Department of Statistics

M.Sc.-II (Sem IV)

Actuarial Statistics: Expt. No-

Roll No: 37

Title: Construction of life Tables

Q.1) Aim: - a) To find chance that one of the original 100 packets.

i)sold in the first week

ii)sold in the second week

iii)unsold by the fourth week

b) To find the retail price of the packets when the shopkeeper can sell 500 packets of Gulabjam each week.

Formulae:

i) $P_x = 1 - q_x$

ii) $l_{x+1} = l_x * P_x$

iii) $L_x = (l_x + l_{x+1})/2$

iv) $T(x) = L_x + T_{x+1}$

v) $e(x) = T(x)/ l_x$

Observation table and Calculations:

year	q_x	p_x	l_x	d_x	L(x)	T(x)	e(x)
0	0.2	0.8	100	20	90	203.7	2.037
1	0.45	0.55	80	36	62	113.7	1.42125
2	0.5	0.5	44	22	33	51.7	1.175
3	0.65	0.35	22	14.3	14.85	18.7	0.85
4	1	0	7.7	7.7	3.85	3.85	0.5

a)

i) The chance that one of the original 100 packet is sold in the first week=0.20

ii) probability that the packet is sold in the second week is the probability that a packet is not sold in the first week and then sold in the second week = 0.80*0.45= 0.36

iii) By the end of the fourth week 7.7 out of 100 packets are left therefore the required probability is 7.7/100 = 0.077

b) l_0= 100 to find the total expected number of packets at all ages = 203.7 which gives the total stock with intake of 500 packets is total stock would be 5*203.7 = 1018.5

The retail price of his stock at any time is 5*203.7*25 = 25462.5 Rs

#Result: -

a)

i)The chance that one of the original 100 packets is sold in the first week is 0.20

ii) The probability that the packet is sold in the second week is 0.36

iii)The chance one of the original 100 packets is unsold in the fourth week is 0.077

b)

The retail price of the packets when the shopkeeper can sell 500 packets of gulabjamuns each week is 25462.5 Rs.

Expt. No. 1

Title: Pharmacokinetic Parameter's Date 25/11/2024

Aim :- To calculate PK parameter's from given concentration values assuming 100% of the administered dose was absorbed.

Given : slope = 0.15

Time (Hr)	2	4	6	8	10	16	18	20	24	28
Concentration (mcg/mL)	3.915	8.005	7.321	5.803	4.403	1.814	1.344	0.996	0.546	0.3

Calculations :

Time	concentration mcg/mL	$\frac{C_{i-1}+C_i}{2}$	$t_{i-1}-t_i$	$\Sigma\left(\frac{C_{i-1}+C_i}{2}\right)(t_{i-1}-t_i)$
2	3.915	–	–	–
4	8.005	5.96	2	11.92
6	7.321	7.663	2	15.326
8	5.803	6.562	2	13.124
10	4.403	5.103	2	10.206
16	1.814	3.1085	6	18.651
18	1.344	1.579	2	3.158
20	0.996	1.17	2	2.34
24	0.546	0.771	4	3.084
28	0.3	0.423	4	1.692
				Σ = 79.501

$\lambda = K_e$ = slope of curve × (-2.303)

= 0.15 × (-2.303)

λ = -0.34545

$$t_{1/2} = \frac{0.693}{ke} = \frac{0.693}{-0.34545} = 2.0060$$

$C_k = C_{10} = 0.3$

C_{max} = max (concentration) = 8.005

T_{max} = corresponding time as max concentration = 4

$$AUC\ (0-t_k) = AUC\ (0-28)$$

$$= \sum_{i=1}^{28} \left(\frac{C_{i-1} + C_i}{2}\right)(t_{i-1} - t_i)$$

$$AUC\ (0-28) = 79.501$$

Now,

$$AUC\ (0-\infty) = AUC\ (0-t_k) + \frac{C_k}{\lambda}$$

$$= 79.501 + \frac{0.3}{(-0.34545)}$$

$$AUC\ (0-\infty) = 78.6325$$

Result:

