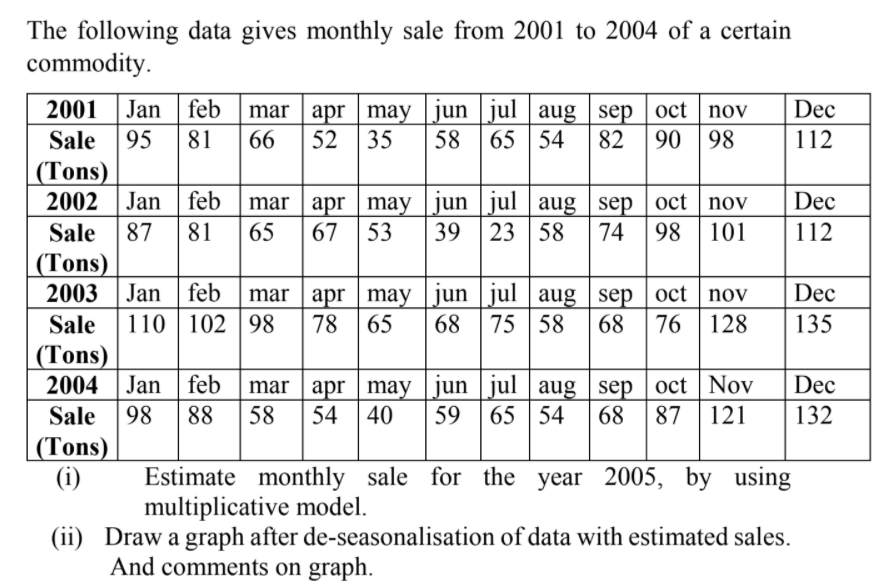
**TIME SERIES ANALYSIS**

**PRACTICAL – 9**

**Submitted By: Ridam Singhal(5040)**

**AIM:** To carry out de-seasonalization of the data using ratio to moving average method, and estimate the values using multiplicative model.

**EXPERIMENT:**



**THEORY:**

RATIO TO MOVING AVERAGE

This method involves the following steps:

1. This method is based on calculating moving averages by considering n = 12 for monthly data, and n = 4 for quarterly data.
2. For monthly data first calculate the successive averages for the groups of size 12 and then take a 2-point moving average of these averages.
3. Convert the data series as the percentages of the 2-point moving average values i.e. ((given data)/(2-point moving average)\*100).
4. These percentages would now represent seasonal variations along with random components.
5. The random component is eliminated by averaging these monthly percentages.
6. Adjusted seasonal indices are computed to make the sum of the indices 1200 or 400 by multiplying them throughout by a correction factor k.

DESEASONALISATION OF DATA

Elimination of seasonal effects from the given values is termed as de-seasonalization of the data. It helps us adjust the given time series for seasonal variations, thus leaving us with trend component, cyclic and irregular movements.

In multiplicative model, de-seasonalized data is obtained by dividing the given values by corresponding indices of seasonal variation.

