**ENM319 Production and Operations Planning & BIM213 Data Structures and Algorithms**

**Final Report**

**Hazırlayanlar :**

**Berkay Gülmüş**

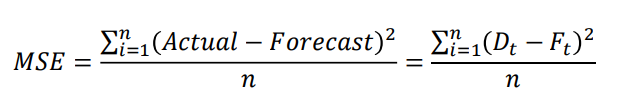
**Yusuf Can Yavuz**

**Furkan Akarsu**

**Alper Arslan**

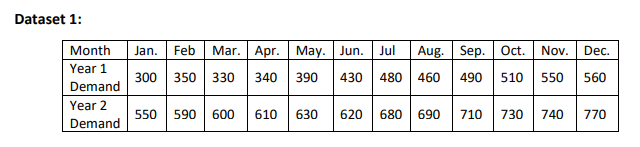
**Yunus Yavuzhan Afşar**

**Formulas for calculate MSE**



Eror=Actual(demand)-Forecast

n=number of demand

 **Dataset 1 Answers**

**Exponential smoothing:**



Demand=

Forecast=

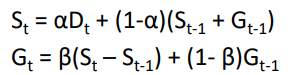
e= eror

α =0,3

In this method we calculate the MSE and we assumed forecast 300 for the first month.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Month** | **Demand** | **Forecast** | **e** |  | **MSE** |
| 1 | 300 | 300 | 0 | 0 | 7507,516 |
| 2 | 350 | 300 | 50 | 2500 |  |
| 3 | 330 | 310 | 20 | 400 |  |
| 4 | 340 | 314 | 26 | 676 |  |
| 5 | 390 | 319,2 | 70,8 | 5012,64 |  |
| 6 | 430 | 333,36 | 96,64 | 9339,29 |  |
| 7 | 480 | 352,69 | 127,31 | 16208,35 |  |
| 8 | 460 | 378,15 | 81,85 | 6699,36 |  |
| 9 | 490 | 394,52 | 95,48 | 9116,37 |  |
| 10 | 510 | 413,62 | 96,38 | 9289,83 |  |
| 11 | 550 | 432,89 | 117,11 | 13714,05 |  |
| 12 | 560 | 456,31 | 103,69 | 10750,7 |  |
| 13 | 550 | 477,05 | 72,95 | 5321,48 |  |
| 14 | 590 | 491,64 | 98,36 | 9674,45 |  |
| 15 | 600 | 511,31 | 88,69 | 7865,39 |  |
| 16 | 610 | 529,05 | 80,95 | 6552,84 |  |
| 17 | 630 | 545,24 | 84,76 | 7184,21 |  |
| 18 | 620 | 562,19 | 57,81 | 3341,74 |  |
| 19 | 680 | 573,75 | 106,25 | 11288,26 |  |
| 20 | 690 | 595 | 95 | 9024,42 |  |
| 21 | 710 | 614 | 96 | 9215,53 |  |
| 22 | 730 | 633,2 | 96,8 | 9369,86 |  |
| 23 | 740 | 652,56 | 87,44 | 7645,48 |  |
| 24 | 770 | 670,05 | 99,95 | 9990,15 |  |
|  |  |  | total | 180180,4 |  |