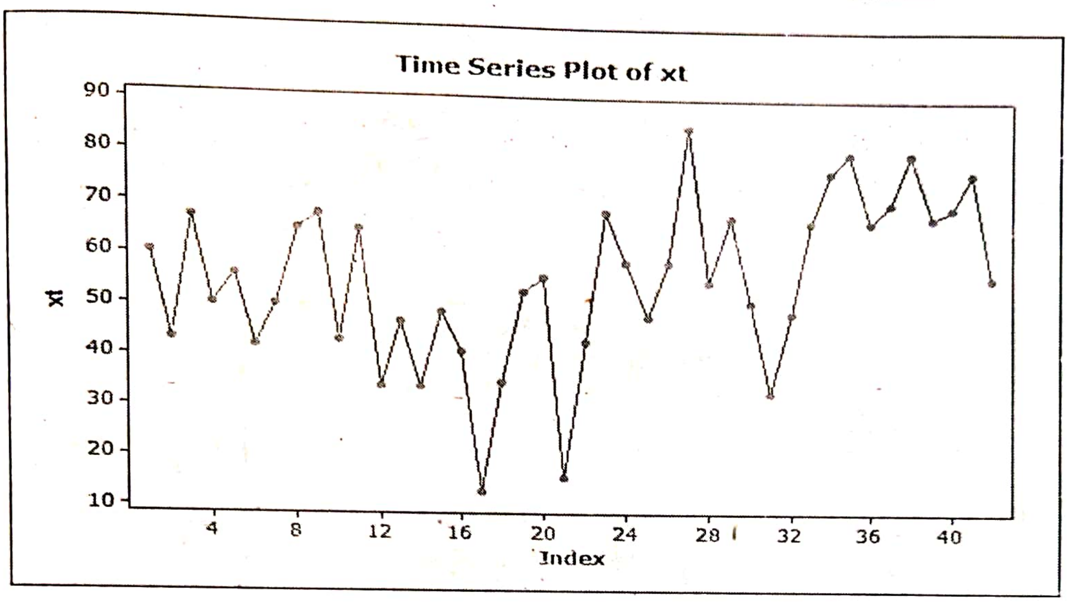
The $AUC\ (0-\infty) = 78.6325$

Exponential Smoothing Methods

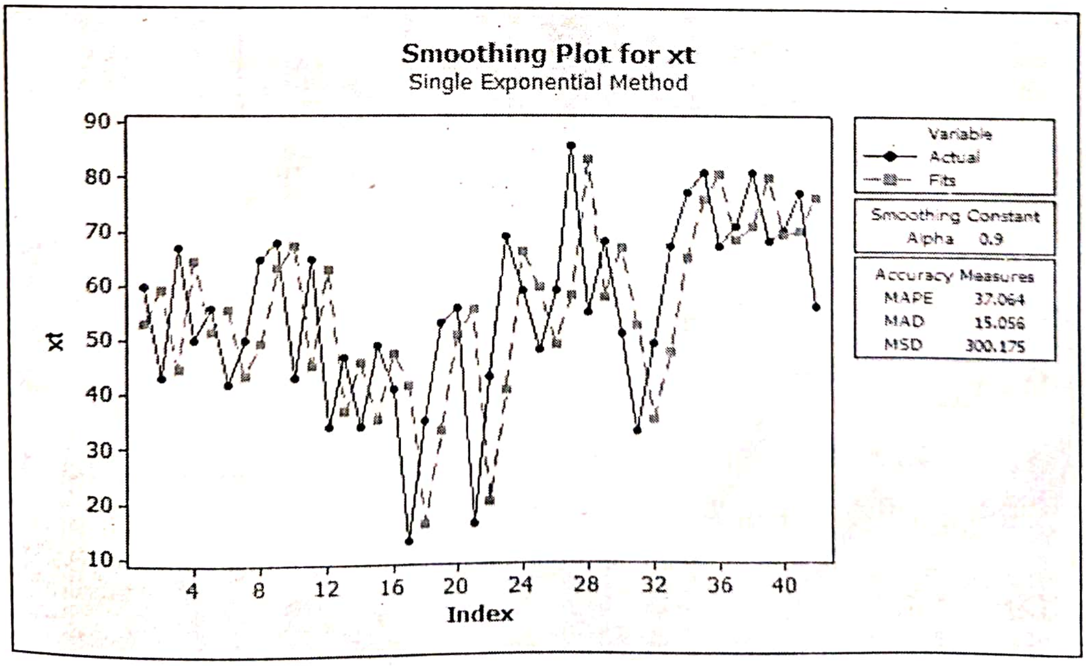
Q.1

Aim : To plot the graph and to check fluctuation in the series seem to be roughly constant in size over time, so it probably appropriate to describe the data using an additive model. Thus, we can make forecast using simple exponential smoothing.