= = TCSI

Where,

y = value of time series

S = seasonal component

C = cyclic component

I = irregular component

**CALCULATION:** (An Excel sheet has also been attached for reference).

Table 9.1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| YEAR | MONTH | SALES | 12 POINT MOVING AVG. | CENTRED MOVING AVG. | RATIO TO MOVING AVG. |
| 2001 | JAN | 95 |  |  |  |
|  |  |  |  |  |  |
| 2001 | FEB | 81 |  |  |  |
|  |  |  |  |  |  |
| 2001 | MAR | 66 |  |  |  |
|  |  |  |  |  |  |
| 2001 | APR | 52 |  |  |  |
|  |  |  |  |  |  |
| 2001 | MAY | 35 |  |  |  |
|  |  |  |  |  |  |
| 2001 | JUN | 58 |  |  |  |
|  |  |  | 74.00 |  |  |
| 2001 | JUL | 65 |  | 73.67 | 0.882352941 |
|  |  |  | 73.33 |  |  |
| 2001 | AUG | 54 |  | 73.33 | 0.736363636 |
|  |  |  | 73.33 |  |  |
| 2001 | SEP | 82 |  | 73.29 | 1.11881751 |
|  |  |  | 73.25 |  |  |
| 2001 | OCT | 90 |  | 73.88 | 1.218274112 |
|  |  |  | 74.50 |  |  |
| 2001 | NOV | 98 |  | 75.25 | 1.302325581 |
|  |  |  | 76.00 |  |  |
| 2001 | DEC | 112 |  | 75.21 | 1.489196676 |
|  |  |  | 74.42 |  |  |
| 2002 | JAN | 87 |  | 72.67 | 1.197247706 |
|  |  |  | 70.92 |  |  |
| 2002 | FEB | 81 |  | 71.08 | 1.13950762 |
|  |  |  | 71.25 |  |  |
| 2002 | MAR | 65 |  | 70.92 | 0.916568743 |
|  |  |  | 70.58 |  |  |
| 2002 | APR | 67 |  | 70.92 | 0.944770858 |
|  |  |  | 71.25 |  |  |
| 2002 | MAY | 53 |  | 71.38 | 0.742556918 |
|  |  |  | 71.50 |  |  |
| 2002 | JUN | 39 |  | 71.50 | 0.545454545 |
|  |  |  | 71.50 |  |  |
| 2002 | JUL | 23 |  | 72.46 | 0.317423807 |
|  |  |  | 73.42 |  |  |
| 2002 | AUG | 58 |  | 74.29 | 0.780706674 |
|  |  |  | 75.17 |  |  |
| 2002 | SEP | 74 |  | 76.54 | 0.966793685 |
|  |  |  | 77.92 |  |  |
| 2002 | OCT | 98 |  | 78.38 | 1.250398724 |
|  |  |  | 78.83 |  |  |
| 2002 | NOV | 101 |  | 79.33 | 1.273109244 |
|  |  |  | 79.83 |  |  |
| 2002 | DEC | 112 |  | 81.04 | 1.382005141 |
|  |  |  | 82.25 |  |  |
| 2003 | JAN | 110 |  | 84.42 | 1.303060217 |
|  |  |  | 86.58 |  |  |
| 2003 | FEB | 102 |  | 86.58 | 1.178055823 |
|  |  |  | 86.58 |  |  |
| 2003 | MAR | 98 |  | 86.33 | 1.135135135 |
|  |  |  | 86.08 |  |  |
| 2003 | APR | 78 |  | 85.17 | 0.915851272 |
|  |  |  | 84.25 |  |  |
| 2003 | MAY | 65 |  | 85.38 | 0.761346999 |
|  |  |  | 86.50 |  |  |
| 2003 | JUN | 68 |  | 87.46 | 0.777513101 |
|  |  |  | 88.42 |  |  |
| 2003 | JUL | 75 |  | 87.92 | 0.853080569 |
|  |  |  | 87.42 |  |  |
| 2003 | AUG | 58 |  | 86.83 | 0.667946257 |
|  |  |  | 86.25 |  |  |
| 2003 | SEP | 68 |  | 84.58 | 0.803940887 |
|  |  |  | 82.92 |  |  |
| 2003 | OCT | 76 |  | 81.92 | 0.927772126 |
|  |  |  | 80.92 |  |  |
| 2003 | NOV | 128 |  | 79.88 | 1.602503912 |
|  |  |  | 78.83 |  |  |
| 2003 | DEC | 135 |  | 78.46 | 1.720658524 |
|  |  |  | 78.08 |  |  |
| 2004 | JAN | 98 |  | 77.67 | 1.261802575 |
|  |  |  | 77.25 |  |  |
| 2004 | FEB | 88 |  | 77.08 | 1.141621622 |
|  |  |  | 76.92 |  |  |
| 2004 | MAR | 58 |  | 76.92 | 0.754062839 |
|  |  |  | 76.92 |  |  |
| 2004 | APR | 54 |  | 77.38 | 0.697899838 |
|  |  |  | 77.83 |  |  |
| 2004 | MAY | 40 |  | 77.54 | 0.515851693 |
|  |  |  | 77.25 |  |  |
| 2004 | JUN | 59 |  | 77.13 | 0.764991896 |
|  |  |  | 77.00 |  |  |
| 2004 | JUL | 65 |  |  |  |
|  |  |  |  |  |  |
| 2004 | AUG | 54 |  |  |  |
|  |  |  |  |  |  |
| 2004 | SEP | 68 |  |  |  |
|  |  |  |  |  |  |
| 2004 | OCT | 87 |  |  |  |
|  |  |  |  |  |  |
| 2004 | NOV | 121 |  |  |  |
|  |  |  |  |  |  |
| 2004 | DEC | 132 |  |  |  |

