Service Operations Management (SOM)

Managing Demand & Supply

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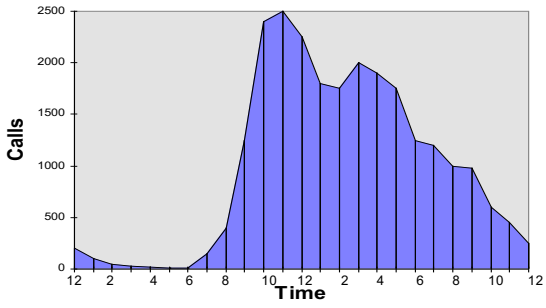
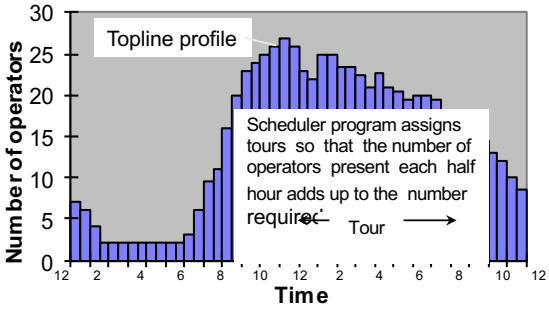
Daily Scheduling of Telephone Operator Workshifts





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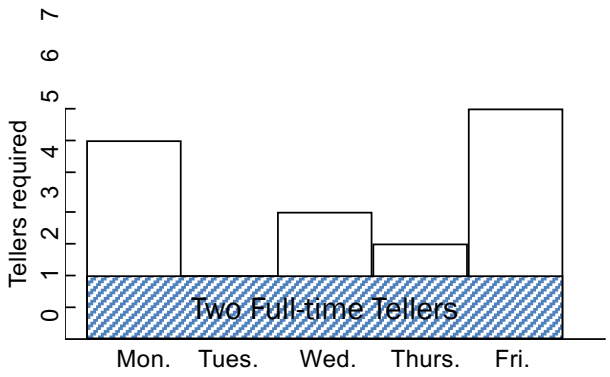
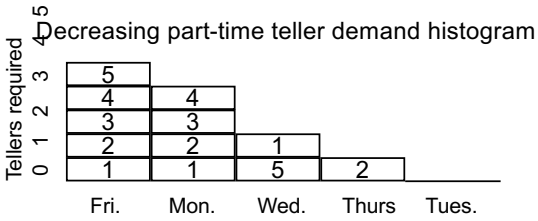
Scheduling Part-time Bank Tellers





DAILY PART-TIME WORK SCHEDULE, X=workday

Teller	Mon.	Tues.	Wed.	Thurs.	Fri.
1	x	….	x	….	x
2	x	….	….	x	x
3,4	x	….	….	….	x
5	….	….	x	….	x

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Managing supply

- Increasing customer participation
- Creating adjustable capacity
- Sharing capacity
- Cross training employees
  - Using part time employees

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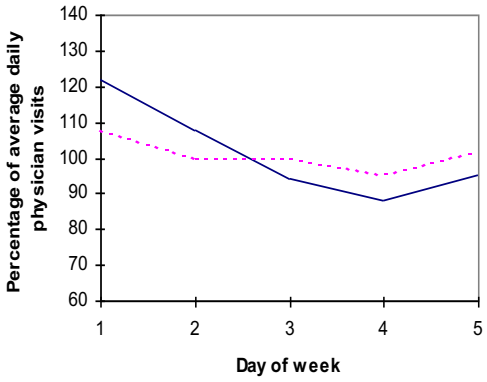
MANAGING DEMAND

Segmenting Demand at a Health Clinic



Smoothing Demand by Appointment Scheduling

Day	Appointments
Monday	84
Tuesday	89
Wednesday	124
Thursday	129
Friday	114

Discriminatory Pricing for Camping

Experience type	Days and weeks of camping season	No. of days	Daily fee
1	Saturdays and Sundays of weeks 10 to 15, plus Dominion Day and civic holidays	14	$6.00
2	Saturdays and Sundays of weeks 3 to 9 and 15 to 19, plus Victoria Day	23	2.50
3	Fridays of weeks 3 to 15, plus all other days of weeks 9 to 15 that are not in experience type 1 or 2	43	0.50
4	Rest of camping season	78	free