**Double-exponential smoothing:**

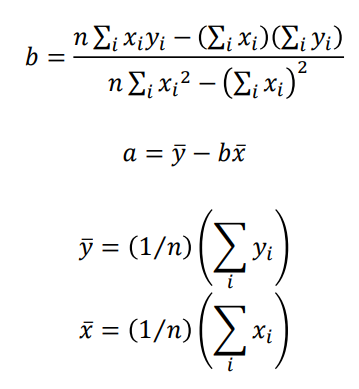


𝛼 = 0.2, 𝛽 = 0.2, = 200, = 50

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Month** | **Demand** |  |  |  | **e** |  | **MSE** |
| 0 |  | 200 | 50 |  |  |  | 3028,907 |
| 1 | 300 | 260 | 52 | 250 | 50 | 2500 |  |
| 2 | 350 | 319,6 | 53,52 | 312 | 38 | 1444 |  |
| 3 | 330 | 364,5 | 51,8 | 373,12 | -43,12 | 1859,33 |  |
| 4 | 340 | 401,03 | 48,74 | 416,29 | -76,29 | 5820,35 |  |
| 5 | 390 | 437,82 | 46,35 | 449,78 | -59,78 | 3573,23 |  |
| 6 | 430 | 473,34 | 44,19 | 484,17 | -54,17 | 2934,79 |  |
| 7 | 480 | 510,02 | 42,68 | 517,52 | -37,52 | 1408,09 |  |
| 8 | 460 | 534,16 | 38,98 | 552,7 | -92,7 | 8594,06 |  |
| 9 | 490 | 556,51 | 35,65 | 573,14 | -83,14 | 6912,21 |  |
| 10 | 510 | 575,73 | 32,36 | 592,16 | -82,16 | 6750,69 |  |
| 11 | 550 | 596,48 | 30,04 | 608,09 | -58,09 | 3374,96 |  |
| 12 | 560 | 613,21 | 27,38 | 626,52 | -66,52 | 4424,38 |  |
| 13 | 550 | 622,47 | 23,76 | 640,59 | -90,59 | 8207,04 |  |
| 14 | 590 | 634,98 | 21,51 | 646,23 | -56,23 | 3161,85 |  |
| 15 | 600 | 645,19 | 19,25 | 656,49 | -56,49 | 3191,26 |  |
| 16 | 610 | 653,55 | 17,07 | 664,44 | -54,44 | 2963,75 |  |
| 17 | 630 | 662,5 | 15,44 | 670,62 | -40,62 | 1650,14 |  |
| 18 | 620 | 666,35 | 13,13 | 677,94 | -57,94 | 3357,32 |  |
| 19 | 680 | 679,58 | 13,15 | 679,48 | 0,52 | 0,27 |  |
| 20 | 690 | 692,19 | 13,04 | 692,73 | -2,73 | 7,47 |  |
| 21 | 710 | 706,18 | 13,23 | 705,22 | 4,78 | 22,8 |  |
| 22 | 730 | 721,53 | 13,65 | 719,41 | 10,59 | 112,16 |  |
| 23 | 740 | 736,14 | 13,85 | 735,18 | 4,82 | 23,23 |  |
| 24 | 770 | 753,99 | 14,65 | 749,99 | 20,01 | 400,38 |  |
| total |  |  |  |  |  | 72693,77 |  |
|  |  |  |  |  |  |  |  |

**Regression analysis:**

First off all we calculated the a and b value with using this formulas;



Then we calculated forecast formula;

Then we calculated eror and MSE .

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **xi** | **yi** | **xi\*yi** | **xi2** | **a** | **b** | **forecast** | **eror** | **e2** | **mse** |
|  | 1 | 300 | 300 | 1 | 301,09 | 19,61 | 321,42 | -21,42 | 458,82 | 358,447917 |
|  | 2 | 350 | 700 | 4 |  |  | 341,03 | 8,97 | 80,41 |  |
|  | 3 | 330 | 990 | 9 |  |  | 360,65 | -30,65 | 939,19 |  |
|  | 4 | 340 | 1360 | 16 |  |  | 380,26 | -40,26 | 1620,8 |  |
|  | 5 | 390 | 1950 | 25 |  |  | 399,87 | -9,87 | 97,46 |  |
|  | 6 | 430 | 2580 | 36 |  |  | 419,49 | 10,51 | 110,56 |  |
|  | 7 | 480 | 3360 | 49 |  |  | 439,1 | 40,9 | 1672,95 |  |
|  | 8 | 460 | 3680 | 64 |  |  | 458,71 | 1,29 | 1,66 |  |
|  | 9 | 490 | 4410 | 81 |  |  | 478,32 | 11,68 | 136,32 |  |
|  | 10 | 510 | 5100 | 100 |  |  | 497,94 | 12,06 | 145,51 |  |
|  | 11 | 550 | 6050 | 121 |  |  | 517,55 | 32,45 | 1052,97 |  |
|  | 12 | 560 | 6720 | 144 |  |  | 537,16 | 22,84 | 521,5 |  |
|  | 13 | 550 | 7150 | 169 |  |  | 556,78 | -6,78 | 45,92 |  |
|  | 14 | 590 | 8260 | 196 |  |  | 576,39 | 13,61 | 185,24 |  |
|  | 15 | 600 | 9000 | 225 |  |  | 596 | 4 | 15,98 |  |
|  | 16 | 610 | 9760 | 256 |  |  | 615,62 | -5,62 | 31,54 |  |
|  | 17 | 630 | 10710 | 289 |  |  | 635,23 | -5,23 | 27,34 |  |
|  | 18 | 620 | 11160 | 324 |  |  | 654,84 | -34,84 | 1213,95 |  |
|  | 19 | 680 | 12920 | 361 |  |  | 674,45 | 5,55 | 30,75 |  |
|  | 20 | 690 | 13800 | 400 |  |  | 694,07 | -4,07 | 16,55 |  |
|  | 21 | 710 | 14910 | 441 |  |  | 713,68 | -3,68 | 13,55 |  |
|  | 22 | 730 | 16060 | 484 |  |  | 733,29 | -3,29 | 10,85 |  |
|  | 23 | 740 | 17020 | 529 |  |  | 752,91 | -12,91 | 166,59 |  |
|  | 24 | 770 | 18480 | 576 |  |  | 772,52 | -2,52 | 6,35 |  |
| total | 300 | 13110 | 186430 | 4900 |  |  |  |  | 8602,75 |  |

