INSTITUTO SUPERIOR DE AGRONOMIA

Applied Operations Research - Linear Programming

1. Consider the various linear programming problems (LPP) and for each of them:

a) Graphically display the feasible region and highlight the vertices.

b) Write the LP problem in the standard form.

c) Apply the Simplex Method and display all simplex tableaus. For each tableau, identify a solution that corresponds to a vertex of the feasible region, if any exists.

d) Consider the optimal solution:

i) Indicate the optimal value of each decision variable and the optimal value of the objective function.

ii) Indicate which constraints are binding and interpret your answer from a graphical point of view.

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| I.1) Max Z = | 2 | x1 | + | 2 | x2 |  |  |
|  subject to: |  |  |  |  |  |  |  |
|  | 1 | x1 | + | 2 | x2 | ≤ | 10 |
|  | 1 | x1 | + | 1 | x2 | ≤ | 6 |
|  | 1 | x1 | + | -2 | x2 | ≤ | 1 |
|  | 1 | x1 | + | -1 | x2 | ≤ | 2 |
|  |  |  |  |  |  |  |  |
|  |  | x1 |  |  | x2 | ≥ | 0 |

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| I.2) Max Z = | 5 | x1 | + | 3 | x2 |  |  |
|  subject to: |  |  |  |  |  |  |  |
|  | 1 | x1 | + | 1 | x2 | ≤ | 2 |
|  | 5 | x1 | + | 2 | x2 | ≤ | 10 |
|  | -2 | x1 | + | -8 | x2 | ≥ | -12 |
|  |  |  |  |  |  |  |  |
|  |  | x1 |  |  | x2 | ≥ | 0 |
|  |  |  |  |  |  |  |  |
| I.3) Max Z = | 4 | x1 | + | 10 | x2 |  |  |
|  subject to: |  |  |  |  |  |  |  |
|  | 2 | x1 | + | 1 | x2 | ≤ | 50 |
|  | 2 | x1 | + | 5 | x2 | ≤ | 100 |
|  | 2 | x1 | + | 3 | x2 | ≤ | 90 |
|  |  |  |  |  |  |  |  |
|  |  | x1 |  |  | x2 | ≥ | 0 |

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| I.4) Max Z = | 2 | x1 | + | 1 | x2 |  |  |
| subject to: |  |  |  |  |  |  |  |
|  | 4 | x1 | + | 3 | x2 | ≤ | 12 |
|  | 4 | x1 | + | 1 | x2 | ≤ | 8 |
|  | 4 | x1 | + | -1 | x2 | ≤ | 8 |
|  |  |  |  |  |  |  |  |
|  |  | x1 |  |  | x2 | ≥ | 0 |

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| I.5) Max Z = | 20 | x1 | + | 25 | x2 |  |  |
|  subject to: |  |  |  |  |  |  |  |
|  | 12 | x1 | + | 16 | x2 | ≤ | 100 |
|  | 16 | x1 | + | 8 | x2 | ≤ | 80 |
|  |  |  |  |  |  |  |  |
|  |  | x1 |  |  | x2 | ≥ | 0 |

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| I.6) Max Z = | 5 | x1 | + | 3 | x2 |  |  |
| subject to: |  |  |  |  |  |  |  |
|  | 1 | x1 | + | 1 | x2 | ≤ | 2 |
|  | 5 | x1 | + | 2 | x2 | ≤ | 10 |
|  | -2 | x1 | + | -8 | x2 | ≥ | -12 |
|  |  |  |  |  |  |  |  |
|  |  | x1 |  |  | x2 | ≥ | 0 |

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| I.7) Max Z = | 30 | x1 | + | 40 | x2 |  |  |
|  subject to: |  |  |  |  |  |  |  |
|  | 60 | x1 | + | 120 | x2 | ≤ | 12000 |
|  | 8 | x1 | + | 5 | x2 | ≤ | 600 |
|  | 3 | x1 | + | 4 | x2 | ≤ | 500 |
|  |  |  |  |  |  |  |  |
|  |  | x1 |  |  | X2 | ≥ | 0 |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| I.8) Max Z = | 30 | x1 | + | 40 | x2 |  |  |
| subject to: |  |  |  |  |  |  |  |
|  | 60 | x1 | + | 120 | x2 | ≤ | 12000 |
|  | 8 | x1 | + | 5 | x2 | ≤ | 600 |
|  | 3 | x1 | + | 4 | x2 | ≤ | 500 |
|  |  |  |  |  |  |  |  |
|  |  | x1 |  |  | X2 | ≥ | 0 |

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| I.9) Max Z = | 3 | x1 | + | 2 | x2 |  |  |
| subject to: |  |  |  |  |  |  |  |
|  | 1 | x1 | + | 2 | x2 | ≤ | 430 |
|  | 3 | x1 | + | 2 | x2 | ≤ | 460 |
|  | 3 | x1 | + | 1 | x2 | ≤ | 420 |
|  |  |  |  |  |  |  |  |
|  |  | x1 |  |  | X2 | ≥ | 0 |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| I.10) Max Z = | 3 | x1 | + | 2 | x2 |  |  |
| subject to: |  |  |  |  |  |  |  |
|  | 1 | x1 | + | 2 | x2 | ≤ | 430 |
|  | 3 | x1 | + | 2 | x2 | ≤ | 460 |
|  | 3 | x1 | + | 1 | x2 | ≤ | 420 |
|  |  |  |  |  |  |  |  |
|  |  | x1 |  |  | X2 | ≥ | 0 |

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