

17. Inventory Management is Important!

Furniture Base is a furniture retailer with a nice showroom but a very unorganized warehouse. Facing fierce competition from other retailers such as Ikea, the company decides to introduce a new inventory policy. Sandy, the chief saleswoman of the kitchen department, analyzed her records over the past three years and determined that 20 kitchen sets were responsible for the majority of the customer orders. These 20 kitchen sets were composed of up to eight features in a variety of styles, as shown in Table 1.

Table 1.

Floor Tile	Wallpaper
(T1) White textured tile	(W1) Plain ivory paper
(T2) Ivory textured tile	(W2) Ivory paper with dark brown stripes
(T3) White checkered tile with blue trim	(W3) Blue paper with marble texture
(T4) White checkered tile with yellow trim	(W4) Yellow paper with marble texture

Light Fixtures	Cabinets
(L1) Large rectangular frosted fixture	(C1) Light solid wood cabinets
(L2) Three small square frosted fixtures	(C2) Dark solid wood cabinets
(L3) One large oval frosted fixture	(C3) Light wood cabinets with glass doors
(L4) Three small frosted globe fixture	(C4) Dark wood cabinets with glass doors

Countertops	Dishwashers
(O1) Plain light-wood countertops	(D1) White energy-saving dishwasher
(O2) Stained light-wood countertops	(D2) Ivory energy-saving dishwasher
(O3) White lacquer-coated countertops	
(O4) Ivory lacquer-coated countertops	

Sinks	Ovens
(S1) Sink with separate hot and cold water taps	(V1) White electric oven
(S2) Divided sink with separate hot and cold water taps	(V2) Ivory electric oven
(S3) Sink with one hot and cold water tap	(V3) White gas oven
(S4) Divided sink with one hot and cold water tap	(V4) Ivory gas oven

Sandy then created Table 2 showing the 20 kitchen sets and the particular features composing each set. To simplify the table, she used the codes shown in parentheses below to represent the particular feature and style. For example, kitchen set 1 consists of floor tile T2, wallpaper W2, light fixture L4, cabinet C2, countertop O2, dishwasher D2, sink S2, and range R2. Notice that sets 14 through 20 do not contain dishwashers.

Table 2. Color codes for the four choices of each feature are added for easy reference.

	Floor Tile	Wall- paper	Light Fixture	Cabinets	Counte r-tops	Dish- washers	Sinks	Ovens
Set 1	T2	W2	L4	C2	O4	D2	S2	V2
Set 2	T2	W1	L1	C4	O4	D2	S4	V2
Set 3	T1	W3	L2	C1	O1	D1	S3	V3
Set 4	T3	W3	L3	C3	O3	D1	S1	V1
Set 5	T4	W4	L1	C1	O2	D1	S2	V1
Set 6	T2	W2	L2	C4	O4	D2	S3	V4
Set 7	T1	W3	L4	C3	O2	D1	S1	V1
Set 8	T2	W1	L3	C1	O1	D2	S3	V4
Set 9	T2	W1	L2	C3	O2	D2	S2	V2
Set 10	T1	W1	L1	C1	O3	D1	S4	V3
Set 11	T3	W1	L3	C3	O1	D1	S1	V3
Set 12	T2	W2	L1	C2	O2	D2	S4	V2
Set 13	T4	W4	L3	C3	O1	D1	S2	V3
Set 14	T4	W4	L4	C1	O3		S1	V1
Set 15	T3	W3	L1	C1	O1		S3	V3
Set 16	T3	W3	L4	C1	O3		S2	V1
Set 17	T1	W4	L2	C3	O3		S4	V3
Set 18	T3	W3	L3	C2	O4		S1	V2
Set 19	T3	W4	L4	C4	O4		S2	V4
Set 20	T3	W3	L1	C1	O2		S3	V4

Sandy knew she had only a limited amount of warehouse space allocated to the kitchen department. The warehouse could hold 5 square meters of tile and 12 rolls of wallpaper in the inventory bins. The inventory shelves could hold two light fixtures, two cabinets, three countertops, and two sinks. Dishwashers and ovens are similar in size, so Furniture Base stored them in similar locations, and the warehouse floor could hold a total of four dishwashers and ovens.

Every kitchen set always includes exactly 2 square meters of tile and exactly five rolls of wallpaper. Therefore, 2 square meters of a particular style of tile and five rolls of a particular style of wallpaper are required for the styles to be in stock.

- Formulate and solve a binary integer programming problem to maximize the total number of kitchen sets (and thus the number of customer orders) Furniture Base stocks in the local warehouse. Assume that when a customer orders a kitchen set, all the particular items composing that kitchen set are replenished at the local warehouse immediately.
- How many of each feature and style should Furniture Base stock in the local warehouse? How many different kitchen sets are in stock?

- c. Furniture Base decides to discontinue carrying nursery sets, and the warehouse space previously allocated to the nursery department is divided between the existing departments at Furniture Base. The kitchen department receives enough additional space to allow it to stock both styles of dishwashers and three of the four styles of ovens. How does the optimal inventory policy for the kitchen department change with this additional warehouse space?
- d. Sandy convinces management that the kitchen department should serve as a testing ground for future inventory policies. To provide adequate space for testing, management decides to allocate all the space freed by the nursery department to the kitchen department. The extra space means that the kitchen department can store not only the dishwashers and ovens from part c, but also all sinks, all countertops, three of the four light fixtures, and three of the four cabinets. How much does the additional space help?