**Deseasonalized regression analysis:**

We seperated the years to 12 season and we calculated average demand of seasons between two years.we calculated deseasonal demand factor for per season.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Season | Year | Demand | Year | Demand | Average Demand | Deseasonal Demand Factor |
| 1 | 1 | 300 | 2 | 550 | 425 | 0,778 |
| 2 | 1 | 350 | 2 | 590 | 470 | 0,8604 |
| 3 | 1 | 330 | 2 | 600 | 465 | 0,8513 |
| 4 | 1 | 340 | 2 | 610 | 475 | 0,8696 |
| 5 | 1 | 390 | 2 | 630 | 510 | 0,9336 |
| 6 | 1 | 430 | 2 | 620 | 525 | 0,9611 |
| 7 | 1 | 480 | 2 | 680 | 580 | 1,0618 |
| 8 | 1 | 460 | 2 | 690 | 575 | 1,0526 |
| 9 | 1 | 490 | 2 | 710 | 600 | 1,0984 |
| 10 | 1 | 510 | 2 | 730 | 620 | 1,135 |
| 11 | 1 | 550 | 2 | 740 | 645 | 1,1808 |
| 12 | 1 | 560 | 2 | 770 | 665 | 1,2174 |
| average |  |  |  |  | 546,25 |  |
|  |  |  |  |  |  |  |

We divided demand to deseasonal demand factors and we find here deseasonal demand.