Table 9.2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| MONTH |  | YEAR | |  | SEASONAL INDICES | ADJUSTED SEASONAL INDICES |
| 2001 | 2002 | 2003 | 2004 |
| JAN |  | 1.19724771 | 1.30306022 | 1.26180258 | 1.254036833 | 1.25449091 |
| FEB |  | 1.13950762 | 1.17805582 | 1.14162162 | 1.153061688 | 1.153479203 |
| MAR |  | 0.91656874 | 1.13513514 | 0.75406284 | 0.935255572 | 0.935594221 |
| APR |  | 0.94477086 | 0.91585127 | 0.69789984 | 0.852840656 | 0.853149463 |
| MAY |  | 0.74255692 | 0.761347 | 0.51585169 | 0.67325187 | 0.673495649 |
| JUN |  | 0.54545455 | 0.7775131 | 0.7649919 | 0.695986514 | 0.696238526 |
| JUL | 0.88235294 | 0.31742381 | 0.85308057 |  | 0.684285772 | 0.684533547 |
| AUG | 0.73636364 | 0.78070667 | 0.66794626 |  | 0.728338856 | 0.728602582 |
| SEP | 1.11881751 | 0.96679369 | 0.80394089 |  | 0.963184027 | 0.963532789 |
| OCT | 1.21827411 | 1.25039872 | 0.92777213 |  | 1.132148321 | 1.132558262 |
| NOV | 1.30232558 | 1.27310924 | 1.60250391 |  | 1.392646246 | 1.393150512 |
| DEC | 1.48919668 | 1.38200514 | 1.72065852 |  | 1.530620114 | 1.531174339 |
| SUM= |  |  |  |  | 11.99565647 | 12 |
|  |  |  |  |  |  |  |
|  |  |  |  |  | Correction Factor(k)= | 1.000362092 |

