Business Analytics

Problem 1 (20%)

Winkler Furniture manufactures two different types of China cabinets: a French Provincial model and a Danish Modern model. Each cabinet produced must go through three departments: carpentry, painting, and finishing. The table on this page contains all relevant information concerning production times per cabinet produced and production capacities for each operation per day, along with net revenue per unit produced. The firm has a contract with an Indiana distributor to produce a minimum of 300 of each cabinet per week (or 60 cabinets per day). Owner Bob Winkler would like to determine a product mix to maximize his daily revenue.

1. Formulate as an LP problem.
2. Solve using an LP software program or spreadsheet.

CABINET STYLE	CARPENTRY (HOURS/ CABINET)	PAINTING (HOURS/ CABINET)	FINISHING (HOURS/ CABINET)	NET REVENUE/ CABINET ($)
French Provincial	3	1.5	0.75	28
Danish Modern	2	1	0.75	25
Department capacity (hours)	360	200	125	

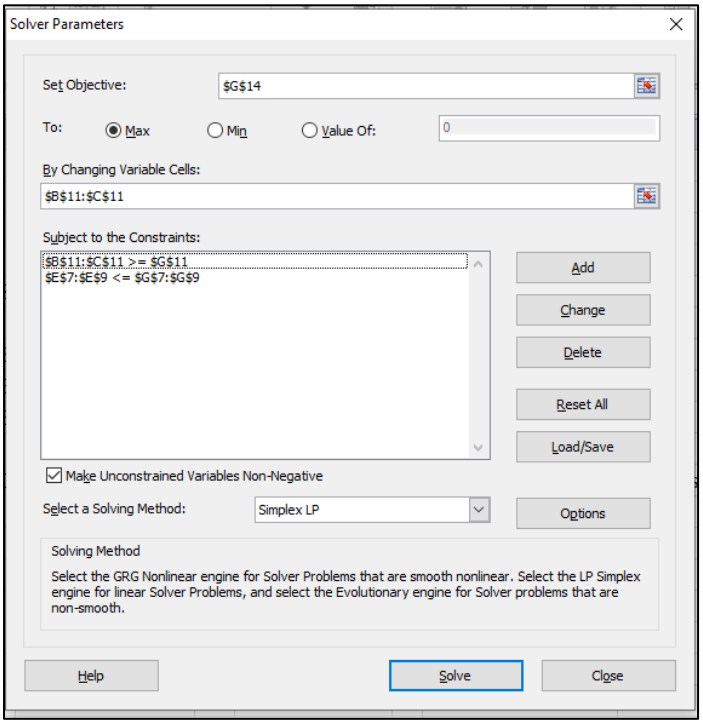
Answer

Input:

- Nilai Net Revenue untuk French Provincial dan Danish Modern sebesar 28 dan 25.
- Constraint untuk Carpentry, Painting, dan Finishing sebesar 360, 200, dan 125 (hours/jam).

Constraint yang disolver:

- Solver untuk memperoleh hasil input optimal yaitu *Carpentry*, *Painting*, dan *Finishing* sebesar 360, 180, dan 112.5.



Dengan menerapkan analisis Solver, didapatkan ukuran pesanan yang optimal yaitu 60 unit untuk model French Provincial dan 90 unit untuk model Danish Modern.

	A	B	C	D	E	F	G	H	I
1	**Problem 1**								
2	**Winkler Furniture**								
3									
4		French Provincial	Danish Modern						
5	Net Revenue	28	25						
6					Constraints				
7	**Carpentry**	3	2		360	<=	360	Hours	
8	**Painting**	1.5	1		180	<=	200	Hours	
9	**Finishing**	0.75	0.75		112.5	<=	125	Hours	
10									
11	Total Production (Cabinet)	60	90			>=	60	cabinets/day	
12									
13							Total Profit		
14							3,930		
15									

Untuk menghitung Total Profit yang dihasilkan, maka perlu menggunakan formula sebagai berikut:

Total Profit = (Net Revenue per French Provincial cabinet x Total Production of French Provincial) + (Net Revenue per Danish Modern cabinet x Total Production of Danish Modern).

Total Profit = (28 x 60) + (25 x 90)

Total Profit = 3.930

Berdasarkan formula tersebut, Total Profit yang diperoleh Winkler Furniture adalah sebesar **$ 3.930**.