We use here regression analysis formulas

deseasonal demand equal to

season numbers equal to

and we calculated a and b value

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **season** | **demand** | **season average** | **deseasonal demand factor** | **deseasonal demand(y)** | **x\*y** |  |
|  | 1 | 300 | 425 | 0,778 | 385,604 | 385,604 | 1 |
|  | 2 | 350 | 470 | 0,8604 | 406,788 | 813,576 | 4 |
|  | 3 | 330 | 465 | 0,8513 | 387,642 | 1162,926 | 9 |
|  | 4 | 340 | 475 | 0,8696 | 390,984 | 1563,936 | 16 |
|  | 5 | 390 | 510 | 0,9336 | 417,738 | 2088,69 | 25 |
|  | 6 | 430 | 525 | 0,9611 | 447,404 | 2684,424 | 36 |
|  | 7 | 480 | 580 | 1,0618 | 452,063 | 3164,441 | 49 |
|  | 8 | 460 | 575 | 1,0526 | 437,013 | 3496,104 | 64 |
|  | 9 | 490 | 600 | 1,0984 | 446,103 | 4014,927 | 81 |
|  | 10 | 510 | 620 | 1,135 | 449,339 | 4493,39 | 100 |
|  | 11 | 550 | 645 | 1,1808 | 465,786 | 5123,646 | 121 |
|  | 12 | 560 | 665 | 1,2174 | 459,997 | 5519,964 | 144 |
|  | 13 | 550 | 425 | 0,778 | 706,941 | 9190,233 | 169 |
|  | 14 | 590 | 470 | 0,8604 | 685,728 | 9600,192 | 196 |
|  | 15 | 600 | 465 | 0,8513 | 704,804 | 10572,06 | 225 |
|  | 16 | 610 | 475 | 0,8696 | 701,472 | 11223,55 | 256 |
|  | 17 | 630 | 510 | 0,9336 | 674,807 | 11471,72 | 289 |
|  | 18 | 620 | 525 | 0,9611 | 645,094 | 11611,69 | 324 |
|  | 19 | 680 | 580 | 1,0618 | 640,422 | 12168,02 | 361 |
|  | 20 | 690 | 575 | 1,0526 | 655,52 | 13110,4 | 400 |
|  | 21 | 710 | 600 | 1,0984 | 646,395 | 13574,3 | 441 |
|  | 22 | 730 | 620 | 1,135 | 643,172 | 14149,78 | 484 |
|  | 23 | 740 | 645 | 1,1808 | 626,694 | 14413,96 | 529 |
|  | 24 | 770 | 665 | 1,2174 | 632,495 | 15179,88 | 576 |
| total | 300 |  |  |  | 13110,005 | 180777,4 | 4900 |

A=362,525

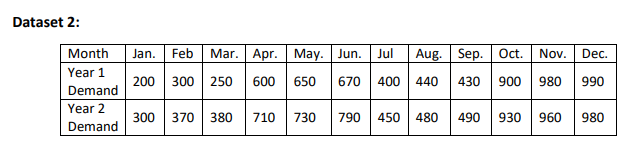
B=14,698

Then when we find a and b value we calculated for two years forecast and find erors and and calcuted MSE.

|  |  |  |  |
| --- | --- | --- | --- |
| **Forecast** | **e** |  | **MSE** |
| 293,48 | 6,52 | 42,5104 | 3880,426 |
| 337,21 | 12,79 | 163,5841 |  |
| 346,15 | -16,15 | 260,8225 |  |
| 366,38 | -26,38 | 695,9044 |  |
| 407,06 | -17,06 | 291,0436 |  |
| 433,18 | -3,18 | 10,1124 |  |
| 494,17 | -14,17 | 200,7889 |  |
| 505,36 | -45,36 | 2057,53 |  |
| 543,5 | -53,5 | 2862,25 |  |
| 578,29 | -68,29 | 4663,524 |  |
| 618,98 | -68,98 | 4758,24 |  |
| 656,06 | -96,06 | 9227,524 |  |
| 430,7 | 119,3 | 14232,49 |  |
| 488,96 | 101,04 | 10209,08 |  |
| 496,3 | 103,7 | 10753,69 |  |
| 519,75 | 90,25 | 8145,063 |  |
| 571,73 | 58,27 | 3395,393 |  |
| 602,7 | 17,3 | 299,29 |  |
| 681,45 | -1,45 | 2,1025 |  |
| 691,02 | -1,02 | 1,0404 |  |
| 737,23 | -27,23 | 741,4729 |  |
| 778,47 | -48,47 | 2349,341 |  |
| 827,24 | -87,24 | 7610,818 |  |
| 870,78 | -100,78 | 10156,61 |  |
| total |  | 93130,22 |  |

Finally the best method is regression analysis for dataset 1.Because the least MSE value find with this method. Here we calculate forecast for next 2 year .

|  |  |
| --- | --- |
| month | forecast |
| 25 | 792,13 |
| 26 | 811,75 |
| 27 | 831,36 |
| 28 | 850,97 |
| 29 | 870,59 |
| 30 | 890,2 |
| 31 | 909,81 |
| 32 | 929,42 |
| 33 | 949,04 |
| 34 | 968,65 |
| 35 | 988,26 |
| 36 | 1007,88 |
| 37 | 1027,49 |
| 38 | 1047,1 |
| 39 | 1066,72 |
| 40 | 1086,33 |
| 41 | 1105,94 |
| 42 | 1125,55 |
| 43 | 1145,17 |
| 44 | 1164,78 |
| 45 | 1184,39 |
| 46 | 1204,01 |
| 47 | 1223,62 |
| 48 | 1243,23 |
|  |  |

