## Seminar 25 (Suggested Solution)

1.
(a & b )

| Sales | 4 M.A. | Center M.A. | Variation | Seasonal Index | Desaesonalized |
|---|---|---|---|---|---|
| 120 | | - | - | 97.81 | 122.69 |
| | | | | | |
| 150 | | - | - | 129.18 | 116.12 |
| | 115 | | | | |
| 90 | | 116.875 | 77.01 | 83.42 | 107.89 |
| | 118.75 | | | | |
| 100 | | 121.25 | 82.47 | 89.59 | 111.62 |
| | 123.75 | | | | |
| 135 | | 128.125 | 105.37 | 97.81 | 138.02 |
| | 132.5 | | | | |
| 170 | | 137.5 | 123.64 | 129.18 | 131.60 |
| | 142.5 | | | | |
| 125 | | 144.375 | 86.58 | 83.42 | 149.84 |
| | 146.25 | | | | |
| 140 | | 152.5 | 91.80 | 89.59 | 156.27 |
| | 158.75 | | | | |
| 150 | | 161.875 | 92.66 | 97.81 | 153.36 |
| | 165 | | | | |
| 220 | | 168.75 | 130.37 | 129.18 | 170.31 |
| | 172.5 | | | | |
| 150 | | 175.625 | 85.41 | 83.42 | 179.81 |
| | 178.75 | | | | |
| 170 | | 182.5 | 93.15 | 89.59 | 189.75 |
| | 186.25 | | | | |
| 175 | | 186.25 | 93.96 | 97.81 | 178.92 |
| | 186.25 | | | | |
| 250 | | 190 | 131.58 | 129.18 | 193.52 |
| | 193.75 | | | | |
| 150 | | - | - | 83.42 | 179.81 |
| | | | | | |
| 200 | | - | - | 89.59 | 223.24 |

| Year | Quarter I | Quarter II | Quarter III | Quarter IV | |
|---|---|---|---|---|---|
| 1990 | - | - | 77.01 | 82.47 | |
| 1991 | 105.37 | 123.64 | 86.58 | 91.80 | |
| 1992 | 92.66 | 130.37 | 85.41 | 93.15 | |
| 1993 | 93.96 | 131.58 | - | - | |
| | | | | | |
| | 97.32 | 128.53 | 83.00 | 89.14 | 99.4975 |
| | | | | | |
| adjustment | 1 / 0.994975 | 1 / 0.994975 | 1 / 0.994975 | 1 / 0.994975 | |
| Adjusted Seasonal Index | **97.81** | **129.18** | **83.42** | **89.59** | |

c. Assume it is an additive model:

| Sales | 4 M.A. | Center M.A. | Variation | Seasonal Index |
|---|---|---|---|---|
| 120 | | - | - | -6.2 |
| 150 | | - | - | 47.14 |
| | 115 | | | |
| 90 | | 116.875 | -26.875 | -24.74 |
| | 118.75 | | | |
| 100 | | 121.25 | -21.25 | -16.2 |
| | 123.75 | | | |
| 135 | | 128.125 | 6.875 | -6.2 |
| | 132.5 | | | |
| 170 | | 137.5 | 32.5 | 47.14 |
| | 142.5 | | | |
| 125 | | 144.375 | -19.375 | -24.74 |
| | 146.25 | | | |
| 140 | | 152.5 | -12.5 | -16.2 |
| | 158.75 | | | |
| 150 | | 161.875 | -11.875 | -6.2 |
| | 165 | | | |
| 220 | | 168.75 | 51.25 | 47.14 |
| | 172.5 | | | |
| 150 | | 175.625 | -25.625 | -24.74 |
| | 178.75 | | | |
| 170 | | 182.5 | -12.5 | -16.2 |
| | 186.25 | | | |
| 175 | | 186.25 | -11.25 | -6.2 |
| | 186.25 | | | |
| 250 | | 190 | 60 | 47.14 |
| | 193.75 | | | |
| 150 | | - | - | -24.74 |
| 200 | | - | - | -16.2 |