Problem 2 (20%)

The Heinlein and Krampf Brokerage firm has just been instructed by one of its clients to invest $250,000 of her money obtained recently through the sale of land holdings in Ohio. The client has a good deal of trust in the investment house, but she also has her own ideas about the distribution of the funds being invested. In particular, she requests that the firm select what-ever stocks and bonds they believe are well rated but within the following guidelines:

- Municipal bonds should constitute at least 20% of the investment.
- At least 40% of the funds should be placed in a combination of electronic firms, aerospace firms, and drug manufacturers.
- No more than 50% of the amount invested in municipal bonds should be placed in a high-risk, high-yield nursing home stock.

Subject to these restraints, the client's goal is to maximize projected return on investments. The analysts at Heinlein and Krampf, aware of these guidelines, prepare a list of high-quality stocks and bonds and their corresponding rates of return:

INVESTMENT	PROJECTED RATE OF RETURN (%)
Los Angeles municipal bonds	5.3
Thompson Electronics, Inc.	6.8
United Aerospace Corp.	4.9
Palmer Drugs	8.4
Happy Days Nursing Homes	11.8

1. Formulate this portfolio selection problem using LP.
2. Solve this problem.

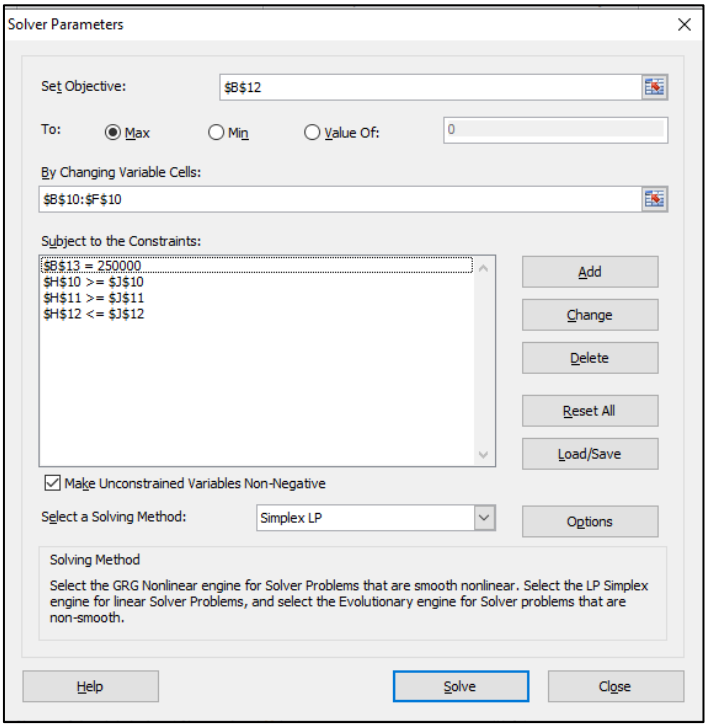
Answer

Input:

- Projected Rate of Return (LA: 5.3%, TE: 6.8%, UAC: 4.9%, PD: 8.4%, HD: 11.8%)
- Angka Constraints pengkalian persentase dengan projected rate of return

Constraints yang disolver:

- Hasil Amount Invested dari hasil pengkalian nilai persentase dengan Projected Rate of Return.



	A	B	C	D	E	F	G	H	I	J	K
1	**Problem 2**										
2	**Heinlein and Krampft Brokerage Firm**										
3											
4	Projected Rate of Return	Los Angeles municipal bonds (LA)	Thompson Electronics, Inc (TE)	United Aerospace Corp (UAC)	Palmer Drugs (PD)	Happy Days Nursing Homes (HD)					
5											
6	Percentage (min)	0.2		0.4		0.2					
7	Percentage (max)	0.5				0.5					
8	Profit per Unit	0.053	0.068	0.049	0.084	0.118					
9										Constraints	
10	Amount Invested	50,000	0	0	175,000	25,000		50,000	>=	50,000	
11	Project Returned	2,650	0	0	14,700	2,950		175,000	>=	100,000	
12	Total Project Returned	20,300						25,000	<=	25,000	
13	Total Invested	250,000									
14											

Hasil solver menghasilkan alokasi investasi sebesar $50.000 untuk LA, $175.000 untuk Palmer Drugs, dan $25.000 untuk Happy Day. Pengembalian proyek untuk setiap investasi dihitung menggunakan formula:

Total Project Returned = (RoR LA x Amount Invested LA) + (RoR PD x Amount Invested PD) + (RoR HD x Amount Invested HD)

Total Project Returned = (0.053 x 50.000) + (0.084 x 175.000) + (0.118 x 25.000)

Total Project Returned = 20.300

Maka, penggunaan maksimal dana investasi diperkirakan akan menghasilkan laba investasi sebesar **$20.300**.