Link of data :- http://robjhyndman.com/tsdldata/misc/kings.dat

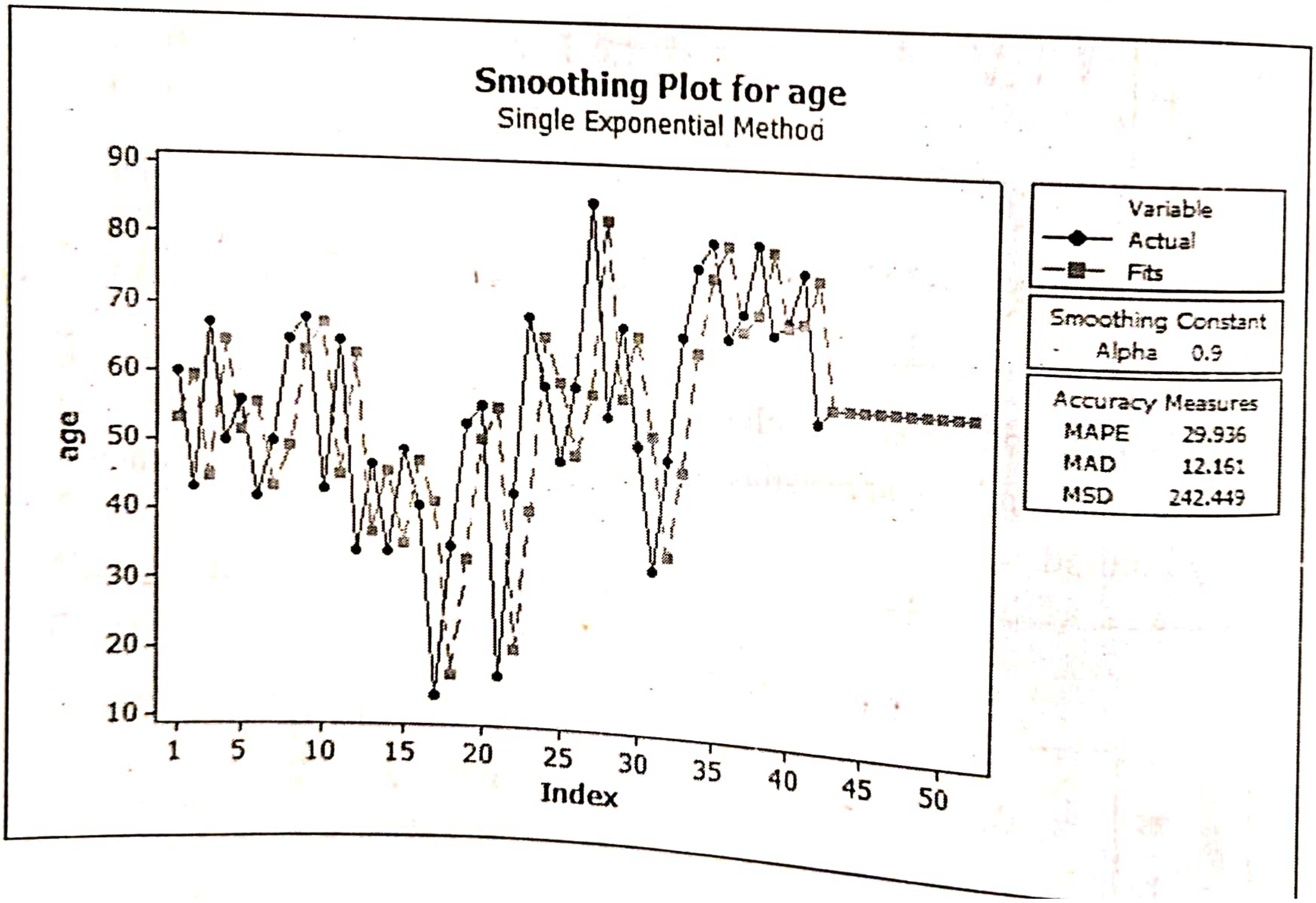


From the above graph we can conclude that there is no upword and downward trend in the data and no seasonality exists. So we use a single exponential smoothing method.



With a smoothing constant $\alpha=0.9$, the exponential smoothing average follows the given data closely, then we have to forecast the 10-year values.

Age	Forecast
43	58.0292
44	58.0292
45	58.0292
46	58.0292
47	58.0292
48	58.0292
49	58.0292
50	58.0292
51	58.0292
52	58.0292



Pt. No. 6

Title: Causal & Invertible process Date 16/12/2024

Aim : To check the given process are causal and/or invertible.

1) $X_t + 0.6 X_{t-1} = Z_t + 1.2 Z_{t-1}$

2) $X_t - 0.5 X_{t-1} = Z_t + 0.4 Z_{t-1}$

3) $X_t = 0.7 X_{t-1} - 0.1 X_{t-2} + Z_t$

4) $X_t + 0.2 X_{t-1} - 0.48 X_{t-2} = Z_t$

5) $X_t + 1.9 X_{t-1} + 0.88 X_{t-2} = Z_t + 0.2 Z_{t-1} + 0.7 Z_{t-2}$

6) $(1 - 0.6B) X_t = (1 - 1.2B + 0.2B^2) Z_t$ where