| Year | Quarter I | Quarter II | Quarter III | Quarter IV | |
|---|---|---|---|---|---|
| 1990 | - | - | -26.875 | -21.25 | |
| 1991 | 6.875 | 32.5 | -19.375 | -12.5 | |
| 1992 | -11.875 | 51.25 | -25.625 | -12.5 | |
| 1993 | -11.25 | 60 | - | - | |
| | -5.41667 | 47.91667 | -23.9583 | -15.4167 | 0.78125 |
| adjustment | -0.78125 | -0.78125 | -0.78125 | -0.78125 | |
| Adjusted Seasonal Index | **-6.19792** | **47.13542** | **-24.7396** | **-16.1979** | |

2. Linear Regression line can be used to represent the steady increasing trend.

| | | x | xY | $x^2$ | Y |
|---|---|---|---|---|---|
| 1990 | I | -9 | -1800 | 81 | 200 |
| | II | -7 | -1750 | 49 | 250 |
| 1991 | I | -5 | -1050 | 25 | 210 |
| | II | -3 | -780 | 9 | 260 |
| 1992 | I | -1 | -230 | 1 | 230 |
| | II | 1 | 270 | 1 | 270 |
| 1993 | I | 3 | 720 | 9 | 240 |
| | II | 5 | 1550 | 25 | 300 |
| 1994 | I | 7 | 1890 | 49 | 270 |
| | II | 9 | 3060 | 81 | 340 |
| Total | | 0 | 1830 | 330 | 2570 |

b = 1830/330 = 5.545455 ; a = 2570/10 = 257
$\hat{Y}$ = 257 + 5.545455 x

Next, we want to determine the seasonal effect of the first-half and second-half of a year. Two-period Moving Average should be used.

| | | Sales | Moving Average | Centered M.A. | Variation |
|---|---|---|---|---|---|
| 1990 | I | 200 | | | |
| | | | 225 | | |
| | II | 250 | | 227.5 | 22.5 |
| | | | 230 | | |
| 1991 | I | 210 | | 232.5 | -22.5 |
| | | | 235 | | |
| | II | 260 | | 240 | 20 |
| | | | 245 | | |
| 1992 | I | 230 | | 247.5 | -17.5 |
| | | | 250 | | |
| | II | 270 | | 252.5 | 17.5 |
| | | | 255 | | |
| 1993 | I | 240 | | 262.5 | -22.5 |
| | | | 270 | | |
| | II | 300 | | 277.5 | 22.5 |
| | | | 285 | | |
| 1994 | I | 270 | | 295 | -25 |
| | | | 305 | | |
| | II | 340 | | | |

| | I | II | | |
|---|---|---|---|---|
| 1990 | - | 22.5 | | |
| 1991 | -22.5 | 20 | | |
| 1992 | -17.5 | 17.5 | | |
| 1993 | -22.5 | 22.5 | | |
| 1994 | -25 | - | | |
| Average | -21.875 | 20.625 | -1.25 | -0.625 |
| Adjustment | +0.625 | +0.625 | | |
| Seasonal Index | -21.25 | 21.25 | | |

For 1995 first-half year, x = 11, so the estimated no. of tourists is (without seasonal effect):

$\hat{Y}$ = 257 + 5.545455 x
= 257 + 5.545455 (11)
= 318.00005
= 318

and the seasonal effect of the first-half year is -21.25, so the actual estimation is

$\hat{Y}$ = 318 - 21.25 (‘ 000)
= 296.75 (‘ 000)

The estimated total no. of tourist in 1996 (x = 15 and 17):

$\hat{Y}$ = {[257 + 5.545455 (15) ] - 21.25 } +{[257 + 5.545455 (17) ] + 21.25 }
= 691.4545 (‘ 000)