

Research Report on Profit Maximization of Sports Shoes (Nike)--Modeling and Finding Solution

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ABSTRACT. *Bubble economy is very common in sneaker market, therefore, Shoe factories need to establish a mathematical model for different shoes (20 pairs) by using Lingo tool to program and calculate the mathematical model to obtain the optimal solution under the constraint of the problem, in the condition of profit maximization, thus they can obtain the production strategy of maximizing sneaker profits.*

KEYWORDS: *Mathematical modeling; Linear programming, Profit maximization; Limited consuming material.*

Description of the problem: A shoe factory decided to produce a certain batch of sports shoes to obtain a certain amount of profits. There are now 20 different styles of sneakers (5 kinds of materials are needed to produce these styles of sneakers). The materials needed to produce each kind of sneakers are also different, needing a total of 5 kinds (vamp, decoration, air cushion, carbon plate, shoelace). Decision variables are set as X1,X2,X3,X4,X5 respectively. Every kind of sneakers need to use some specific types of materials and have a certain amount of consumption; each material has a certain amount of material using limitation. Sneaker manufacturers hope to maximize profits under these limited conditions.

1. Basic data of the modeling

The following figure shows the types of components required for different footwear styles (5 types), as well as the different footwear styles produced (20 types), the final profit (/pair) and the maximum monthly consumption of various consumables.

	Vamp/square decimeter	Decoratio n	Air cushion	Carbo n plate	Shoelaces	Profit /yuan
Air Jordan 1 OG "Bred"	64	0	1	0	2	696
Air Jordan 1"Turbo Green"	66	0	1	0	2	689
Air Jordan 1 HI "OW"	67	1	1	0	4	687
Air Jordan 1 HI "UNC"	56	0	1	0	1	703
Air Jordan 1 HI "TS"	63	0	1	0	2	694
Air Force 1 LOW "MCA"	53	1	1	0	1	374
Air Force 1 HI "BHM"	58	1	1	0	2	356
Air Force 1 LOW "VOLT"	60	1	1	0	1	347
Air Force 1 LOW "TS"	52	0	1	0	2	378
Air Force 1 MID "SUP"	49	1	1	0	1	389
Air Jordan 11"Concord"	86	0	1	1	1	650
Air Jordan 11"Space Jam"	94	1	1	1	1	707
Air Jordan 11 "Win Like 82"	88	0	1	1	1	668
Air Jordan 11"72-10"	92	0	1	1	1	712
Air Jordan 11 "Cap and Gown"	84	1	1	1	1	732
Poamposite One "USA"	102	4	2	1	2	730
Poamposite One "Floral"	100	2	2	1	1	749
Poamposite One"LNY"	99	0	2	1	1	762
Poamposite One 'Maroon'	103	0	2	1	1	732
Poamposite One "Galaxy"	98	2	2	1	2	764
Max/month	40000	300	6000	896	20000	

2. Model construction

Variable is defined as a model

Air Jordan 1 OG "Bred"	x1
Air Jordan 1 OG "Green"	x2
Air Jordan 1 OG "OW"	x3
Air Jordan 1 OG "UNC"	x4
Air Jordan 1 OG "TS"	x5
Air Force 1 Low "MCA"	x6
Air Force 1 Low "BHM"	x7
Air Force 1 Low "VOLT"	x8
Air Force 1 Low "TS"	x9
Air Force 1 Low "SUP"	x10
Air Jordan 11 "Space Jam"	x11
Air Jordan 11 "Concord"	x12
Air Jordan 11 "Win Like 82"	x13
Air Jordan 11 "72-10"	x14
Air Jordan 11 "Cap and Grown"	x15
Poamposite One "USA"	x16
Poamposite One "Floral"	x17
Poamposite One "LNY"	x18
Poamposite One "Maroon"	x19
Poamposite One "Galaxy"	x20

