UBS, GURGAON
Executive MBA Program
Course on Operations Management (EMB – 108)

Handout on Aggregate Planning - Numerical Technique
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An Aggregate Planning Problem, and its Numerical Solution

Example: The Fine Furniture Corporation produces a metal and wood frame, which is used in production of various products like sofas, chairs, and recliners. The demand, cost, and production data for the next six months are:

Demand data:

Month	May	June	July	Aug.	Sep.	Oct.
Forecast demand	980	1,320	1,320	1,320	880	880

Beginning inventory: 100 units

Cost data:

Inventory holding cost	Rs.10/unit/month
Stockout	Rs.30/ unit/month
Hiring	Rs.700 per worker
Layoff	Rs.900 per worker
Normal time labor	Rs.7.00 per hour
Overtime labor	Rs.10.50 per hour

Production data:

Working hours	8 hours per day
Labor requirement	4 hours/unit
Current workforce	20 workers
Workdays/month	22

Compute the cost for each of the following strategies or plans:

I. Constant workforce, vary inventory and stockout only.
II. Constant workforce of 20 workers, vary overtime only.
III. Exact production; vary workforce.

Because the number of working days is the same for each month, the same number of units will be produced each month.

Labor cost per unit produced under normal time
= (4 hrs/unit)(Rs.7.00 per hour under normal time)
= Rs.28

Cost of hiring = Rs.700/worker
If n are required, it will be 700n.

	May	Jun.	Jul.	Aug.	Sep.	Oct.
Beginning inventory	100					
Demand	980	1,320	1,320	1,320	880	880
Production requirements	880	1,320	1,320	1,320	880	880
Cumulative production reqmts.	880	2200	3520	4840	5720	6600

Plan – I:

- Constant workforce
- Vary inventory and stockout only

Estimation of workforce required:

No. of labor hours reqd. over next 6-month period
= 6600 units x 4 hrs per unit
= 26,400 hrs

No. of labor hours available over next 6-month period
= 6 months x 22 days per month x 8 hrs a day
= 1056 hrs
Hence, no. of workers reqd. = 26400/1056 = 25
No. of units produced by this 25-strong labor force
= (25 workers x 22 days x 8 hrs a day)/(4 hrs per unit)
= 1100 units

Month	Units produced (1)	Cumul. units produced (2)	Cumul. production reqmt. (3)	Inventory position (+: hold - : short) (2) - (3) = (4)	Holding cost (4)x10 if '+'	Shortage cost (4)x30 if '-'	Labor cost (1)x28
May	1100	1100	880	+220	2200	-	30800
Jun.	1100	2200	2200	0	-	-	30800
Jul.	1100	3300	3520	-220	-	6600	30800
Aug.	1100	4400	4840	-440	-	13200	30800
Sep.	1100	5500	5720	-220	-	6600	30800
Oct.	1100	6600	6600	0	-	-	30800
Total					2200	26400	184800

To these three types of costs, viz. inventory holding cost, shortage cost, and direct production labor cost, we have to add the cost of hiring five additional workers at the beginning of May.

Hiring cost for 5 workers = Rs.5(700) – 3500

Hence, total cost of Plan–I = Rs.2200 + 26400 + 184800 + 3500 = Rs.216,900

Plan – II:

- Constant workforce of 20 workers
- Vary overtime only.

No. of workers = 20
No. of units that can be produced per month by these 20 workers
= (20 x 22 x 8)/4 = 880 units

Labor cost per unit under normal time = Rs. 7 x 4 = 28
Labor cost per unit under overtime = Rs. (10.50 x 4) = 42

With constant workforce of 20 workers, we can produce exactly the required number to match the fluctuating demand, by varying overtime.

Month	Production reqd. in month to match full demand (1)	Production possible under NT (2)	Production reqd. under OT (3) = (1) – (2)	Production labor cost for NT (2) x 28	Production labor cost for OT (3) x 42
May	880	880	0	24640	0
Jun.	1320	880	440	24640	18480
Jul.	1320	880	440	24640	18480
Aug.	1320	880	440	24640	18480
Sep.	880	880	0	24640	0
Oct.	880	880	0	24640	0
Total				147,840	55,440

There are no other costs (such as inventory holding, shortage, hiring or layoff of labor) in this plan. Hence, total cost of Plan–II = Rs.147840 + 55,440 = 203,280.

Plan – III:

- Exact production; vary workforce.

No. of units that can be produced by a single worker in a month
= (22 days x 8 hrs/day)/(4 hrs/unit) = 44 units.

All units are produced at Normal time rate.
Total no. of units to be produced in 6-month period = 6600 units.

Hence, total labor cost under Normal time for 6600 units
= 6600 x 28 = 184,800

Computation of varying workforce level for producing exactly to match demand every month:

Month	Production reqd. (1)	No. of workers reqd. (2) = (1)/44	No. of workers hired or laid off w.r.t initial 20 or previous month	Cost of hiring	Cost of layoff
May	880	20	20 – 20 = 0	-	-
Jun.	1320	30	30 – 20 = +10 (hiring)	10 x 700 = 7000	-
Jul.	1320	30	30 – 30 = 0	-	-
Aug.	1320	30	30 – 30 = 0	-	-
Sep.	880	20	20 – 30 = -10 (layoff)	-	10 x 900 = 9000
Oct.	880	20	20 – 20 = 0	-	-
Total				7000	9000

To the above hiring and layoff cost, we add the total labor cost under NT for 6600 units (computed earlier). Hence, total cost of Plan – III = 184800 + 7000 + 9000 = 200,800.

Comparison of the costs of each plan:

Costs	I: Constant workforce; constant monthly output; vary inventory/shortage	II: Constant no. of workers = 20; vary overtime production, i.e. vary monthly output	III: Vary monthly output by varying workforce size
Normal time labor	184,800	147,840	184,800
Overtime labor	0	55,440	0
Inventory holding	2200	0	0
Stockout	26400	0	0
Hiring	3500	0	7,000
Layoff	0	0	9,000
Total	216,900	203,280	200,800