**Dataset 2 answers**

**Exponential smooting:**



Demand=

Forecast=

e= eror

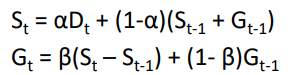
α =0,3

In this method we calculate the MSE and we assumed forecast 200 for the first month.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Month** | **Demand** | **Forecast** | **e** |  |
| 1 | 200 | 200 | 0 | 0 |
| 2 | 300 | 200 | 100 | 10000 |
| 3 | 250 | 220 | 30 | 900 |
| 4 | 600 | 226 | 374 | 139876 |
| 5 | 650 | 300,8 | 349,2 | 121940,6 |
| 6 | 670 | 370,64 | 299,36 | 89616,41 |
| 7 | 400 | 430,51 | -30,51 | 930,98 |
| 8 | 440 | 424,41 | 15,59 | 243,06 |
| 9 | 430 | 427,53 | 2,47 | 6,11 |
| 10 | 900 | 428,02 | 471,98 | 222763,1 |
| 11 | 980 | 522,42 | 457,58 | 209381,6 |
| 12 | 990 | 613,93 | 376,07 | 141425,5 |
| 13 | 300 | 689,15 | -389,15 | 151435,7 |
| 14 | 370 | 611,32 | -241,32 | 58234,31 |
| 15 | 380 | 563,05 | -183,05 | 33508,88 |
| 16 | 710 | 526,44 | 183,56 | 33693,01 |
| 17 | 730 | 563,15 | 166,85 | 27837,34 |
| 18 | 790 | 596,52 | 193,48 | 37433,04 |
| 19 | 450 | 635,22 | -185,22 | 34306,09 |
| 20 | 480 | 598,18 | -118,18 | 13965,39 |
| 21 | 490 | 574,54 | -84,54 | 7147,04 |
| 22 | 930 | 557,63 | 372,37 | 138657,8 |
| 23 | 960 | 632,11 | 327,89 | 107514,7 |
| 24 | 980 | 697,68 | 282,32 | 79702 |
|  |  |  |  |  |

MSE=78822,84

**Double-Exponential Smoothing:**



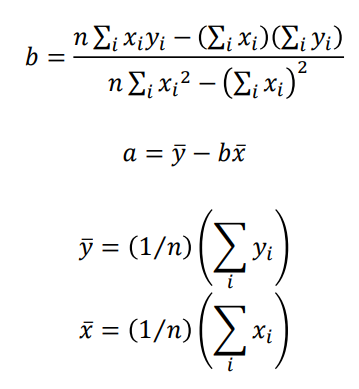
𝛼 = 0.2, 𝛽 = 0.2, = 200, = 50

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Month** |  |  |  |  | **e** |  |
| 0 |  | 200 | 50 | 0 | 0 | 0 |
| 1 | 200 | 240 | 40 | 250 | -50 | 2500 |
| 2 | 300 | 284 | 44 | 280 | 20 | 400 |
| 3 | 250 | 312,4 | 28,4 | 328 | -78 | 6084 |
| 4 | 600 | 392,64 | 80,24 | 340,8 | 259,2 | 67184,64 |
| 5 | 650 | 508,3 | 115,66 | 472,88 | 177,12 | 31371,49 |
| 6 | 670 | 633,17 | 124,87 | 623,97 | 46,03 | 2118,95 |
| 7 | 400 | 686,44 | 53,26 | 758,04 | -358,04 | 128196,1 |
| 8 | 440 | 679,76 | -6,68 | 739,7 | -299,7 | 89818,46 |
| 9 | 430 | 624,46 | -55,29 | 673,08 | -243,08 | 59087,79 |
| 10 | 900 | 635,34 | 10,87 | 569,17 | 330,83 | 109448,6 |
| 11 | 980 | 712,97 | 77,63 | 646,21 | 333,79 | 111417,1 |
| 12 | 990 | 830,48 | 117,51 | 790,6 | 199,4 | 39761,63 |
| 13 | 300 | 818,39 | -12,09 | 947,99 | -647,99 | 419889,2 |
| 14 | 370 | 719,04 | -99,35 | 806,3 | -436,3 | 190361,4 |
| 15 | 380 | 571,76 | -147,29 | 619,7 | -239,7 | 57454,14 |
| 16 | 710 | 481,58 | -90,18 | 424,47 | 285,53 | 81527,33 |
| 17 | 730 | 459,12 | -22,46 | 391,4 | 338,6 | 114653,1 |
| 18 | 790 | 507,33 | 48,21 | 436,66 | 353,34 | 124851,6 |
| 19 | 450 | 534,43 | 27,1 | 555,53 | -105,53 | 11137,47 |
| 20 | 480 | 545,22 | 10,8 | 561,53 | -81,53 | 6647,05 |
| 21 | 490 | 542,82 | -2,41 | 556,02 | -66,02 | 4358,61 |
| 22 | 930 | 618,33 | 75,51 | 540,41 | 389,59 | 151781,9 |
| 23 | 960 | 747,07 | 128,74 | 693,84 | 266,16 | 70842,69 |
| 24 | 980 | 896,65 | 149,58 | 875,81 | 104,19 | 10854,95 |
|  |  |  |  |  | total | 1891748 |