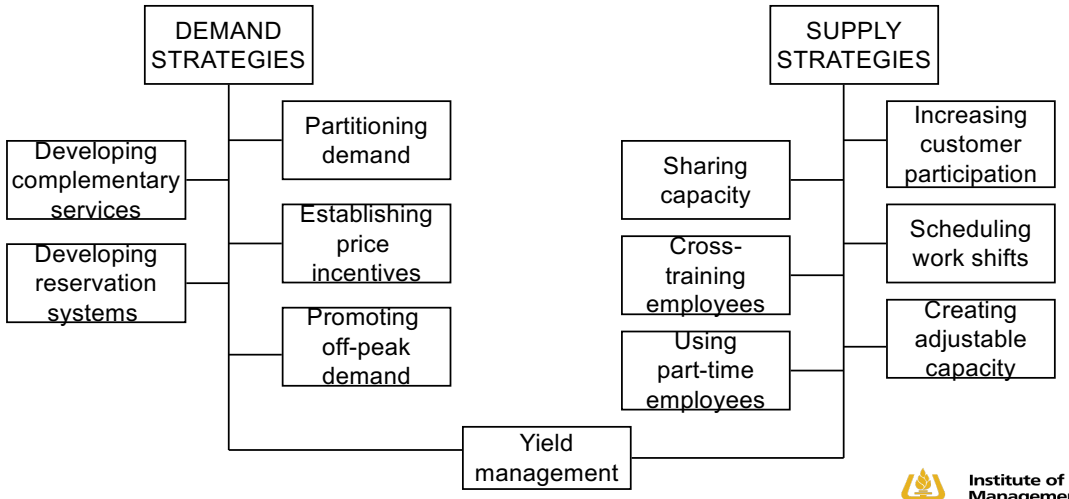
EXISTING REVENUE VS PROJECTED REVENUE FROM DISCRIMINATORY PRICING

	Existing flat fee of $2.50		Discriminatory fee	
Experience type	Campsites occupied	Revenue	Campsites occupied (est.)	Revenue
1	5.891	$14,727	5,000	$30,000
2	8,978	22,445	8,500	21,250
3	6,129	15,322	15,500	7.750
4	4,979	12,447	....	....
Total	25,977	$ 64,941	29,000	$59,000

Managing demand

- Promoting off peak demand
- Developing complementary services
- Reservation systems and overbooking

Yield Management



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Yield Management

- "Selling the right capacity to the right customer at the right price"
- Business Requirements
  - Limited Fixed Capacity
  - Business environment where YM can help
    - Ability to segment markets
    - Perishable inventory
    - Advance sales
    - Fluctuating demand
    - Accurate, detailed information systems

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Industries that Fully Use YM Techniques

- Transportation-oriented industries
  - Airlines
  - Railroads
  - Car rental agencies
  - Shipping
- Vacation-oriented industries
  - Tour operators
  - Cruise ships
  - Resorts
- Hotels, medical, broadcasting

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Elements of a Yield Management System

- Overbooking
- Price Discrimination & Capacity Allocation
- Network Management

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Overbooking

- Need for overbooking
- Fairness concerns
- Pros and cons v/s waitlisting

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Overbooking

- Two basic costs:
  - Stock outs
    - customers have a reservation and there are no rooms left
    - Customers have booked tickets but no seats available
  - Overage
    - customers denied advance reservation and rooms are unoccupied
    - Empty seats flying in the aircraft

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Hotel No-Show Experience

No-Shows	% of Experiences	Cumulative % of Experience
0	5	5
1	10	15
2	20	35
3	15	50
4	15	65
5	10	75
6	5	80
7	5	85
8	5	90
9	5	95
10	5	100

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What other data do you need?

