Restaurant Scheduling

Team Jaguar (aka the only group dorky enough to give themselves a team name)

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Objective

- Study how restaurants schedule making their food orders
- Restaurant has a selection of different dishes on the menu and does not pre-cook any selection
- Some metrics for success: L_{max}, ΣU_j, and ΣT_j

BAR
LE MONDE
PÂTISSERIE
BRASSERIE
LE MONDE
LE MONDE

Constraints and Data

<u>Stations</u>

A 6 burners

B 2 ovens (4 spaces each)

C 1 griddle

D 1 grill (4 spaces)

E 1 cold station

<u>Popular Dishes</u>

T1 Roasted Chicken	(Main)
T2 Steak Frites	(Main)
T3 Onion Soup	(Appetizer)
T4 Nicoisse Salad	(Appetizer)
T5 Potato Tart	(Main)
T6 Escargot	(Appetizer)

Data

Processing Times

	A	B	C	D	E
T1	13	x	x	x	x
T2	x	x	x	13	x
T3	x	x	7	x	x
T4	x	x	x	x	5
T5	x	10	x	x	2
T6	x	x	7	x	x

Constraints and Notes

For T5 (Potato Tart,) B(oven) ---> E(cold station)

Appetizer → main course for each participant

Deadline of 25 min for main course, and 15 min for appetizer

Base Case 1

- One batch of orders of all 6 dishes simultaneously
- Assume 1 machine at each station
- No appetizer constraint

	0 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9	9 - 10	10 - 11	11 - 12	12 - 13	13 - 14
A	J1													
B	J5													
C	J3							J6						
D	J2													
E	J4										J5			

Base Case 2

- 18 customers, ordering 6 of each of the 3 main courses
- In addition, 6 of the customers order 2 of each of the 3 appetizers
- Orders taken simultaneously

Base Case 2

	0 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9	9 - 10	10 - 11	11 - 12	12 - 13	13 - 14	14 - 15	15 - 16	16 - 17	17 - 18	18 - 19	19 - 20	20 - 21	21 - 22	22 - 23	23 - 24	24 - 25	25 - 26	26 - 27	27 - 28
A1	J1																											
A2	J2																											
A3	J3																											
A4	J4																											
A5	J5																											
A6	J6																											
B1	J13																											
B2	J14																											
B3	J15																											
B4	J16																											
B5	J17																											
B6	J18																											
B7																												
B8																												
C1	J19							J20							J23							J24						
D1	J7													J11														
D2	J8													J12														
D3	J9																											
D4	J10																											
E1	J21					J22					J13		J14		J15		J16		J17		J18							

Base Case 2

	Main Course	Appetizer	Type	Deadline	Completion	Tardiness
J1	x		1	25	13	
J2	x		1	25	13	
J3	x		1	25	13	
J4	x		1	25	13	
J5	x		1	25	13	
J6	x		1	25	13	
J7	x		2	25	13	
J8	x		2	25	13	
J9	x		2	25	13	
J10	x		2	25	13	
J11	x		2	25	26	1
J12	x		2	25	26	1
J13	x		5	25	12	
J14	x		5	25	14	
J15	x		5	25	16	
J16	x		5	25	18	
J17	x		5	25	20	
J18	x		5	25	22	
J19		x	3	15	7	
J20		x	3	15	14	
J21		x	4	15	5	
J22		x	4	15	10	
J23		x	6	15	21	6
J24		x	6	15	28	13

- Station C had most delays, but inevitable
- Station D delays also inevitable
- Though no delays, station E most interesting, since different types of orders processed here

Simulating Data for Further Cases

- Randomly generated interarrival times (0,1)
- Rounded to nearest integer, to simulate group arrivals (interarrival time = 0)

- Jobs 1-20 main dishes (all order main dish)
- ⅓ probability either dish type 1, 2, 5
- Jobs 21-29 Appetizers (~ ½ order appetizer)
- ⅙ probability either dish type 3, 4, 6

