1. Least Absolute Deviations method to find from a set of points.

Part A:

* 1. Objective:

Constraints:

* 1. The LAD regression line appears to be. The sum of absolute deviations for the LAD regression is 12.5 compared to the 13.5 found with the LSR method.

LINDO Input:

|  |  |
| --- | --- |
| 1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17 | MIN U1 + U2 + U3 + U4 + U5 + U6  ST  U1 + A0 + A1> 5  U1 - A0 - A1 > -5  U1 + A0 + A1 > 3  U1 - A0 - A1 > -3  U2 + A0 + 2 A1 > 13  U2 - A0 - 2 A1 > -13  U3 + A0 + 3 A1 > 8  U3 - A0 - 3 A1 > -8  U4 + A0 + 4 A1 > 10  U4 - A0 - 4 A1 > -10  U5 + A0 + 5 A1 > 14  U5 - A0 - 5 A1 > -14  U6 + A0 + 6 A1 > 18  U6 - A0 - 6 A1 > -18  END |

Output:

|  |
| --- |
| LP OPTIMUM FOUND AT STEP 0  OBJECTIVE FUNCTION VALUE  1) 11.50000  VARIABLE VALUE REDUCED COST  U1 1.000000 0.000000  U2 6.500000 0.000000  U3 1.000000 0.000000  U4 1.500000 0.000000  U5 0.000000 0.750000  U6 1.500000 0.000000  A0 **1.500000** 0.000000  A1 **2.500000** 0.000000  ROW SLACK OR SURPLUS DUAL PRICES  2) 0.000000 -0.625000  3) 2.000000 0.000000  4) 2.000000 0.000000  5) 0.000000 -0.375000  6) 0.000000 -1.000000  7) 13.000000 0.000000  8) 2.000000 0.000000  9) 0.000000 -1.000000  10) 3.000000 0.000000  11) 0.000000 -1.000000  12) 0.000000 0.000000  13) 0.000000 -0.250000  14) 0.000000 -1.000000  15) 3.000000 0.000000  NO. ITERATIONS= 0 |

* 1. Visual inspection shows that both LAD and LSR provide good regression equations that fit the data set. As previously mentioned, the LAD process had less total absolute deviation from the data set than LSR.

Part B:

1. Objective:

Constraints:

1. The MMAD regression line for this data set is. The minimum of the maximum absolute deviation for the MMAD method was 3.84 compared to the 5.5 found with LSR.

LINDO Input:

|  |  |
| --- | --- |
| 1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17 | MIN T  ST  T + A0 + A1 > 5  T - A0 - A1 > -5  T + A0 + A1 > 3  T - A0 - A1 > -3  T + A0 + 2 A1 > 13  T - A0 - 2 A1 > -13  T + A0 + 3 A1 > 8  T - A0 - 3 A1 > -8  T + A0 + 4 A1 > 10  T - A0 - 4 A1 > -10  T + A0 + 5 A1 > 14  T - A0 - 5 A1 > -14  T + A0 + 6 A1 > 18  T - A0 - 6 A1 > -18  END |

Output:

|  |
| --- |
| LP OPTIMUM FOUND AT STEP 2  OBJECTIVE FUNCTION VALUE  1) 7.500000  VARIABLE VALUE REDUCED COST  T 7.500000 0.000000  A0 10.500000 0.000000  A1 0.000000 0.000000  ROW SLACK OR SURPLUS DUAL PRICES  2) 13.000000 0.000000  3) 2.000000 0.000000  4) 15.000000 0.000000  5) 0.000000 -0.500000  6) 5.000000 0.000000  7) 10.000000 0.000000  8) 10.000000 0.000000  9) 5.000000 0.000000  10) 8.000000 0.000000  11) 7.000000 0.000000  12) 4.000000 0.000000  13) 11.000000 0.000000  14) 0.000000 -0.500000  15) 15.000000 0.000000  NO. ITERATIONS= 2  LP OPTIMUM FOUND AT STEP 2  OBJECTIVE FUNCTION VALUE  1) 3.833333  VARIABLE VALUE REDUCED COST  T 3.833333 0.000000  A0 4.500000 0.000000  A1 2.333333 0.000000  ROW SLACK OR SURPLUS DUAL PRICES  2) 5.666667 0.000000  3) 2.000000 0.000000  4) 7.666667 0.000000  5) 0.000000 -0.333333  6) 0.000000 -0.500000  7) 7.666667 0.000000  8) 7.333333 0.000000  9) 0.333333 0.000000  10) 7.666667 0.000000  11) 0.000000 -0.166667  12) 6.000000 0.000000  13) 1.666667 0.000000  14) 4.333333 0.000000  15) 3.333333 0.000000  NO. ITERATIONS= 2  LP OPTIMUM FOUND AT STEP 2  OBJECTIVE FUNCTION VALUE  1) 3.833333  VARIABLE VALUE REDUCED COST  T 3.833333 0.000000  A0 4.500000 0.000000  A1 2.333333 0.000000  ROW SLACK OR SURPLUS DUAL PRICES  2) 5.666667 0.000000  3) 2.000000 0.000000  4) 7.666667 0.000000  5) 0.000000 -0.333333  6) 0.000000 -0.500000  7) 7.666667 0.000000  8) 7.333333 0.000000  9) 0.333333 0.000000  10) 7.666667 0.000000  11) 0.000000 -0.166667  12) 6.000000 0.000000  13) 1.666667 0.000000  14) 4.333333 0.000000  15) 3.333333 0.000000  NO. ITERATIONS= 2  T 3.833333 0.000000  A0 4.500000 0.000000  A1 2.333333 0.000000  ROW SLACK OR SURPLUS DUAL PRICES  2) 5.666667 0.000000  3) 2.000000 0.000000  4) 7.666667 0.000000  5) 0.000000 -0.333333  6) 0.000000 -0.500000  7) 7.666667 0.000000  8) 7.333333 0.000000  9) 0.333333 0.000000  10) 7.666667 0.000000  11) 0.000000 -0.166667  12) 6.000000 0.000000  13) 1.666667 0.000000  14) 4.333333 0.000000  15) 3.333333 0.000000  NO. ITERATIONS= 2  LP OPTIMUM FOUND AT STEP 2  OBJECTIVE FUNCTION VALUE  1) 3.833333  VARIABLE VALUE REDUCED COST  T 3.833333 0.000000  A0 **4.500000** 0.000000  A1 **2.333333** 0.000000  ROW SLACK OR SURPLUS DUAL PRICES  2) 5.666667 0.000000  3) 2.000000 0.000000  4) 7.666667 0.000000  5) 0.000000 -0.333333  6) 0.000000 -0.500000  7) 7.666667 0.000000  8) 7.333333 0.000000  9) 0.333333 0.000000  10) 7.666667 0.000000  11) 0.000000 -0.166667  12) 6.000000 0.000000  13) 1.666667 0.000000  14) 4.333333 0.000000  15) 3.333333 0.000000  NO. ITERATIONS= 2 |