Constraint condition

$$64x_1+66x_2+67x_3+56x_4+63x_5+53x_6+58x_7+60x_8+52x_9+49x_{10}+86x_{11}+94x_{12}+88x_{13}+92x_{14}+84x_{15}+102x_{16}+110x_{17}+99x_{18}+103x_{19}+98x_{20}\leq 40000$$

$$x_3+x_6+x_8+x_{10}+x_{12}+x_{15}+4x_{16}+2x_{17}+2x_{20}\leq 300$$

$$x_1+x_2+x_3+x_4+x_5+x_6+x_7+x_8+x_9+x_{10}+x_{11}+x_{12}+x_{13}+x_{14}+x_{15}+2x_{16}+2x_{17}+2x_{18}+2x_{19}+2x_{20}\leq 6000$$

$$x_{11}+x_{12}+x_{13}+x_{14}+x_{15}+x_{16}+x_{17}+x_{18}+x_{19}+x_{20}\leq 896$$

$$2x_1+2x_2+4x_3+x_4+2x_5+x_6+2x_7+x_8+2x_9+x_{10}+x_{11}+x_{12}+x_{13}+x_{14}+x_{15}+2x_{16}+x_{17}+x_{18}+x_{19}+2x_{20}\leq 20000$$

$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}, x_{11}, x_{12}, x_{13}, x_{14}, x_{15}, x_{16}, x_{17}, x_{18}, x_{19}, x_{20} \geq 0$
and is an integer

Objective function:

$$Z = 696x_1 + 689x_2 + 687x_3 + 703x_4 + 694x_5 + 374x_6 + 356x_7 + 347x_8 + 378x_9 + 389x_{10} + 650x_{11} + 707x_{12} + 668x_{13} + 712x_{14} + 732x_{15} + 730x_{16} + 749x_{17} + 762x_{18} + 732x_{19} + 764x_{20}$$

Model for complete sneaker (Nike) profit maximization:

$$\max = 696x_1 + 689x_2 + 687x_3 + 703x_4 + 694x_5 + 374x_6 + 356x_7 + 347x_8 + 378x_9 + 389x_{10} + 650x_{11} + 707x_{12} + 668x_{13} + 712x_{14} + 732x_{15} + 730x_{16} + 749x_{17} + 762x_{18} + 732x_{19} + 764x_{20};$$

$$64x_1 + 66x_2 + 67x_3 + 56x_4 + 63x_5 + 53x_6 + 58x_7 + 60x_8 + 52x_9 + 49x_{10} + 86x_{11} + 94x_{12} + 88x_{13} + 92x_{14} + 84x_{15} + 102x_{16} + 100x_{17} + 99x_{18} + 103x_{19} + 98x_{20} \leq 40000;$$

$$x_3 + x_6 + x_7 + x_8 + x_{10} + x_{12} + x_{15} + 4x_{16} + 2x_{17} + 2x_{18} \leq 300;$$

$$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + x_{11} + x_{12} + x_{13} + x_{14} + x_{15} + 2x_{16} + 2x_{17} + 2x_{18} + 2x_{19} + 2x_{20} \leq 6000;$$

$$x_{11} + x_{12} + x_{13} + x_{14} + x_{15} + x_{16} + x_{17} + x_{18} + x_{19} + x_{20} \leq 896;$$

$$2x_1 + 2x_2 + 4x_3 + x_4 + 2x_5 + x_6 + 2x_7 + x_8 + 2x_9 + x_{10} + x_{11} + x_{12} + x_{13} + x_{14} + x_{15} + 2x_{16} + x_{17} + x_{18} + x_{19} + 2x_{20} \leq 20000;$$

$$\begin{aligned} & @gin(x_1); @gin(x_2); @gin(x_3); @gin(x_4); @gin(x_5); @gin(x_6); @gin(x_7); @gin(x_8); \\ & @gin(x_9); @gin(x_{10}); @gin(x_{11}); @gin(x_{12}); @gin(x_{13}); @gin(x_{14}); @gin(x_{15}); \\ & @gin(x_{16}); @gin(x_{17}); @gin(x_{18}); @gin(x_{19}); @gin(x_{20}); \end{aligned}$$