Simulation Data

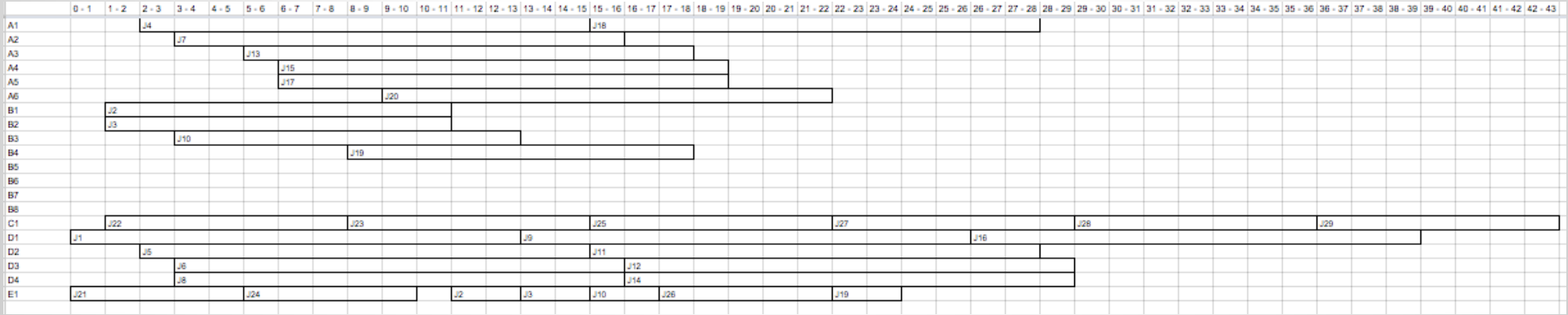
	A	B	C
1	Arrival Time	Main Dish Selection	Appetizer Selection
2	0	Dish 2	Dish 4
3	1	Dish 5	Dish 6
4	1	Dish 5	No Appetizer
5	2	Dish 1	Dish 6
6	2	Dish 2	No Appetizer
7	3	Dish 2	No Appetizer
8	3	Dish 1	Dish 4
9	3	Dish 2	Dish 6
10	3	Dish 2	No Appetizer
11	3	Dish 5	No Appetizer
12	3	Dish 2	No Appetizer
13	4	Dish 2	No Appetizer
14	5	Dish 1	Dish 4
15	6	Dish 2	No Appetizer
16	6	Dish 1	Dish 6
17	6	Dish 2	No Appetizer
18	6	Dish 1	No Appetizer
19	6	Dish 1	Dish 6
20	8	Dish 5	Dish 3
21	9	Dish 1	No Appetizer

Jobs	Dish	Release	Due	Associated Job
1	Dish 2	0	25	J21
2	Dish 5	1	26	J22
3	Dish 5	1	26	
4	Dish 1	2	27	J23
5	Dish 2	2	27	
6	Dish 2	3	28	
7	Dish 1	3	28	J24
8	Dish 2	3	28	J25
9	Dish 2	3	28	
10	Dish 5	3	28	
11	Dish 2	3	28	
12	Dish 2	4	29	
13	Dish 1	5	30	J26
14	Dish 2	6	31	
15	Dish 1	6	31	J27
16	Dish 2	6	31	
17	Dish 1	6	31	
18	Dish 1	6	31	J28
19	Dish 5	8	33	J29
20	Dish 1	9	34	
21	Dish 4	0	15	
22	Dish 6	1	16	
23	Dish 6	2	17	
24	Dish 4	3	18	
25	Dish 6	3	18	
26	Dish 4	5	20	
27	Dish 6	6	21	
28	Dish 6	6	21	
29	Dish 3	8	23	

Simulation Case 1

Actual Restaurant Method: FIFO

- Appetizer Constraint: Appetizers must come before associated main course
  - if the main course completes first, we hold it until the appetizer comes out
  - the delay is the time between when the main course is made and when it is served
  - adjusted completion time = completion time + delay