- Room rent is $50
- 20% customers mutter menacingly and walk out
- Others are so upset they break furniture worth $150

Stock outs: 0.8 x $150 = $120

Overage: $50

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Overbooking Approach 1: Using Averages

The average number of no-shows is calculated by 0x0.05 + 1x0.10 + 2x0.20 + 3x0.15 +…+ 10x0.05 = 4.05.

Take up to four overbookings.

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Overbooking Approach 2: Spreadsheet Analysis

		Number of Reservations Overbooked									
No-Shows	Probability	0	1	2	3	4	5	6	7	8	9	10
0	0.05	$ 0	$120	$240	$360	$480	$600	$720	$840	$960	$1,080	$1,200
1	0.10	$ 50	$ 0	$120	$240	$360	$480	$600	$720	$840	$ 960	$1,080
2	0.20	$100	$ 50	$ 0	$120	$240	$360	$480	$600	$720	$ 840	$ 960
3	0.15	$150	$100	$ 50	$ 0	$120	$240	$360	$480	$600	$ 720	$ 840
4	0.15	$200	$150	$100	$ 50	$ 0	$120	$240	$360	$480	$ 600	$ 720
5	0.10	$250	$200	$150	$100	$ 50	$ 0	$120	$240	$360	$ 480	$ 600
6	0.05	$300	$250	$200	$150	$100	$ 50	$ 0	$120	$240	$ 360	$ 480
7	0.05	$350	$300	$250	$200	$150	$100	$ 50	$ 0	$120	$ 240	$ 360
8	0.05	$400	$350	$300	$250	$200	$150	$100	$ 50	$ 0	$ 120	$ 240
9	0.05	$450	$400	$350	$300	$250	$200	$150	$100	$ 50	$ 0	$ 120
10	0.05	$500	$450	$400	$350	$300	$250	$200	$150	$100	$ 50	$ 0
Total Cost		$203	$161	$137	$146	$181	$242	$319	$405	$500	$ 603	$ 714

$EV = \sum p_i C_i$ $F^* \left(\frac{C_u}{C_u + C_o} \right)$

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Overbooking Approach 3: Marginal Cost Approach

Book more guests until:

E(cost of dissatisfied customer) = E(cost of empty room)

- Cost of dissatisfied customer * Probability that there are ***fewer*** no-shows than overbooked rooms =
  - 120 * Prob (no shows < overbook)
- Cost of empty room * Probability that there are ***more*** no-shows than overbooked rooms
  - 50* Prob (no shows >= overbook)

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Hotel No show experience

- Co/(Cs + Co) = P(Overbook ≥ No Shows) Hotel Data
  - Cs = $120, Co = $50.00
  - Co/(Cs + Co) = 29.%
    - Overbook 2 rooms

50 / (120 + 50)

Table 9.1: Hotel No-Show Experience

No-Shows	% of Experiences	Cumulative % of Experiences
0	5	5
1	10	15
2	20	35

29%

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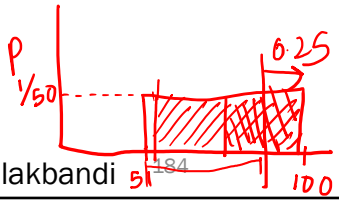
Capacity Allocation with Exogenous Prices

- Business capacity = 100
- Demand forecast: premium profit ($10,000/seat) demand: uniformly distributed (51, 100)
  - Costs you $2500
- Discount price ($2,500/seat) demand: unlimited demand at this price – infinite discounters available
  - Costs you $0



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Static Methods

- Fixed Number, Fixed Time Rules
  - Fixed Time Rule
    - Accept discount bookings until a specific date
    - Motivation
    - Distinct, Static System – Fixed Number Rule
    - Average of 75 premium bookings, so reserve
      - » exactly 75 slots for premium customers
      - » exactly 25 slots for discount customers

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Static Methods

- Fixed Number, Fixed Time Rules
  - Nested, Static system – Fixed Number Rule
    Average of 75 premium bookings, so reserve
    75 slots for premium customers
    remaining 25 go FCFS
  - Example:
    85 premium and 15 passengers wish to book
  - Distinct, Static system: 75 premium,15 discount
    Nested, Static system: 85 premium,15 discount