$$x_1 \geq 10; x_2 \geq 10; x_3 \geq 10; x_4 \geq 10; x_5 \geq 10; x_6 \geq 10; x_7 \geq 10; x_8 \geq 10; x_9 \geq 10;$$

$$x_{10} \geq 10; x_{11} \geq 10; x_{12} \geq 10; x_{13} \geq 10; x_{14} \geq 10; x_{15} \geq 10; x_{16} \geq 10; x_{17} \geq 10; x_{18} \geq 10; x_{19} \geq 10; x_{20} \geq 10;$$

$$x_1 \leq 50; x_2 \leq 50; x_3 \leq 50; x_4 \leq 50; x_5 \leq 50; x_6 \leq 50; x_7 \leq 50; x_8 \leq 50; x_9 \leq 50;$$

$$x_{10} \leq 50; x_{11} \leq 50; x_{12} \leq 50; x_{13} \leq 50; x_{14} \leq 50; x_{15} \leq 50; x_{16} \leq 50; x_{17} \leq 50; x_{18} \leq 50; x_{19} \leq 50; x_{20} \leq 50;$$

` Global optimal solution found.
Objective value: 360825.0
Objective bound: 360825.0
Infeasibilities: 0.000000
Extended solver steps: 519
Total solver iterations: 600

Variable	Value	Reduced Cost
X1	50.00000	-696.0000
X2	50.00000	-689.0000
X3	50.00000	-687.0000
X4	50.00000	-703.0000
X5	50.00000	-694.0000
X6	10.00000	-374.0000
X7	10.00000	-356.0000
X8	10.00000	-347.0000
X9	10.00000	-378.0000
X10	49.00000	-389.0000
X11	10.00000	-650.0000
X12	10.00000	-707.0000
X13	10.00000	-668.0000
X14	45.00000	-712.0000
X15	50.00000	-732.0000
X16	10.00000	-730.0000
X17	10.00000	-749.0000
X18	10.00000	-762.0000
X19	10.00000	-732.0000
X20	46.00000	-764.0000

Model Solving: (Lingo Model)

Solution implementation:

1. Air Jordan OG "Bred" 50 pairs need to production

2. Air Jordan OG “Green”	50 pairs need to production
3. Air Jordan OG “OW”	50 pairs need to production
4. Air Jordan OG “UNC”	50 pairs need to production
5. Air Jordan OG “TS”	50 pairs need to production
6. Air Force 1 Low “MCA”	10 pairs need to production
7. Air Force 1 Low “BHM”	10 pairs need to production
8. Air Force 1 Low “VOLT”	10 pairs need to production
9. Air Force 1 Low “TS”	10 pairs need to production
10. Air Force 1 Low “SUP”	49 pairs need to production
11. Air Jordan 11 “Space Jam”	10 pairs need to production
12. Air Jordan 11 “Concord”	10 pairs need to production
13. Air Jordan 11 “Win Like 82”	10 pairs need to production
14. Air Jordan 11 “72-10”	45 pairs need to production
15. Air Jordan 11 “Cap and Grown”	50 pairs need to production
16. Poamposite One “USA”	10 pairs need to production
17. Poamposite One “Floral”	10 pairs need to production
18. Poamposite One “LNY”	10 pairs need to production
19. Poamposite One “Maroon”	10 pairs need to production
20. Poamposite One “Galaxy”	46 pairs need to production

3. Conclusion

This modeling is to solve the problem of how to make sports brands (Nike) produce sports shoes with limited materials to achieve maximize profits. Since the utilization rate of consumables cannot reach 100%, the chances of real experiments are slim, making the model unable to carry out solution verification, thus the team cannot apply the established model in practice. This modeling activity only involves the knowledge of operational research, there is no in-depth research (integer programming and non-linear programming). The lack of strain capacity of the model is caused by less restrictive conditions, which can be seen from the difference of 20 feasible solution intervals. The simplified model is given in this modeling, and the optimal solution meeting the requirements of the target is obtained through numerical calculation.

References

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