Problem 3 (20%)

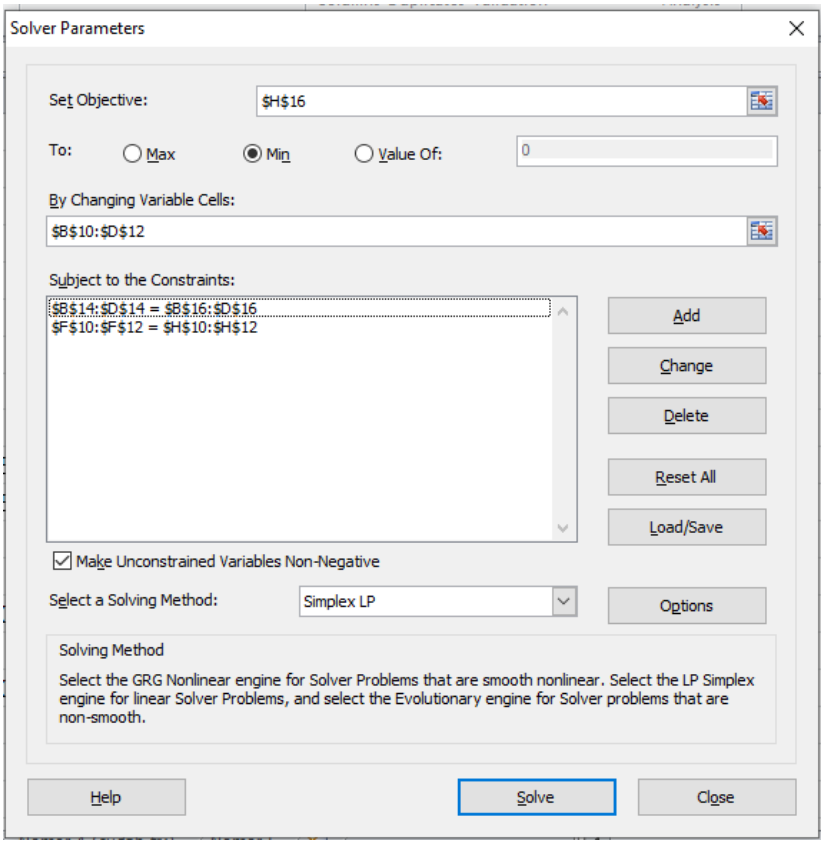
The management of the Executive Furniture Corporation decided to expand the production capacity at its Des Moines factory and to cut back the production capacities at its other two factories. It also recognized a shifting market for its desks and revised the requirements at its three warehouses. The table on this page provides the requirement at each warehouse, the capacity at each factory, and the shipping cost per unit to ship from each factory to each warehouse. Find the least-cost way to meet the requirements given the capacity at each factory.

TO / FROM	ALBUQUERQUE	BOSTON	CLEVELAND	CAPACITY
DES MOINES	$5	$4	$3	300
EVANSVILLE	$8	$4	$3	150
FORT LAUDERDALE	$9	$7	$5	250
REQUIREMENTS	200	200	300	

Answer

Input:

- Constraints pada Des Moines (300), Evansville (150), Fort Lauderdale (250), dan permintaan data termasuk Albuquerque (200), Boston (200), Cleveland (300).



