t$.

- A. 1.7 B. 1.9 C. 2.1 D. 2.3 E. 2.5 (9881-120-12)

A14. You are given the following observations from a time series:

t	1	2	3	4	5
y _t	15.6	3.4	13.3	-4.6	-1.8

Use simple exponential smoothing with smoothing constant $\alpha = .60$ to calculate the smoothed value \tilde{y}_5 of the fifth observation.

- A. -1.8 B. -.5 C. 1.2 D. 5.2 E. 11.3 (98S-120-12)

A15. You predict annual sales using exponential smoothing with a smoothing constant $\alpha = .2$. You are given:

$$\tilde{y}_{1995} = 20 \quad y_{1996} = 27 \quad y_{1997} = 29$$

Determine \tilde{y}_{1997} .

- A. 23 B. 25 C. 26 D. 28 E. 31 (98F-120-11)

A16. You apply Holt's two-parameter exponential smoothing method with smoothing parameters $\alpha = .4$ and $\gamma = .2$ to a time series y_t , resulting in:

$$\tilde{y}_{t-1} = 20 \quad r_t = 4.1 \quad r_{t-1} = 5$$

Determine y_t .

- A. 14 B. 17 C. 20 D. 21 E. 23 (98F-120-12)

A17. You smooth a time series y_t using Holt's two-parameter exponential smoothing method. You calculate:

t	y _t	\tilde{y}_t	r _t
1995	120.5	120.0	10.0
1996	135.0	131.5	11.2
1997	147.7	144.2	12.4
1998	146.6	\tilde{y}_{1998}	r ₁₉₉₈

Determine the two-period forecast \hat{y}_{2000} by first completing Holt's two-parameter exponential smoothed series.

- A. < 166 B. ≥ 166 but < 168 C. ≥ 168 but < 170 D. ≥ 170 but < 172 E. ≥ 172
(00S-4-13)

A18. You are given:

i)

t	0	1	2
y _t	1.0	1.2	1.3

- ii) $y_t = 0$, for $t < 0$.
iii) $\alpha = .6$

Use double exponential smoothing to determine $\tilde{\tilde{y}}_2$.

- A. .96 B. .99 C. 1.16 D. 1.20 E. 1.33 (02F-4-22)

0,9804 175

$$\sum_{k=0}^{\infty} (\alpha + 1)(1-\alpha)^k y_{t-k}$$

$k=0$

$$0,6^2 (\cancel{0,4} \times y_2 + 2 \times 0,4 \times y_1 + 3 \times 0,4^2 \times y_0)$$

A19. Which of the following statements about moving average models is false?

- A. Both unweighted and exponentially weighted moving average (EWMA) models can be used to forecast future values of a time series.
- B. Forecasts using unweighted moving average models are determined by applying equal weights to a specified number of past observations of the time series.
- C. Forecasts using EWMA models may not be true averages because the weights applied to the past observations do not necessarily sum to one.
- D. Forecasts using both unweighted and EWMA models are adaptive because they automatically adjust themselves to the most recently available data.
- E. Using an EWMA model, the two-period forecast is the same as the one-period forecast. (03F-4-38)

A20. You use single exponential smoothing with $\alpha = .1$ to make one-step-ahead forecasts, that is, $\hat{y}_{t+1} = \bar{y}_t$, $t = 0, 1, 2, 3$, for the following data:

t	y_t	$\bar{y}_t = \hat{y}_{t+1}$
0		81
1	80	
2	81	
3	89	
4	74	

Determine the mean forecast error $1/4 \sum_{t=1}^4 (y_t - \hat{y}_t)$.

- A. -.5 B. -.1 C. 0 D. .1 E. .5 (05-ASM-3)

B. Extrapolation and Seasonal Adjustment

B1. You are given the following quarterly sales data and moving averages:

Quarter (t)	Sales (y_t)	Moving Average (\bar{y}_t)
1	15	24.00
2	15	25.00
3	20	26.25
4	50	25.50
5	20	26.00
6	12	26.25
7	22	25.00
8	51	25.25
9	15	26.75
10	13	27.50
11	28	28.25
12	54	28.75

Determine y_1^α , the seasonally adjusted sales in the first quarter of the first year.

- A. 15 B. 17 C. 19 D. 21 E. 23 (9881-120-20) (Sample-4-1)

B2. The following data represent the number of trucks remaining in a lot at the end of each week during a two-month period:

Month	Week			
	1	2	3	4
1	121	132	144	161
2	143	154	168	183

Forecast the next observation using a four-period moving average with equal weights.

- A. 140 B. 151 C. 162 D. 183 E. 198 (98S-120-11)

B3. You are using a three-point moving average to forecast values of a time series. The last three recorded values of the time series are as follows:

$$y_{98} = 100 \quad y_{99} = 99 \quad y_{100} = 101$$

Determine $(\hat{y}_{105} - \hat{y}_{104})$, the difference between the five-step-ahead and the four-step-ahead forecasted values.

- A. -.22 B. -.04 C. 0 D. .04 E. .22 (00F-4-9)

B4. Based on four years of monthly sales data, you are given:

t	Original Series	12-Month Average
June 1993	825	843
June 1994	784	804
June 1995	710	740
June 1996	918	905

Given $\sum_{i=1}^{12} \bar{z}_i = 11.9607$, calculate the seasonally adjusted sales for June 1996.

- A. 892 B. 904 C. 915 D. 919 E. 932 (01S-4-27)

92
 $\sum_{t=1}^{12} SI_t = 67,8428$ **179**

B5. Which of the following statements about moving-average models is false?

- ✓ A. Both simple (unweighted) moving average models and exponentially weighted moving average (EWMA) models can be used to forecast future values of a time series.
- ✓ B. EWMA models always give greater weight to more recent observations of the time series. *Si α est gran*
- ✓ C. Forecasts using EWMA models represent true averages because the weights applied to the observations sum to one. *$\alpha \sum (1-\alpha)^k = 1$*
- ✓ D. Moving average forecasts are adaptive because they automatically adjust themselves to the most recently available data.
- F E. With an EWMA model, the differences between adjacent forecasted values of a time series from a fixed starting point increase as the number of steps ahead increases. (01F-4-16)