MSE=78822,83

**Regression analysis:**

First off all we calculated the a and b value with using this formulas;



Then we calculated forecast formula;

Then we calculated eror and MSE .

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **\*** |  | **Forecast** | **e** |  |
|  | 1 | 200 | 200 | 1 | 393,3 | -193,3 | 37364,89 |
|  | 2 | 300 | 600 | 4 | 411,2 | -111,2 | 12365,44 |
|  | 3 | 250 | 750 | 9 | 429,1 | -179,1 | 32076,81 |
|  | 4 | 600 | 2400 | 16 | 447 | 153 | 23409 |
|  | 5 | 650 | 3250 | 25 | 464,9 | 185,1 | 34262,01 |
|  | 6 | 670 | 4020 | 36 | 482,8 | 187,2 | 35043,84 |
|  | 7 | 400 | 2800 | 49 | 500,7 | -100,7 | 10140,49 |
|  | 8 | 440 | 3520 | 64 | 518,6 | -78,6 | 6177,96 |
|  | 9 | 430 | 3870 | 81 | 536,5 | -106,5 | 11342,25 |
|  | 10 | 900 | 9000 | 100 | 554,4 | 345,6 | 119439,4 |
|  | 11 | 980 | 10780 | 121 | 572,3 | 407,7 | 166219,3 |
|  | 12 | 990 | 11880 | 144 | 590,2 | 399,8 | 159840 |
|  | 13 | 300 | 3900 | 169 | 608,1 | -308,1 | 94925,61 |
|  | 14 | 370 | 5180 | 196 | 626 | -256 | 65536 |
|  | 15 | 380 | 5700 | 225 | 643,9 | -263,9 | 69643,21 |
|  | 16 | 710 | 11360 | 256 | 661,8 | 48,2 | 2323,24 |
|  | 17 | 730 | 12410 | 289 | 679,7 | 50,3 | 2530,09 |
|  | 18 | 790 | 14220 | 324 | 697,6 | 92,4 | 8537,76 |
|  | 19 | 450 | 8550 | 361 | 715,5 | -265,5 | 70490,25 |
|  | 20 | 480 | 9600 | 400 | 733,4 | -253,4 | 64211,56 |
|  | 21 | 490 | 10290 | 441 | 751,3 | -261,3 | 68277,69 |
|  | 22 | 930 | 20460 | 484 | 769,2 | 160,8 | 25856,64 |
|  | 23 | 960 | 22080 | 529 | 787,1 | 172,9 | 29894,41 |
|  | 24 | 980 | 23520 | 576 | 805 | 175 | 30625 |
| total | 300 | 14380 | 200340 | 4900 | 5745,4 | 8634,6 | 1180533 |