	A	B	C	D	E	F	G	H	I
1	**Problem 3**								
2	**Executive Furniture Corporation**								
3									
4	Cost	Albuquerque	Boston	Cleveland					
5	Des Moines	5	4	3					
6	Evansville	8	4	3					
7	Fort Lauderdale	9	7	5					
8									
9	Shipment	Albuquerque	Boston	Cleveland				Constraints	
10	Des Moines	200	50	50		300	=	300	
11	Evansville	0	150	0		150	=	150	
12	Fort Lauderdale	0	0	250		250	=	250	
13									
14	Total Received	200	200	300					
15		=	=	=				Total Cost (Minimum)	
16	Demand	200	200	300				3200	
17									

Hasil Solver menunjukan bahwa:

- Shipment Des Moines adalah 300, dengan alokasi pengiriman minimum ke Albuquerque (200), Boston (50), dan Cleveland (50) untuk meminimalkan biaya.
- Shipment Evansville adalah 150, dengan pengiriman minimum ke Boston (150) untuk meminimalkan biaya.
- Shipment Fort Lauderdale adalah 250, dengan pengiriman minimum ke Cleveland (250) untuk meminimalkan biaya.

Hasil dari Solver juga menunjukkan bahwa Total Received sudah sesuai dengan demand, yakni Albuquerque (200), Boston (200), dan Cleveland (300), dengan Total Cost (Minimum) sebesar **$3.200**.

Problem 4 (20%)

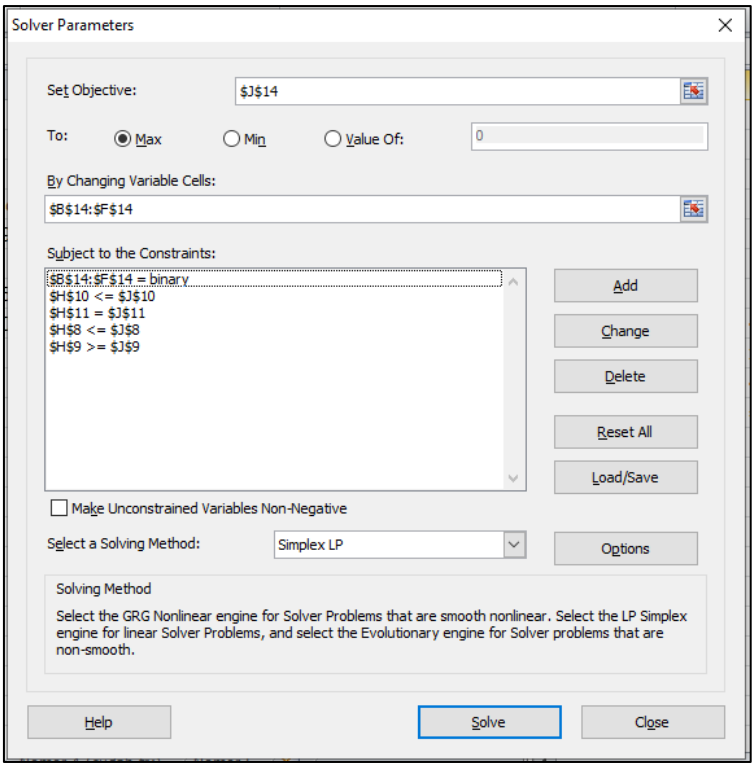
Puma SE, a German multinational company that manufactures athletic and casual apparel, footwear, and accessories, is launching their new jersey for the upcoming soccer season. They need to determine which famous soccer players to choose to be ambassadors for their new jersey. Before the selection, the company conducts a customer survey where they assign a “favorable” rating to each ambassador under consideration. This rating is on a scale from 1 to 5, with 1 being the least favorable and 5 being the most favorable. Puma is going to sell the jersey as a limited edition, with only 10,000 pieces around the world, at a selling price of $350. The company has a budget of $640,000 for hiring their ambassadors, and would like the total favorable factor to be at least 15, reflecting an average favor per ambassador of at least 3. To avoid duplication of genres, at most one of ambassadors 2 and 3 may be chosen, and ambassador 5 must be chosen. Finally, Puma wishes to maximize its revenue. Data are shown below.