$Z_t \sim WN(0, \sigma^2)$

Solution :

1) The given process is,

$$X_t + 0.6 X_{t-1} = Z_t + 1.2 Z_{t-1}$$

The given process is ARMA(1,1) process

$$\phi(z) = 1 - \phi z$$
$$= 1 - (-0.6) z$$

consider, $\phi(z) = 0$

$$1 - (-0.6) z = 0$$
$$1 + 0.6 z = 0$$
$$\therefore z = -1/0.6 = -1.66$$
$$\therefore |z| = 1.66 > 1$$
$$\therefore |z| > 1$$

The given process is causal.

Now, $\theta(z) = 1 + \theta z$

$\theta(z) = 1 + 1.2 z$

consider, $\theta(z) = 0$

$\therefore 1 + 1.2 z = 0$

$\therefore z = -1/1.2 = -0.83$

$\therefore |z| = 0.83 < 1$

$\therefore$ The given process is not invertible.

<u>Result</u>:

The given process is causal and not invertible

ii) $x_t - 0.5 x_{t-1} = z_t + 0.4 z_{t-1}$

The given process is ARMA(1,1) process

$\therefore \phi(z) = 1 - \phi z$
$= 1 - 0.5 z$

consider, $\phi(z) = 0$

$\therefore 1 - 0.5 z = 0$

$\therefore z = \frac{1}{0.5} = 2$

$\therefore |z| = 2 > 1$

$\therefore$ The given process is causal.