A=375,4

B=17,9

Mse=49188,87

**Deseasonal Regression Analysis:**

We seperated the years to 12 season and we calculated average demand of seasons between two years.we calculated deseasonal demand factor for per season.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Season** | **Year** | **Demand** | **Year** | **Demand** | **Averaged Demand** | **Deseasonal Demand Factors** |
| 1 | 1 | 200 | 2 | 300 | 250 | 0,417 |
| 2 | 1 | 300 | 2 | 370 | 335 | 0,559 |
| 3 | 1 | 250 | 2 | 380 | 315 | 0,526 |
| 4 | 1 | 600 | 2 | 710 | 655 | 1,093 |
| 5 | 1 | 650 | 2 | 730 | 690 | 1,152 |
| 6 | 1 | 670 | 2 | 790 | 730 | 1,218 |
| 7 | 1 | 400 | 2 | 450 | 425 | 0,709 |
| 8 | 1 | 440 | 2 | 480 | 460 | 0,768 |
| 9 | 1 | 430 | 2 | 490 | 460 | 0,768 |
| 10 | 1 | 900 | 2 | 930 | 915 | 1,527 |
| 11 | 1 | 980 | 2 | 960 | 970 | 1,619 |
| 12 | 1 | 990 | 2 | 980 | 985 | 1,644 |
|  |  |  |  | average | 599,167 |  |

We divided demand to deseasonal demand factors and we find here deseasonal demand.

We use here regression analysis formulas

deseasonal demand equal to

season numbers equal to

and we calculated a and b value

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Season** | **Demand** | **Season Average** | **Deseasonal Demand Factor** | **Deseasonal Demand(y)** | **x\*y** |  |
|  | 1 | 200 | 250 | 0,417 | 479,616 | 479,616 | 1 |
|  | 2 | 300 | 335 | 0,559 | 536,673 | 1073,346 | 4 |
|  | 3 | 250 | 315 | 0,526 | 475,285 | 1425,855 | 9 |
|  | 4 | 600 | 655 | 1,093 | 548,948 | 2195,792 | 16 |
|  | 5 | 650 | 690 | 1,152 | 564,236 | 2821,18 | 25 |
|  | 6 | 670 | 730 | 1,218 | 550,082 | 3300,492 | 36 |
|  | 7 | 400 | 425 | 0,709 | 564,175 | 3949,225 | 49 |
|  | 8 | 440 | 460 | 0,768 | 572,917 | 4583,336 | 64 |
|  | 9 | 430 | 460 | 0,768 | 559,896 | 5039,064 | 81 |
|  | 10 | 900 | 915 | 1,527 | 589,391 | 5893,91 | 100 |
|  | 11 | 980 | 970 | 1,619 | 605,312 | 6658,432 | 121 |
|  | 12 | 990 | 985 | 1,644 | 602,19 | 7226,28 | 144 |
|  | 13 | 300 | 250 | 0,417 | 719,424 | 9352,512 | 169 |
|  | 14 | 370 | 335 | 0,559 | 661,896 | 9266,544 | 196 |
|  | 15 | 380 | 315 | 0,526 | 722,433 | 10836,5 | 225 |
|  | 16 | 710 | 655 | 1,093 | 649,588 | 10393,41 | 256 |
|  | 17 | 730 | 690 | 1,152 | 633,681 | 10772,58 | 289 |
|  | 18 | 790 | 730 | 1,218 | 648,604 | 11674,87 | 324 |
|  | 19 | 450 | 425 | 0,709 | 634,697 | 12059,24 | 361 |
|  | 20 | 480 | 460 | 0,768 | 625 | 12500 | 400 |
|  | 21 | 490 | 460 | 0,768 | 638,021 | 13398,44 | 441 |
|  | 22 | 930 | 915 | 1,527 | 609,037 | 13398,81 | 484 |
|  | 23 | 960 | 970 | 1,619 | 592,959 | 13638,06 | 529 |
|  | 24 | 980 | 985 | 1,644 | 596,107 | 14306,57 | 576 |
| total | 300 |  |  |  | 14380,168 | 186244,1 | 4900 |

