Optimisation Project

ENGSCI 355, S2 2018

# Problem Description

Kemito Pipfruit pack and distribute apples and avocadoes. They have a number of suppliers that provide them with produce that is then packed and shipped to a number of markets.

Kemito is investing in new, automated packing machines at their 4 packhouses. Their two lines of produce, apples and avocadoes, are completely separate so they need a distribution and (packing machine) investment plan for each line. There are 4 suppliers and 5 markets for avocadoes and 10 suppliers and 15 markets for apples. In addition, although Kemito has guaranteed contracts with their suppliers, the demand in each market is not known beforehand. Kemito has 10 periods of historical data for the demand in each market for both avocadoes and apples.

# Supply/Demand Data

The supply and demand data for apples and avocadoes is given in Tables 1 and 2. Note that avocado data is given first as it has lower volume and less suppliers/markets.

## Table 1. Supply Demand data for Avocadoes

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | **Demand (Units/Period – Historical)** | | | | | | | | | |
| **Supplier** | **Supply**  **(Units/ Period)** | **Market** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| S1 | 531 | D1 | 6 | 1953 | 1976 | 262 | 1101 | 145 | 10 | 109 | 335 | 719 |
| S2 | 285 | D2 | 1609 | 12 | 58 | 131 | 407 | 1159 | 306 | 98 | 1240 | 224 |
| S3 | 983 | D3 | 326 | 77 | 8 | 524 | 67 | 160 | 1665 | 106 | 58 | 1077 |
| S4 | 264 | D4 | 85 | 9 | 7 | 765 | 64 | 180 | 5 | 1439 | 70 | 20 |
|  | | D5 | 35 | 9 | 13 | 173 | 216 | 210 | 74 | 102 | 152 | 20 |

Table 2. Supply Demand data for Apples

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | **Demand (Units/Period – Historical)** | | | | | | | | | |
| **Supplier** | **Supply (Units/**  **Period)** | **Market** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| S1 | 69 | D1 | 173 | 12 | 1138 | 1854 | 116 | 4 | 26 | 868 | 141 | 180 |
| S2 | 10 | D2 | 50 | 715 | 67 | 82 | 101 | 2 | 2 | 38 | 125 | 172 |
| S3 | 841 | D3 | 114 | 12 | 233 | 71 | 52 | 5 | 1754 | 10 | 100 | 74 |
| S4 | 195 | D4 | 17 | 32 | 884 | 120 | 32 | 5 | 3 | 10 | 431 | 93 |
| S5 | 945 | D5 | 78 | 17 | 221 | 66 | 32 | 2 | 4 | 10 | 278 | 57 |
| S6 | 357 | D6 | 209 | 12 | 524 | 66 | 72 | 3 | 2 | 49 | 1286 | 53 |
| S7 | 364 | D7 | 21 | 42 | 146 | 225 | 29 | 2 | 2 | 36 | 100 | 2266 |
| S8 | 968 | D8 | 1644 | 10 | 81 | 74 | 84 | 6 | 11 | 10 | 193 | 53 |
| S9 | 594 | D9 | 32 | 11 | 111 | 254 | 131 | 2 | 6 | 14 | 306 | 97 |
| S10 | 14 | D10 | 29 | 19 | 62 | 84 | 45 | 14 | 2 | 3178 | 104 | 89 |
|  | | D11 | 47 | 10 | 74 | 71 | 2475 | 4218 | 15 | 14 | 193 | 53 |
| D12 | 195 | 351 | 121 | 467 | 32 | 2 | 4 | 11 | 100 | 55 |
| D13 | 1570 | 12 | 97 | 336 | 655 | 5 | 16 | 14 | 104 | 304 |
| D14 | 16 | 2846 | 60 | 77 | 30 | 2 | 14 | 52 | 100 | 80 |
| D15 | 155 | 249 | 93 | 66 | 29 | 76 | 2488 | 36 | 350 | 289 |

Packhouse Data

There are three different sized automated packing machines that Kemito are considering. Each packhouse can contain as many of each type of machine as necessary, but machines are pre-configured for apples or avocadoes, not both.

The data on the machines is given in Table 3.

## Table 3. Data for Packing Machines

|  |  |  |
| --- | --- | --- |
| **Size** | **Average Packing Rate (Units/Period)** | **Cost ($1,000s)** |
| Small | 100 | 10 |
| Medium | 375 | 25 |
| Large | 500 | 35 |

The transportation cost from the suppliers and markets to/from the packhouses are given in Tables 4 and 5 (for avocadoes and apples respectively).

## Table 4. Transportation Cost to/from packhouses for Avocado suppliers/markets

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cost ($/unit) From/To** | T1 | T2 | T3 | T4 |
| S1 | 21 | 84 | 42 | 93 |
| S2 | 38 | 61 | 5 | 51 |
| S3 | 67 | 9 | 74 | 89 |
| S4 | 48 | 4 | 11 | 18 |
| D1 | 77 | 73 | 16 | 64 |
| D2 | 97 | 33 | 40 | 91 |
| D3 | 60 | 66 | 14 | 90 |
| D4 | 96 | 46 | 63 | 44 |
| D5 | 44 | 97 | 52 | 70 |

Table 5. Transportation Cost to/from packhouses for Apple suppliers/markets

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cost ($/unit) From/To** | T1 | T2 | T3 | T4 |
| S1 | 65 | 34 | 44 | 38 |
| S2 | 3 | 35 | 79 | 35 |
| S3 | 68 | 10 | 3 | 32 |
| S4 | 80 | 90 | 80 | 2 |
| S5 | 73 | 98 | 36 | 9 |
| S6 | 80 | 56 | 47 | 48 |
| S7 | 20 | 63 | 72 | 67 |
| S8 | 87 | 47 | 72 | 20 |
| S9 | 24 | 68 | 83 | 1 |
| S10 | 32 | 20 | 96 | 36 |
| D1 | 93 | 51 | 99 | 41 |
| D2 | 66 | 92 | 71 | 46 |
| D3 | 42 | 90 | 10 | 53 |
| D4 | 19 | 57 | 64 | 29 |
| D5 | 58 | 15 | 2 | 59 |
| D6 | 24 | 87 | 83 | 1 |
| D7 | 59 | 72 | 29 | 61 |
| D8 | 97 | 99 | 48 | 29 |
| D9 | 22 | 78 | 39 | 57 |
| D10 | 84 | 20 | 68 | 19 |
| D11 | 51 | 8 | 39 | 83 |
| D12 | 2 | 14 | 99 | 38 |
| D13 | 85 | 14 | 6 | 48 |
| D14 | 7 | 93 | 1 | 71 |
| D15 | 92 | 40 | 79 | 75 |

Deliverables

For the optimisation part of the ENGSCI 355 project, each group must deliver:

1. A group report of at most 3×A4 sides, detailing your model and solution, due by the Wednesday lab of week 7. Be sure to include background, any relevant data processing steps, model description and your best distribution and (packing machine) investment plan for both apples and avocadoes. An “editor” version of the report is due by the Wednesday lab of week 6 (for aegrotat purposes, not marked, but used for evaluation purposes in the case that the editor does not sit the final exam). **Groups must determine their editors for each of the 3 reports (Optimisation, Conceptual Model, and Simulation) and let Mike know by start of week 5.**
2. A group presentation on the group’s optimisation model, given in the Wednesday lab of week 6.