Table 9.3

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| INDEX NOS. | YEAR | MONTH | SALES (y) | SEASONAL FACTOR | DESEASONALISED DATA | EXPECTED VALUES |
| 1 | 2001 | JAN | 95 | 1.25449091 | 75.72793017 | 90.8671673 |
| 2 | 2001 | FEB | 81 | 1.153479203 | 70.22233241 | 83.80026407 |
| 3 | 2001 | MAR | 66 | 0.935594221 | 70.54340284 | 68.17347628 |
| 4 | 2001 | APR | 52 | 0.853149463 | 60.95063323 | 62.35072219 |
| 5 | 2001 | MAY | 35 | 0.673495649 | 51.96767056 | 49.3668943 |
| 6 | 2001 | JUN | 58 | 0.696238526 | 83.30478402 | 51.18467144 |
| 7 | 2001 | JUL | 65 | 0.684533547 | 94.95517104 | 50.47236973 |
| 8 | 2001 | AUG | 54 | 0.728602582 | 74.114478 | 53.8794323 |
| 9 | 2001 | SEP | 82 | 0.963532789 | 85.10348685 | 71.46089103 |
| 10 | 2001 | OCT | 90 | 1.132558262 | 79.46611047 | 84.24194868 |
| 11 | 2001 | NOV | 98 | 1.393150512 | 70.3441582 | 103.9269385 |
| 12 | 2001 | DEC | 112 | 1.531174339 | 73.14647141 | 114.5548082 |
| 13 | 2002 | JAN | 87 | 1.25449091 | 69.35084131 | 94.12633468 |
| 14 | 2002 | FEB | 81 | 1.153479203 | 70.22233241 | 86.79700304 |
| 15 | 2002 | MAR | 65 | 0.935594221 | 69.4745634 | 70.60415007 |
| 16 | 2002 | APR | 67 | 0.853149463 | 78.53254666 | 64.5672045 |
| 17 | 2002 | MAY | 53 | 0.673495649 | 78.69390114 | 51.116636 |
| 18 | 2002 | JUN | 39 | 0.696238526 | 56.01528581 | 52.99349913 |
| 19 | 2002 | JUL | 23 | 0.684533547 | 33.59952206 | 52.25078788 |
| 20 | 2002 | AUG | 58 | 0.728602582 | 79.60443933 | 55.77234181 |
| 21 | 2002 | SEP | 74 | 0.963532789 | 76.80070765 | 73.96414921 |
| 22 | 2002 | OCT | 98 | 1.132558262 | 86.52976473 | 87.18433504 |
| 23 | 2002 | NOV | 101 | 1.393150512 | 72.4975508 | 107.5463435 |
| 24 | 2002 | DEC | 112 | 1.531174339 | 73.14647141 | 118.5327991 |
| 25 | 2003 | JAN | 110 | 1.25449091 | 87.68497178 | 97.38550207 |
| 26 | 2003 | FEB | 102 | 1.153479203 | 88.4281223 | 89.79374201 |
| 27 | 2003 | MAR | 98 | 0.935594221 | 104.7462648 | 73.03482385 |
| 28 | 2003 | APR | 78 | 0.853149463 | 91.42594984 | 66.7836868 |
| 29 | 2003 | MAY | 65 | 0.673495649 | 96.51138819 | 52.86637769 |
| 30 | 2003 | JUN | 68 | 0.696238526 | 97.66767782 | 54.80232682 |
| 31 | 2003 | JUL | 75 | 0.684533547 | 109.5636589 | 54.02920603 |
| 32 | 2003 | AUG | 58 | 0.728602582 | 79.60443933 | 57.66525132 |
| 33 | 2003 | SEP | 68 | 0.963532789 | 70.57362324 | 76.4674074 |
| 34 | 2003 | OCT | 76 | 1.132558262 | 67.10471551 | 90.12672141 |
| 35 | 2003 | NOV | 128 | 1.393150512 | 91.87808418 | 111.1657485 |
| 36 | 2003 | DEC | 135 | 1.531174339 | 88.16762178 | 122.51079 |
| 37 | 2004 | JAN | 98 | 1.25449091 | 78.11933849 | 100.6446694 |
| 38 | 2004 | FEB | 88 | 1.153479203 | 76.29092904 | 92.79048098 |
| 39 | 2004 | MAR | 58 | 0.935594221 | 61.99268734 | 75.46549764 |
| 40 | 2004 | APR | 54 | 0.853149463 | 63.29488835 | 69.00016911 |
| 41 | 2004 | MAY | 40 | 0.673495649 | 59.3916235 | 54.61611939 |
| 42 | 2004 | JUN | 59 | 0.696238526 | 84.7410734 | 56.61115451 |
| 43 | 2004 | JUL | 65 | 0.684533547 | 94.95517104 | 55.80762419 |
| 44 | 2004 | AUG | 54 | 0.728602582 | 74.114478 | 59.55816082 |
| 45 | 2004 | SEP | 68 | 0.963532789 | 70.57362324 | 78.97066558 |
| 46 | 2004 | OCT | 87 | 1.132558262 | 76.81724012 | 93.06910778 |
| 47 | 2004 | NOV | 121 | 1.393150512 | 86.85350145 | 114.7851535 |
| 48 | 2004 | DEC | 132 | 1.531174339 | 86.2083413 | 126.488781 |
| 49 | 2005 | JAN |  |  |  | 103.6322396 |
| 50 | 2005 | FEB |  |  |  | 95.5374917 |
| 51 | 2005 | MAR |  |  |  | 77.69361527 |
| 52 | 2005 | APR |  |  |  | 71.03194455 |
| 53 | 2005 | MAY |  |  |  | 56.22004928 |
| 54 | 2005 | JUN |  |  |  | 58.26924656 |
| 55 | 2005 | JUL |  |  |  | 57.43784083 |
| 56 | 2005 | AUG |  |  |  | 61.29332787 |
| 57 | 2005 | SEP |  |  |  | 81.26531892 |
| 58 | 2005 | OCT |  |  |  | 95.76629528 |
| 59 | 2005 | NOV |  |  |  | 118.1029415 |
| 60 | 2005 | DEC |  |  |  | 130.1352727 |



Graph 9.1

Graph 9.2

**RESULT:**

* The seasonal and adjusted indices calculated by ratio to moving average method have been shown in Table 9.2.
* The value of correction factor (k) is coming out to be 1.000362092.
* Trend without seasonal effect and estimated sales are computed by

de-seasonalization of data.

* Table 9.3 shows de-seasonalized data computed by dividing no. of aircrafts by seasonal factor (adjusted seasonal indices).
* Values of a & b are obtained by plotting the Graph 9.1 for deseasonalized values, and fitting the trend line to obtain its equation, and are shown below Table 9.3
* As a = 72.217 and b = 0.2165, equation for trend values (2005) without seasonal effect is:

72.217 + (0.2165)\*t

* We obtain the estimated values for all the years by multiplying the above equation by the respective seasonal factor (for each month).
* Estimated monthly values for the year 2001-2005 have been computed and summarized along with the de-seasonalized data in Table 9.3.
* Graph 9.2 shows the estimated sales (2001-2005) along with the de-seasonalized sales (2001-2004).

**CONCLUSION:**

* After de-seasonalization, we can see that the seasonal effect has been removed to an extent.
* Variation in Expected values is more than the variation in Deseasonalised values.