Now, MA(1) process,

$\theta(z) = 1 + \theta z$

$\theta(z) = 1 + 0.4 z$

consider, $\theta(z) = 0$

$\therefore 1 + 0.4 z = 0$

$\therefore z = \frac{-1}{0.4} = -2.5$

$\therefore |z| = 2.5 > 1$

$\therefore$ The given process is invertible.

Q. 2

Aim: To check whether survival function for the patient with low grade ovarian cancer is same as that with well differentiated ovarian cancer.

Hypothesis:

Ho: survival function with low grade ovarian cancer is same as that with well differentiated ovarian cancer.

v/s

H1: Survival function with low grade ovarian cancer is not same as that with well differentiated ovarian cancer

R commands:

```
Install packages ("survival")
library (survival)
t = c(0.92, 2.93, 5.76, 6.91, 10.16, 12.9, 12.92, 13.85,
      14.70, 15.20, 23.32, 24.97, 25.33, 36.38, 39.67,
      1.12, 2.89, 4.51, 6.55, 9.21, 9.57, 9.84, 9.87,
      10.16, 11.55, 11.78, 12.14, 12.19, 12.17, 12.39, 12.57,
      12.89, 14.11, 14.84, 36.81)
length (t)
Status = c(rep(1,21), 0,0 rep(1,9, 0,1,0)
Status
gr = c(rep(1,15), rep(2,20)
gr
df = data.fram (t, status, gr)
df
Survdiff (surv(t, status == 1)~gr, rho = 0)
```

Output:

```
Survdiff (surv (t, status == 1) ~gr, rho = 0)
Call :
  Survdiff (formula = surv (t, status == 1) ~ gr, rho = 0)
```

N	observed	expected	$(O-E)^2/E$	$(O-E)^2/V$
gr = 1	15	15	18.3	0.597	1.65
gr = 2	20	16	12.7	0.860	1.65

Chisq = 1.7 on 1 degree of freedom, p = 0.2

Result:

$\alpha = 0.05 < P = 0.2$, Hence, we accept Ho at 5 los

Since, survival function for the patient with low grade ov cancer is same as that with well differenticited ovarian cancer.

cl
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DEPARTMENT OF STATISTICS

Expt. No.

Title : Analysis of Categorical outcomes Date

Q.1

Aim : To conclude that the probabilities of attaining a goal SBP level is greater for individual receiving test treatment than for those receiving the placebo after accounting for differences in response among centers.

Formulaes : Hypothesis to be tested.

H_0 : The probability of attaining a goal SBP level is greater for individual receiving test treatment than for those receiving plaabo

H_1 : V/S

H_1 : The prob. of attaining a goal SBP level is less for individual receiving test treatment than for those receiving placebo.

Test Statistic from Montel-Haenszel test is

$$\chi^2_{(MH)} = \frac{n(ad-bc)^2}{n_1 \times n_0 \times m_1 \times m_0}$$

$$\chi^2_{tab} = \chi^2_{(m-1)(n-1)\alpha}$$

where

m = no. of rows.

n = no. of columns.

calculation :

center 4 attained SBP<140 ?	placebo	Test	Total
Yes	34 = a	82 = b	116 = m_1
NO	112 = c	72 = d	184 = m_0
Total	146 = n_1	154 = n_0	300

$$\chi^2_{(MH)} = \frac{n[ad-bc]^2}{n_0 \times n_1 \times m_0 \times m_1}$$

$$= \frac{300[(39\times 72)-(82\times 112)]^2}{146\times 154\times 116\times 184}$$

$$= \frac{300[2448-9184]^2}{479,898,496}$$

$$\chi^2_{(MH)} = 28.36$$

$$\chi^2_{(m-1)(n-1),\alpha} = \chi^2_{(2-1)(2-1),\alpha} = \chi^2_{(1,0.05)}$$

$$\chi^2_{tab} = 0.8531$$

Result:

$\chi^2_{cal} > \chi^2_{tab}$

we reject H_0

∴ The prob. of attaining goal SBP level is less for individual receving test treatment than for those receving the placebo after accounting for difference in response among centers.