

Knapsack Problem

Q. Find an optimal solution for knapsack problem where $n=7$, $m=15$

$$(P_1, P_2, P_3, P_4, P_5, P_6, P_7) = (10, 5, 15, 7, 6, 18, 3)$$

$$(w_1, w_2, w_3, w_4, w_5, w_6, w_7) = (2, 3, 5, 7, 1, 4, 1)$$

Solⁿ:

Number of objects $(n) = 7$

Capacity $(m) = 15$

Object	1	2	3	4	5	6	7
P_i	10	5	15	7	6	18	3
w_i	2	3	5	7	1	4	1
P_i/w_i	5	1.67	3	1	6	4.5	3

Method 1: Select object with maximum profit (P_i)

Object	Profit (P_i)	Weight (w_i)	Remaining Weight
-	-	-	15
6	18	4	$15 - 4 = 11$
3	15	5	$11 - 5 = 6$
1	10	2	$6 - 2 = 4$
4	$4 \times 1 = 4$	4	$4 - 4 = 0$
Total	47		

Method 2: Select object with minimum weight (w_i)

Object	Profit (P_i)	Weight (w_i)	Remaining Weight
-	-	-	15
5	6	1	$15 - 1 = 14$
7	3	1	$14 - 1 = 13$
1	10	2	$13 - 2 = 11$
2	5	3	$11 - 3 = 8$
6	18	4	$8 - 4 = 4$
	$4 * 3 = 12$	4	$4 - 4 = 0$
Total	54		

Method 3: Select object with maximum (P_i/w_i)

Object	Profit (P_i)	Weight (w_i)	Remaining Weight
-	-	-	15
5	6	1	$15 - 1 = 14$
1	10	2	$14 - 2 = 12$
6	18	4	$12 - 4 = 8$
3	15	5	$8 - 5 = 3$
7	3	1	$3 - 1 = 2$
2	$2 * 1.67 = 3.34$	2	$2 - 2 = 0$
Total	55.34		

Conclusion: With the help of profit approach
Profit/Weight is the best method

Q. Find the optimal solution for knapsack problem
 $n = 7$, $m = 16$

$$(P_1, P_2, P_3, P_4, P_5, P_6, P_7) = (10, 15, 12, 4, 6, 16, 8)$$

$$(W_1, W_2, W_3, W_4, W_5, W_6, W_7) = (2, 4, 5, 4, 2, 3, 3)$$

Solⁿ:

Number of objects $(n) = 7$

Capacity $(m) = 16$

Objects	1	2	3	4	5	6	7
P_i	10	15	12	4	6	16	8
W_i	2	4	5	4	2	3	3
P_i/W_i	5	3.75	2.4	1	3	5.33	2.66

Method 1: Select object with maximum profit (P_i)

Object	Profit	Weight	Remaining Weight
—	—	—	16
6	16	3	$16 - 3 = 13$
2	15	4	$13 - 4 = 9$
3	12	5	$9 - 5 = 4$
1	10	2	$4 - 2 = 2$
7	$2 \times 2.66 = 5.32$	2	$2 - 2 = 0$
Total	58.32		

Method 2: Select object with minimum weight (w_i)

Object	Profit	Weight	Remaining Weight
—	—	—	16
1	10	2	$16 - 2 = 14$
5	6	2	$14 - 2 = 12$
6	16	3	$12 - 3 = 9$
7	8	3	$9 - 3 = 6$
2	15	4	$6 - 4 = 2$
4	$2 \times 1 = 2$	2	$2 - 2 = 0$
Total	57		

Method 3: Select object with maximum ratio (P_i/w_i)

Object	Profit	Weight	Remaining Weight
—	—	—	16
6	16	3	$16 - 3 = 13$
1	10	2	$13 - 2 = 11$
2	15	4	$11 - 4 = 7$
5	6	2	$7 - 2 = 5$
7	8	3	$5 - 3 = 2$
3	$2 \times 2.4 = 4.8$	2	$2 - 2 = 0$
Total	59.8		

Conclusion: With the help of profit approach
Profit / Weight is the best method.

Q. Find the optimal solution for Knapsack problem
Capacity = 18

Object	1	2	3	4	5	6	7
profit	9	15	12	4	6	16	18
Weight	2	3	5	4	3	6	3
P_i/W_i	4.5	5	2.4	1	2	2.66	2.66

Solⁿ:

Method 1: Select object with maximum profit (P_i)

Object	Profit	Weight	Remaining Weight
—	—	—	18
6	16	6	$18 - 6 = 12$
2	15	3	$12 - 3 = 9$
3	12	5	$9 - 5 = 4$
1	9	2	$4 - 2 = 2$
7	$2 \times 2.66 = 5.32$	2	$2 + 2 = 0$
Total	57.32		

Method 2: Select object with minimum weight (w_i)

Object	Profit	Weight	Remaining Weight
-	-	-	18
1	9	2	$18 - 2 = 16$
2	15	3	$16 - 3 = 13$
5	6	3	$13 - 3 = 10$
7	8	3	$10 - 3 = 7$
4	4	4	$7 - 4 = 3$
3	$3 \times 2.4 = 7.2$	3	$3 - 3 = 0$
Total	49.2		

Method 3: Select object with maximum ratio (P_i/w_i)

Object	Profit	Weight	Remaining Weight
-	-	-	18
2	15	3	$18 - 3 = 15$
1	9	2	$15 - 2 = 13$
6	16	6	$13 - 6 = 7$
7	8	3	$7 - 3 = 4$
3	$4 \times 2.4 = 9.6$	4	$4 - 4 = 0$
Total	57.6		

Conclusion: With the help of profit approach
Profit/weight is the best method

Q. Find the optimal solution for knapsack problem

$$n=7, \quad m=15$$

$$(P_1, P_2, P_3, P_4, P_5, P_6, P_7) = (15, 20, 10, 7, 6, 18, 3)$$

$$(W_1, W_2, W_3, W_4, W_5, W_6, W_7) = (2, 3, 5, 7, 1, 4, 1)$$

Solⁿ:

Object	1	2	3	4	5	6	7
P_i	15	20	10	7	6	18	3
W_i	2	3	5	7	1	4	1
P_i / W_i	7.5	6.66	2	1	6	4.5	3

Method 1: Select object with maximum profit

Object	Profit	Weight	Remaining weight
—	—	—	15
2	20	3	$15 - 3 = 12$
6	18	4	$12 - 4 = 8$
1	15	2	$8 - 2 = 6$
3	10	5	$6 - 5 = 1$
4	7	1	$1 - 1 = 0$
Total	64		

Method 2: Select object with minimum weight

Object	Profit	Weight	Remaining weight
-	-	-	15
5	6	1	$15 - 1 = 14$
7	3	1	$14 - 1 = 13$
1	15	2	$13 - 2 = 11$
2	20	3	$11 - 3 = 8$
6	18	4	$8 - 4 = 4$
3	$4 \times 2 = 8$	4	$4 - 4 = 0$
Total	76		

Method 3: Select object with maximum ratio (P_i/w_i)

Object	Profit	Weight	Remaining weight
-	-	-	15
1	15	2	$15 - 2 = 13$
2	20	3	$13 - 3 = 10$
5	6	1	$10 - 1 = 9$
6	18	4	$9 - 4 = 5$
7	3	1	$5 - 1 = 4$
3	$4 \times 2 = 8$	4	$4 - 4 = 0$
Total	76		

Conclusion: With the help of profit approach P_i/w_i & using minimum weight both are the best methods