A=5,645

B=528,6

Then when we find a and b value we calculated for two years forecast and find erors and and calcuted MSE.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Season** | **Forecast** | **e** |  | **MSE** |
| 1 | 222,78 | -22,78 | 518,9284 | 1661,404 |
| 2 | 301,8 | -1,8 | 3,24 |  |
| 3 | 286,95 | -36,95 | 1365,303 |  |
| 4 | 602,44 | -2,44 | 5,9536 |  |
| 5 | 641,46 | 8,54 | 72,9316 |  |
| 6 | 685,09 | -15,09 | 227,7081 |  |
| 7 | 402,79 | -2,79 | 7,7841 |  |
| 8 | 440,65 | -0,65 | 0,4225 |  |
| 9 | 444,98 | -14,98 | 224,4004 |  |
| 10 | 893,37 | 6,63 | 43,9569 |  |
| 11 | 956,34 | 23,66 | 559,7956 |  |
| 12 | 980,38 | 9,62 | 92,5444 |  |
| 13 | 251,03 | 48,97 | 2398,061 |  |
| 14 | 339,67 | 30,33 | 919,9089 |  |
| 15 | 322,58 | 57,42 | 3297,056 |  |
| 16 | 676,48 | 33,52 | 1123,59 |  |
| 17 | 719,5 | 10,5 | 110,25 |  |
| 18 | 767,6 | 22,4 | 501,76 |  |
| 19 | 450,82 | -0,82 | 0,6724 |  |
| 20 | 492,67 | -12,67 | 160,5289 |  |
| 21 | 497,01 | -7,01 | 49,1401 |  |
| 22 | 996,81 | -66,81 | 4463,576 |  |
| 23 | 1066,01 | -106,01 | 11238,12 |  |
| 24 | 1091,75 | -111,75 | 12488,06 |  |
| total |  |  | 39873,69 |  |

Finally the best method is deseasonal regression analysis for dataset 2.Because the least MSE value find with this method. Here we calculate forecast for next 2 year .

|  |  |
| --- | --- |
| season | forecast |
| 25 | 279,275 |
| 26 | 377,532 |
| 27 | 358,214 |
| 28 | 750,519 |
| 29 | 797,535 |
| 30 | 850,103 |
| 31 | 498,849 |
| 32 | 544,696 |
| 33 | 549,032 |
| 34 | 1100,249 |
| 35 | 1175,677 |
| 36 | 1203,112 |
| 37 | 307,523 |
| 38 | 415,398 |
| 39 | 393,845 |
| 40 | 824,559 |
| 41 | 875,572 |
| 42 | 932,61 |
| 43 | 546,877 |
| 44 | 596,721 |
| 45 | 601,056 |
| 46 | 1203,688 |
| 47 | 1285,348 |
| 48 | 1314,477 |

PROGRAMMING

1. Exponential Smoothing Method

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

Time complexity: O(n)

1. Double-Exponential Smoothing

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

Time complexity: O(n)

1. Regression Analysis

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

Time complexity: O(n)

1. Deseasonalized Regression Analysis

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

Time complexity: O(n)

1. MSE

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

1. LINKEDLIST

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

The best choice is doubly Linkedlist. Because we dont know size of datasets before customer inserts it.

TERMINAL

metin içeren bir resim

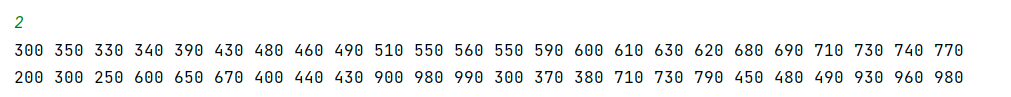
Açıklama otomatik olarak oluşturuldu

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

You can add dataset like this.

List all datasets



Forecasts DATASET1

tablo içeren bir resim

Açıklama otomatik olarak oluşturuldu

Forecasts DATASET2

tablo içeren bir resim

Açıklama otomatik olarak oluşturuldu

Replace Value

metin, tablo içeren bir resim

Açıklama otomatik olarak oluşturuldu

Find Maximum Sales Count



Find Minimum Sales Count



Print Dataset In Reverse

tablo içeren bir resim

Açıklama otomatik olarak oluşturuldu

Find Max Forecasted Sales

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

Find Min Forecasted Sales

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

Sort Forecasted Sales

tablo içeren bir resim

Açıklama otomatik olarak oluşturuldu

Search Value On DataSet

metin içeren bir resim

Açıklama otomatik olarak oluşturuldu