Simulation Case 1

Jobs	Dish	Release	Due	Associated Job	Completion Time	Adjusted Completion Time	Tardiness	Delay
1	Dish 2	0	25	J21	13	13		
2	Dish 5	1	26	J22	12	12		
3	Dish 5	1	26		14	14		
4	Dish 1	2	27	J23	15	15		
5	Dish 2	2	27		15	15		
6	Dish 2	3	28		16	16		
7	Dish 1	3	28	J24	16	16		
8	Dish 2	3	28	J25	16	22		6
9	Dish 2	3	28		26	26		
10	Dish 5	3	28		16	16		
11	Dish 2	3	28		28	28		
12	Dish 2	4	29		29	29		
13	Dish 1	5	30	J26	18	21		3
14	Dish 2	6	31		29	29		
15	Dish 1	6	31	J27	19	29		10
16	Dish 2	6	31		39	39	8	
17	Dish 1	6	31		19	19		
18	Dish 1	6	31	J28	28	36	5	8
19	Dish 5	8	33	J29	23	43	10	20
20	Dish 1	9	34		22	22		
21	Dish 4	0	15		5	5		
22	Dish 6	1	16		8	8		
23	Dish 6	2	17		15	15		
24	Dish 4	3	18		10	10		
25	Dish 6	3	18		22	22	4	
26	Dish 4	5	20		21	21	1	
27	Dish 6	6	21		29	29	8	
28	Dish 6	6	21		36	36	15	
29	Dish 3	8	23		43	43	20	

Simulation Case 1 Results

Associated Job	Completion Time	Adjusted Completion Time	Tardiness	Delay
Sum	602	649	71	47
Count	29	29	8	5
Average	20.75862069	22.37931034	8.875	9.4
Max	43	43	20	20

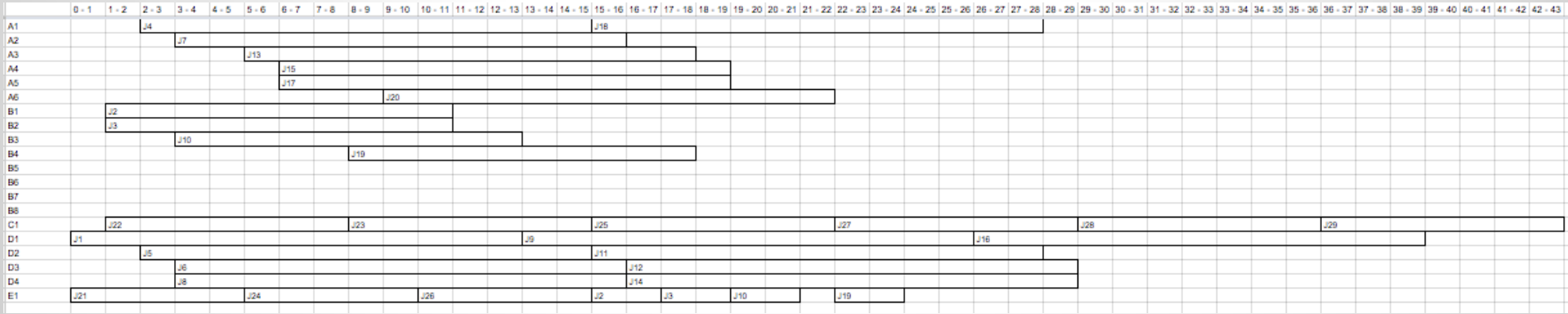
Consequences of tardiness:

Upset customers →

Simulation Case 2

Prioritize appetizers

- Move J26 (appetizer) before J2, J3, and J10 (all main courses) on station E when they are all available and need to be processed
- Rationale: appetizers hold back their associated main courses



Result Comparison

	Completion Time	Adjusted Completion Time	Tardiness	Delay
		Case 1		
Sum	602	649	71	47
Count	29	29	8	5
Average	20.75862069	22.37931034	8.875	9.4
Max	43	43	20	20
		Case 2		
Sum	611	655	70	44
Count	29	29	7	4
Average	21.06896552	22.5862069	10	11
Max	43	43	20	20

Tradeoff between completion time sum and tardiness

Simulation Case 3

- Hypothetical addition of another station C

	Completion Time	Adjusted Completion Time	Tardiness	Delay
		Case 1		
Sum	602	649	71	47
Count	29	29	8	5
Average	20.75862069	22.37931034	8.875	9.4
Max	43	43	20	20
		Case 2		
Sum	611	655	70	44
Count	29	29	7	4
Average	21.06896552	22.5862069	10	11
Max	43	43	20	20
		Case 3		
Sum	551	551	9	0
Count	29	29	2	0
Average	19	19	4.5	#DIV/0!
Max	39	39	8	0