Binary Programming

1. Long John owns a company that flips houses. Of the several project homes he is considering he’s noted the following in a table to help him decide which to take on. The plumbing, painting, landscaping, carpeting, and cleaning numbers all indicate the number of hours it would take him to complete the work.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | House  1 | House  2 | House  3 | House  4 | House  5 | House  6 | House  7 | House  8 | House  9 | House  10 |
| Potential Value | $125,000 | $135,000 | $178,000 | $110,000 | $108,000 | $124,000 | $244,000 | $192,000 | $130,000 | $275,000 |
| Cost | $76,000 | $106,000 | $136,750 | $76,500 | $60,000 | $101,000 | $158,000 | $130,300 | $95,000 | $167,000 |
| Plumbing | 238 | 211 | 264 | 145 | 211 | 100 | 400 | 422 | 185 | 304 |
| Painting | 150 | 125 | 115 | 80 | 130 | 50 | 250 | 160 | 100 | 200 |
| Landscaping | 210 | 175 | 161 | 112 | 182 | 70 | 350 | 224 | 140 | 280 |
| Carpentry | 264 | 330 | 143 | 242 | 165 | 180 | 220 | 385 | 330 | 396 |
| Cleaning | 300 | 280 | 310 | 410 | 335 | 200 | 350 | 325 | 390 | 325 |

The total amount of hours he has to devote to the various jobs is contained in the following table.

|  |  |
| --- | --- |
| **Skills** | **Maximum hours available** |
| Plumbing | 1152 |
| Painting | 1152 |
| Landscaping | 1728 |
| Carpentry | 1728 |
| Cleaning | 2880 |

1. If the maximum amount that he can invest in this venture is $500,000. To maximize his profit, which of the homes should he choose and how much can he expect to gain in profit? ***Hint: You get the objective function from subtracting the potential values from the cost.***
2. In looking over the table, Long John noticed that homes 7 – 10 are on opposite sides of the town. Out of these four houses, he would rather only do two of them. How would this change the houses he chooses and his overall profit?
3. Mr. D is assigning workers to three different tasks. In the end, each task should have a total of 5 students. The scores below indicate how well they complete each of the tasks according to a performance evaluation that was given the week before.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Performance Scores | | Tasks | | |
| Task 1 | Task 2 | Task 3 |
| **Workers** | 1 | 3 | 5 | 1 |
| 2 | 2 | 4 | 2 |
| 3 | 4 | 1 | 4 |
| 4 | 4 | 4 | 4 |
| 5 | 3 | 1 | 4 |
| 6 | 5 | 5 | 4 |
| 7 | 3 | 4 | 3 |
| 8 | 5 | 5 | 2 |
| 9 | 2 | 1 | 1 |
| 10 | 2 | 2 | 4 |
| 11 | 1 | 4 | 1 |
| 12 | 5 | 4 | 5 |
| 13 | 5 | 1 | 5 |
| 14 | 3 | 5 | 1 |
| 15 | 2 | 4 | 2 |

Indicate which task each of the students would be assigned to if Mr. D wishes to maximize their performance scores.

1. The Renovaçión Home Improvement Store decided to revisit their assignment of their workers. Adan and Haemon threatened to quit otherwise. They now have decided that up to two employees may be assigned to any department.
   1. Who would be assigned to each department?
   2. Which department would not be assigned an employee?
   3. Think of way to ensure that every department has coverage but up to two employees may work in any department as well. Who would be assigned to each department in this case? ***HINT: You’ll need to add another constraint to the bottom.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ($) | | Department | | | | |
| Appliances | Flooring | Plumbing | Doors | Lighting |
| Employee | Joshua | 1,555 | 525 | 370 | 275 | 560 |
| Adan | 1,250 | 450 | 285 | 250 | 540 |
| Ha | 850 | 500 | 320 | 330 | 550 |
| Tyson | 1,675 | 490 | 375 | 350 | 580 |
| Valley | 1,125 | 510 | 365 | 345 | 190 |
| Lacole | 950 | 500 | 195 | 335 | 350 |
| Haemon | 1,050 | 300 | 345 | 200 | 545 |