Ambassadors	Cost ($)	Favor Rating	Sales Estimate
1	196,000	4	9,200 pieces
2	200,000	5	9,900 pieces
3	205,000	4	9,800 pieces
4	180,000	4	9,000 pieces
5	190,000	3	8,900 pieces

Answer

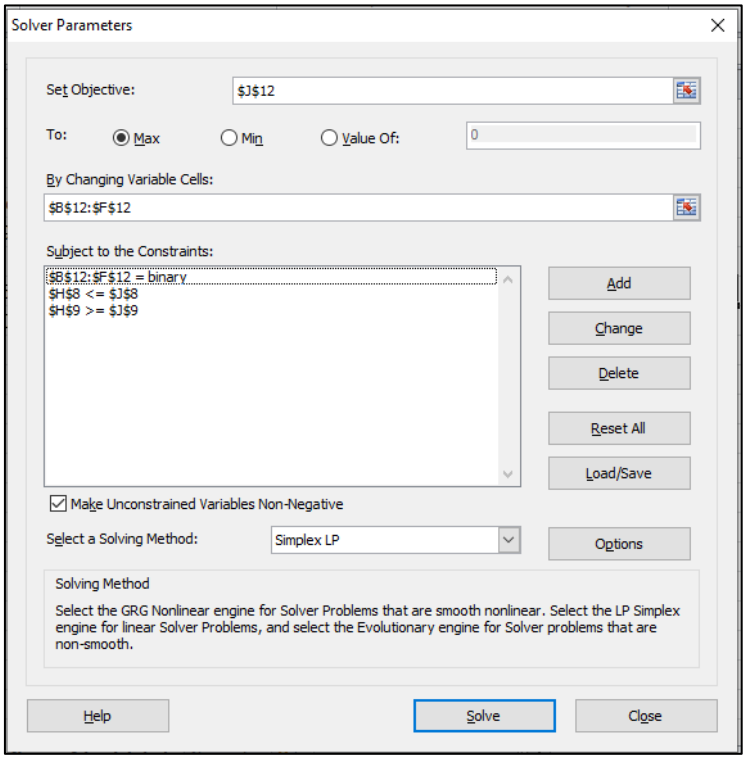
Input:

- Nilai revenue per ambassador dengan mengalikan Sales Estimate dengan Selling Price
- Nilai Cost dan Favor Rating disesuaikan dengan soal yang diberikan
- Constraint untuk cost sebesar $ 640.000 dan Favor Rating sebesar 15
- Pertimbangan dalam memilih ambassadors 2 dan 3 untuk constraint (1), serta ambassadors 5 untuk constraint (2)



	A	B	C	D	E	F	G	H	I	J	K
1	**Homework - Problem 4**										
2	**Puma SE**										
3											
4	Type of Investment	Ambassador 1	Ambassador 2	Ambassador 3	Ambassador 4	Ambassador 5		Selling Price			
5	Sales Estimate	9200	9900	9800	9000	8900		350			
6											
7	Revenue	3220000	3465000	3430000	3150000	3115000				Constraints	
8	Cost	196000	200000	205000	180000	190000		640,000.00	<=	640000	
9	Favor Rating	4	5	4	4	3		13.42857143	>=	15	
10	Amb 2 or 3	0	1	1	0	0		1	<=	1	
11	Amb 5	0	0	0	0	1		1	=	1	
12											
13										Total Reveneu	
14	Yes or No	0.357142857	1	0	1	1				10,880,000	
15											

Hasil dari solver menunjukkan bahwa cost berhasil lebih kecil dari batasan, tetapi terdapat masalah dengan favor rating dan juga variabel biner (yes or no), oleh karena itu, perlu ada penyesuaian terkait batasan. Batasan yang akan dihapus adalah "pertimbangan ambassador 2 atau 3" dan "ambassador 5".



	A	B	C	D	E	F	G	H	I	J	K
1	**Homework - Problem 4**										
2	**Puma SE**										
3											
4	Type of Investment	Ambassador 1	Ambassador 2	Ambassador 3	Ambassador 4	Ambassador 5		Selling Price			
5	Sales Estimate	9200	9900	9800	9000	8900		350			
6											
7	Revenue	3220000	3465000	3430000	3150000	3115000				Constraints	
8	Cost	196000	200000	205000	180000	190000		601,000.00	<=	640000	
9	Favor Rating	4	5	4	4	3		13	>=	13	
10											
11										Total Reveneu	
12	Yes or No	1	1	1	0	0				10,115,000	
13											

