

Knapsack Problems (Exercises)

NASA

NASA is determining how many of three types of objects should be brought on board the space shuttle. The weight and benefit of each of the items are given in the table. If the space shuttle can carry a maximum of 26 kg of items 1 – 3, which items should be taken on the space shuttle?

Item	Benefit	Weight (kg)
1	10	3
2	15	4
3	17	5

1. Formulate an Integer Programming Model that will solve the requirements of the NASA.
2. Solve the formulated Integer Programming Model using Solver.
3. Solve the formulated Integer Programming Model using the Branch & Bound Knapsack Algorithm.
4. Solve the formulated Integer Programming Model using the Branch & Bound Simplex Algorithm.
5. Solve the formulated Integer Programming Model using the Cutting Plane Algorithm.

Jack

Jack is moving from Gauteng to Mpumalanga and has rented a truck that can haul up to 1 100 dm³ of furniture. The volume and value of each item Jack is considering moving on the truck are given in the table. Which items should Jack bring to Mpumalanga?

Item	Value (R 000)	Volume (dm ³)
Bedroom set	60	800
Dining room set	48	600
Stereo	14	300
Sofa	31	400
TV set	10	200

1. Formulate an Integer Programming Model that will solve the requirements of Jack.
2. Solve the formulated Integer Programming Model using Solver.
3. Solve the formulated Integer Programming Model using the Branch & Bound Knapsack Algorithm.
4. Solve the formulated Integer Programming Model using the Branch & Bound Simplex Algorithm.
5. Solve the formulated Integer Programming Model using the Cutting Plane Algorithm.

Investment Co.

Four Projects are available for investment. The projects require the cash flows and yield the net present values (NPV) (in millions) shown in the table. If R6 million is available for investment at time 0, find the investment plan that maximizes NPV.

Project	Cash Outflow at Time 0	NPV
1	3	5
2	5	8
3	2	3
4	4	7

1. Formulate an Integer Programming Model that will solve the requirements of the Investment Co.
2. Solve the formulated Integer Programming Model using Solver.
3. Solve the formulated Integer Programming Model using the Branch & Bound Knapsack Algorithm.
4. Solve the formulated Integer Programming Model using the Branch & Bound Simplex Algorithm.
5. Solve the formulated Integer Programming Model using the Cutting Plane Algorithm.

Aqualonia Currency

The tiny island country of Aqualonia's currency system contains coins for the denominations 1¢, 5¢, 10¢, 20¢, 25¢, and 50¢. You have taken a holiday job at a convenience store in Aqualonia and must give a customer 91¢ in change.

1. Formulate an IP that can be used to minimise the number of coins needed to give the correct change.
2. Solve the formulated Integer Programming Model using Solver.
3. Solve the formulated Integer Programming Model using the Branch & Bound Knapsack Algorithm.
4. Solve the formulated Integer Programming Model using the Branch & Bound Simplex Algorithm.
5. Solve the formulated Integer Programming Model using the Cutting Plane Algorithm.