1. The slopes of the LSR and MMAD regression lines were nearly identical (2.33 vs 2. 31). There just seems to be an offset in the direction to reduce the maximum standard deviation found on the third point.
2. All three methods of regression will create identical solutions if all elements of a data set lie on a line. For instance, produces for all regression methods.

Part C:

Objective:

Constraints:

LINDO Input:

|  |  |
| --- | --- |
| 1  2  3  4  5  6  7  8  9  10  11  12  13  14 | MIN U1 + U2 + U3 + U4 + U5 + U6  ST  U1 + A0 + A1 + A2 > 5  U1 - A0 - A1 - A2 > -5  U2 + A0 + A1 + 2 A2 > 9  U2 - A0 - A1 - 2 A2 > -9  U3 + A0 + 2 A1 + 2 A2 > 12  U3 - A0 - 2 A1 - 2 A2 > -12  U4 + A0 + A2 > 3  U4 - A0 - A2 > -3  U5 + A0 = 0  U6 + A0 + 1 A1 + 3 A2 > 11  U6 - A0 - 1 A1 - 3 A2 > -11  END |

LINDO Output:

|  |
| --- |
| LP OPTIMUM FOUND AT STEP 2  OBJECTIVE FUNCTION VALUE  1) 0.0000000E+00  VARIABLE VALUE REDUCED COST  U1 0.000000 1.000000  U2 0.000000 1.000000  U3 0.000000 1.000000  U4 0.000000 1.000000  U5 0.000000 1.000000  U6 0.000000 1.000000  T 5.333333 0.000000  A0 0.000000 0.000000  A1 3.833333 0.000000  ROW SLACK OR SURPLUS DUAL PRICES  2) 4.166667 0.000000  3) 6.500000 0.000000  4) 6.166667 0.000000  5) 4.500000 0.000000  6) 0.000000 0.000000  7) 10.666667 0.000000  8) 8.833333 0.000000  9) 1.833333 0.000000  10) 10.666667 0.000000  11) 0.000000 0.000000  12) 10.500000 0.000000  13) 0.166667 0.000000  14) 10.333333 0.000000  15) 0.333333 0.000000  NO. ITERATIONS= 2  LP OPTIMUM FOUND AT STEP 8  OBJECTIVE FUNCTION VALUE  1) 2.000000  VARIABLE VALUE REDUCED COST  U1 1.000000 0.000000  U2 0.000000 0.000000  U3 0.000000 0.500000  U4 0.000000 0.000000  U5 0.000000 1.500000  U6 1.000000 0.000000  A0 **0.000000** 0.000000  A1 **3.000000** 0.000000  A2 **3.000000** 0.000000  ROW SLACK OR SURPLUS DUAL PRICES  2) 2.000000 0.000000  3) 0.000000 -1.000000  4) 0.000000 -1.000000  5) 0.000000 0.000000  6) 0.000000 -0.500000  7) 0.000000 0.000000  8) 0.000000 -1.000000  9) 0.000000 0.000000  10) 0.000000 0.500000  11) 2.000000 0.000000  12) 0.000000 -1.000000  NO. ITERATIONS= 8 |

This algorithm results in.