

# A General Model for Periodic Chemical Production Scheduling

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## Supplementary Information

### Single-stage example

	A	B	C	D	E
Max. inventory	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
Inventory cost	1	1	1	1	1
Demand	0.5	1	0.5	0.5	1

Table S1-2. Processing time (h) and cost (\$) (given in parentheses)

	U1	U2	U3
PA	3 (10)	3 (10)	3 (10)
PB	6 (10)	6 (10)	6 (10)
PC	5 (10)	5 (10)	5 (10)
PD	5 (10)	5 (10)	5 (10)
PE	5 (10)	5 (10)	5 (10)

Table S1-3. Unit capacities (kg)

	U1	U2	U3
Min. capacity	0	0	0
Max. capacity	15	15	15

### Mixed-process example

Table S2-1. Max. inventory level (kg) and inventory cost (\$/(kg·h))

	IA1	IB1	IC1	IA2	IB2	IC2	A	B	C
Max. inventory	300	300	300	300	300	300	300	300	300
Inventory cost	0.5	0.5	0.5	0.1	0.1	0.1			

Table S2-2. Processing time (h) and cost (\$) (given in parentheses) of batch tasks

	PIA	PIB	PIC
Batch1	14 (20)	10 (20)	8 (20)
Batch2	14 (20)	11 (20)	9 (20)

Table S2-3. Min/max processing rate (kg/h) and cost (\$/h) (given in parentheses) of continuous tasks

	PIA2	PIB2	PIC2	PA	PB	PC
PFR1	5/23.3 (0.5)	5/17.5 (0.5)	5/17.5 (0.5)			
PFR2				5/23.3 (0.5)	5/17.5 (0.5)	5/17.5 (0.5)

Table S2-4. Unit capacities (kg)

	Batch1	Batch2
Min. capacity	50	50
Max. capacity	70	70

Table S2-1. Changeover time (h)

	PIA2	PIB2	PIC2
PIA2		6	12
PIB2	6		6
PIC2	12	6	

## Multi-stage example

Table S3-1. Max. inventory level (kg), inventory cost (\$/(kg·h)), demand (kg/24h), and price (\$/kg)

	IA1	IB1	IC1	ID1	IE1	IF1
Max. inventory	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
Inventory cost	0.5	0.5	0.5	0.5	0.5	0.5
	A	B	C	D	E	F
Max. inventory	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
Demand	3.6	2.4	6	3.6	3.6	6
Price	55	65	80	60	50	60

Table S3-2. Processing time (h) and cost (\$) (given in parentheses)

	U1	U2	U3	U4	U5	U6
PA1	5 (5)	5 (5)	4 (5)			
PA2				9 (5)	7 (5)	7 (5)
PB1	5 (5)	5 (5)	5 (5)			
PB2				9 (5)	7 (5)	7 (5)
PC1	6 (5)	4 (5)	5 (5)			
PC2				9 (5)	7 (5)	7 (5)
PD1	5 (5)	5 (5)	5 (5)			
PD2				7 (5)	9 (5)	8 (5)
PE1	4 (5)	5 (5)	4 (5)			
PE2				8 (5)	9 (5)	7 (5)
PF1	4 (5)	5 (5)	5 (5)			
PF2				8 (5)	7 (5)	9 (5)
SA	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)
SB	1 (2)	1 (2)	1 (2)	1 (2)	1 (2)	1 (2)
SC	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)
SD	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)
SE	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)
SF	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)

Table S3-3. Production tasks and the corresponding setup tasks

Setup tasks	PA	PB	PC	PD	PE	PF
	SA	SB	SC	SD	SE	SF

Table S3-4. Unit capacities (kg)

	U1	U2	U3	U4	U5	
	Min. capacity	1.2	1	1.4	1.4	1.6
	Max. capacity	6	5	7	7	8

## Network example

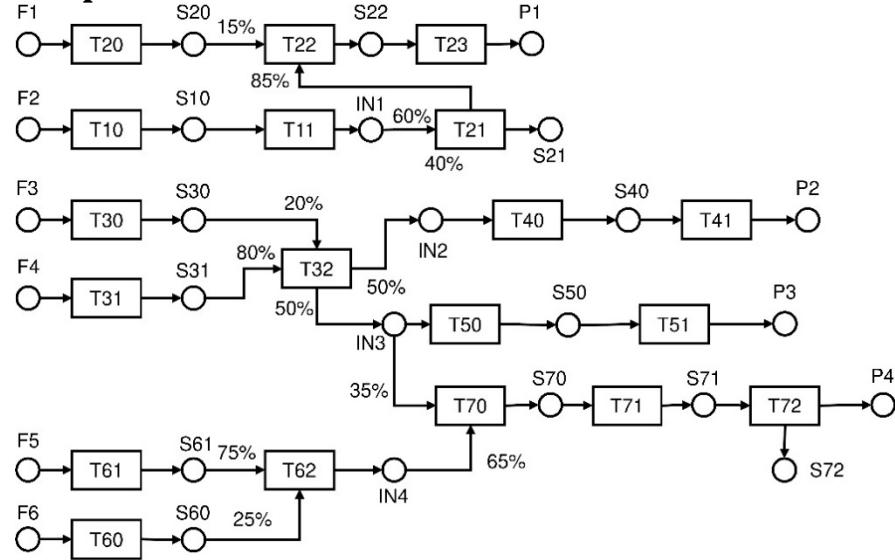


Fig. S1 The network process.

Table S4-1. Max. inventory level (kg) and price (\$)/kg)

	S20	S10	S30	S31	S61	S60	IN1	IN2	IN3	IN4	S22	S21
Max. inventory	500	0	1000	1000	1000	0	2500	2500	2500	2500	0	50
	S40	S22	S21	S40	S50	S70	S71	S72	P1	P2	P3	P3
Max. inventory Price	0	0	50	0	0	0	500	125	1250	1250	1250	1250

Table S4-2. Processing time (h) and cost (\$) (given in parentheses)

	U1	U2	U3	U4	U5	U6	U7	U8
T20					5 (20)			
T10	4 (10)							
T30				2 (10)				
T31			2 (15)					
T61						6 (20)		
T60				3 (12)				
T22							2 (25)	
T11							3 (30)	
T32		4 (8)						
T62							2 (12)	
T23				3 (14)				
T21								
T40					3 (18)			
T50					2 (25)			
T70						3 (16)		
T41		2 (6)						
T51		2 (10)					2 (10)	
T71							2 (8)	
T72			1 (16)				1 (15)	

Table S4-3. Unit capacities (kg)

	U1	U2	U3	U4	U5	U6	U7	U8
Min. capacity	1.2	1	1.4	1.4	1.6	1.2	1.4	1.6
Max. capacity	6	5	7	7	8	6	7	8

## Model statistics

Table S5-1. Model statistics

	Subsection 5.1.1	Subsection 5.1.2 (10h period)	Subsection 5.1.2 (26h period)	Subsection 5.1.3
Constraints	331	326	774	774
Discrete variables	109	109	269	269
Continuous variables	217	167	407	407
Obj. values	207.5	192.5	493	500
CPU	1	1	278	11
Optimality gap	0	0	0	0
	Subsection 5.1.4	Subsection 5.2	Subsection 5.3.1	Subsection 5.3.2
Constraints	886	2318	12047	8650
Discrete variables	309	1161	10816	2561
Continuous variables	497	2506	17408	5084
Obj. values	563	1478.5	23712	14035
CPU	13	58	3600	1800
Optimality gap	0	0	4.18	2.09

The units of obj. values, CPU, and optimality gap are \$, s, and %, respectively.