Hasil dari solver menunjukkan bahwa constraints pada cost berhasil memenuhi kriteria dengan nilai yang lebih rendah dari $640.000, didukung dengan variabel biner (ya atau tidak) yang memiliki hasil yang baik. Kedua hasil tersebut dapat terbilang sangat efisiensi terkait biaya yang akan digunakan. Walaupun favor rating masih di bawah constraint (15), ini masih dapat dimaklumi karena lebih baik untuk menurunkan sedikit favor rating dibandingkan dengan meningkatkan cost. Hasil analisis juga menunjukkan bahwa ambassador 1, 2, dan 3 layak untuk diinvestasikan karena potensi pendapatan mereka yang lebih tinggi dibandingkan dengan ambassador 4 dan 5. Dengan demikian, berdasarkan analisis tersebut, total pendapatan yang diperoleh adalah **$10.115.000.**

Problem 5 (20%)

Chair Manufacturing. Andalus Furniture Company has two manufacturing plants, one at Aynor and another at Spartanburg. The cost in dollars of producing a kitchen chair at each of the two plants is given here.

The cost of producing one (1) chair in Aynor (A) factory is: $75A + 5A^2 + 100$

The cost of producing one (1) chair in Spartanburg (S) factory is: $25S + 2.5S^2 + 150$

For example. the cost for 2 chairs from Aynor factory is equal to $75x2 + 5x2^2 + 100 = 150 + 20 + 100 = 270$.

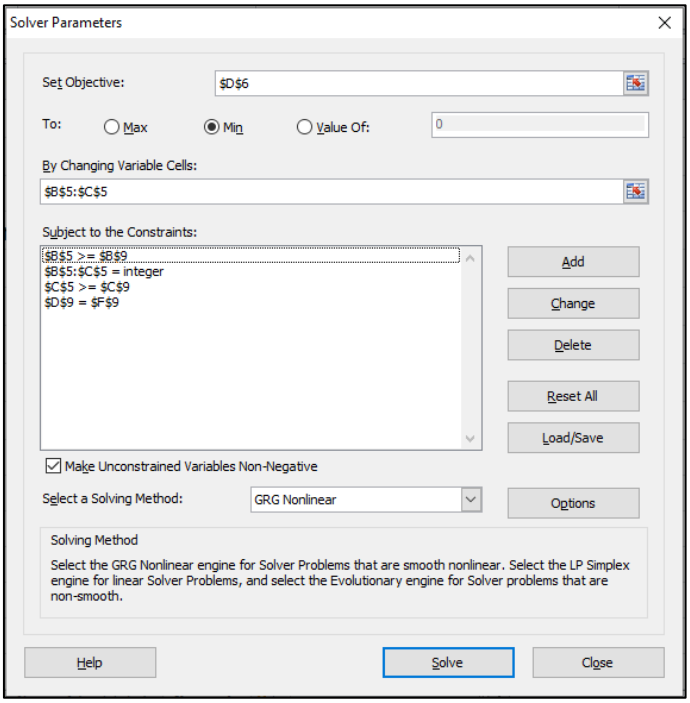
Andalus needs to manufacture a total of 40 kitchen chairs to meet an order just received. In order to keep the both factories operating, at least 10 chairs should be produced from each factory. How

many chairs should be made at Aynor, and how many should be made at Spartanburg in order to minimize total production cost?

Answer

Input:

- Nilai Cost Aynor (100) dan Cost Spartanburg (150)
- Constraints Aynor (10) dan Spartanburg (10) dengan total (40)
- Formula terkait non-linear programing, yaitu
  - The cost of producing one chair in Aynor (A) factory = $75A + 5A^2 + 100$
  - The cost of producing one chair in Spartanburg (S) factory = $25S + 2.5S^2 + 150$



	A	B	C	D	E	F	G
1	**Homework - Problem 5**						
2	**Andalus Furniture Company**						
3							
4	Products	Aynor	Spartanburg				
5		10	30	Total Cost			
6	Cost	1350	3150	4500			
7							
8		>=	>=	Usage		Constraints	
9	Constraints	10	10	40	=	40	
10							

Hasil dari Solver menunjukkan bahwa jumlah produksi yang diperlukan untuk mencapai biaya minimum adalah Aynor (10) dan Spartanburg (30), dengan formula sebagai berikut:

Total Cost = Cost Aynor + Cost Spartanburg

Total Cost = 1350 + 3150

Total Cost = $4.500

Maka total cost yang didapat adalah **$4.500**