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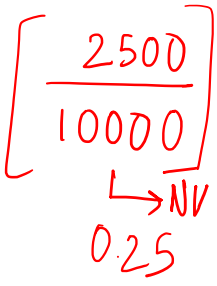
Nested, Static System – Fixed Number Rule

- EMSR heuristic (Expected Marginal Seat Revenue)
  - Allocating first through 51st seats
    revenue per seat:
    100% certain of $10,000 premium vs. $2,500 discount

    Allocating 52nd seat
    98% certain of $10,000
    = $9,800 expected revenue vs. $2,500 discount

    Allocating 53nd seat
    96% certain of $10,000

    = $9,600 expected revenue vs. $2,500 discount



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Nested, Static System – Fixed Number Rule

- 88^{th} seat
  24% certain of $10,000 = $2,400 vs. $2,500 discount

  On average flight:
  75 premium passengers
  13 discount passengers
  12 empty seats

  Optimal Allocation
  87 seats premium, 13 seats discount

- Rule:
  Accept discount passenger until
  pr(spill) < discount revenue/premium revenue

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Capacity Allocation

- Littlewood's rule
  - Accept discount passenger until
    pr(spill) < discount revenue/premium revenue
- EMSR a and EMSRb
  - When there are multiple classes
    - EMSR a: Protect each class against every lower class
    - EMSR b: Protect each class using weighted average of the lower class
    - Refer Worksheet

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↳ 0

Desn → ?

$49

full fare

$69

Capacity

95

$1 - \frac{49}{69}$

full fare

$D \sim N(60, 15)$

C_u = Lost revenue → $20

C_o = Empty seat → $49

$\rightarrow \frac{20}{20+49}$

$= 0.29$ CR

$P(a < x) = 60 + Z_{\alpha}\ 15$ (-0.55) = 51

Limit discount

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F(x)

1

0.75

x

Cumulative demand function

1 - 20%

2 - 30%

3 - 40%

4 - 10%

50

20

1 2 3 4

x

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Four Types of Fares

Fare Type:	BUSINESS	COACH	DISCOUNT	PROMOTION
Prices:	250-140%	140%-70%	60%-30%	40%-25%
Letter codes:	F, C, J	Y	H, Q, M	K, V
Commissions:	10%-30%	10%-15%	10%-15%	0%-10%
Seat size:	BIG	small	small	small
Service:	high	normal	normal	normal
Early Purchase?	0 days	0 days	14-30 days	30-60 days
Refundable?	yes	yes	partial	no
Min. Stay?	no	no	7-14 days	7-14 days
Days "full":	under 5%	under 5%	5%-50%	20%-80%
Typical user:	business	business	holiday	group
Elasticity:	-0.5	-0.7	-1.4	-2.0

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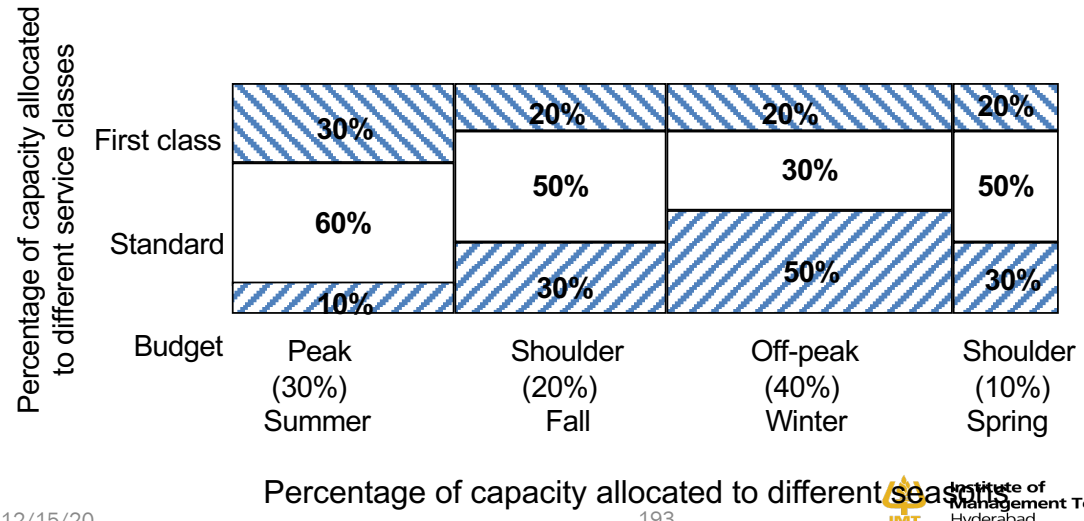
Seasonal Allocation of Rooms by Service Class for Resort Hotel



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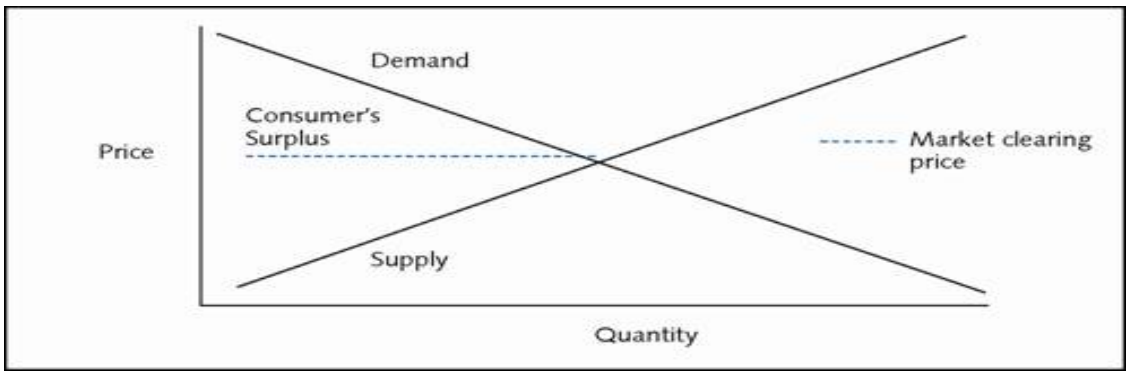
Traditional Supply and Demand Equilibrium



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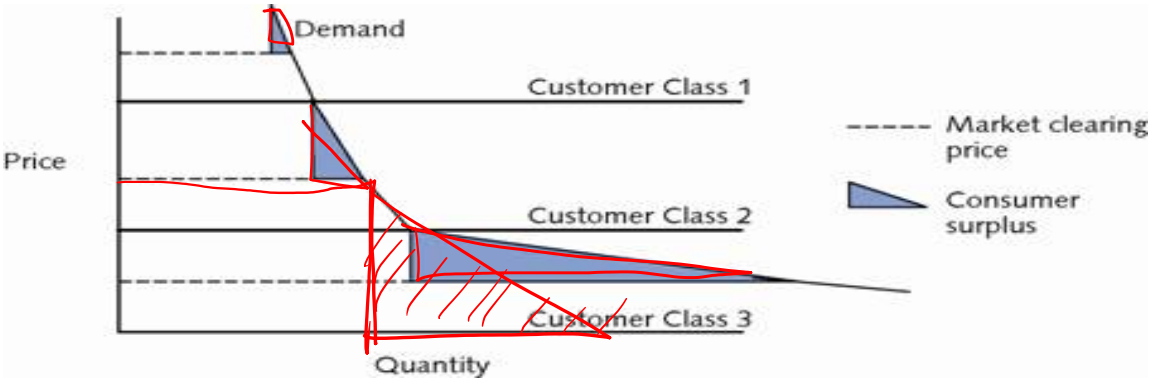
Price Discrimination



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Yield Management – Implementation

- Alienating Customers
  - Difficulty of customer understanding
  - Customer cheating
- Employee Issues
  - Limiting decision power
  - Sabotage: add, not subtract responsibility
  - Reward system: in-synch with managerial goals - Consistency across personnel and units
  - Exception processing
  - Monitoring
- Cost/Time of Implementation

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THANK YOU

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