**Capacitated Lot Sizing Problem With Set Up, Inventory and Backorders With A CAP on Capacity Utilization**

**By**

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Lot sizing problem with backorder, inventory, setup and production cost is as follows.

**Problem P (Original Problem):**

Min sum(t), [XP(t)\*CXP(t) + XINV(t)\*CINV(t) + CSETUP(t)\*y(t)+

XSHT(t)\*CSHT(t)] (1)

s.t.

XP(t) <= CAP(t)\*y(t) for all t (2)

XINV(0) + sum(t=1 to t1), XP(t) + XSHT(t1) = sum(1 to t1), DEM(t) + XINV(t1) (3)

XSHT(T) = 0 (4)

XINV(t), XP(t), XSHT(t) >= 0 for all t (5)

Sum(t), y(t)\*cap(t) >= sum(t), dem(t) 5(a)

XP(t)/CAP(t) + M\*(1 – y(t)) >= 0.85 5(b)

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XP(t) >= y(t)\*CAP(t)\*0.85;

And XP(t) <= y(t)\*CAP(t);

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Probably above can address some of your concerns; and help pose problem only in XP(t) and XINV(t): coolly investigate;

y(t) = (0,1) binary for all t (6)

Constraints (\*\*\*) ensure that if setup happens, then capacity used is at least 85% and it can be specified differently by decision maker to suit his needs.

**Method 1:** Solve problem P by feeding it to GAMS (for T = 30 & 50: 20 problems each). Record the following: CPU time taken, Objective Function Value for each of the problems (prepare a table for T = 30 and separate table for T = 50).

Eliminate XSHT(t1) by using equation (3). Now the constraint in problem RP is (7):

sum(1 to t1), DEM(t) + XINV(t1) - sum(t=1 to t1), XP(t) - XINV(0) >= 0 (7)

**Reduced Problem RP:**

Min sum(t1 = 1 to T), [XP(t1)\*CXP(t1) + XINV(t1)\*CINV(t1) +

CSETUP(t1)\*y(t1) + {sum(t=1 to t1), DEM(t) + XINV(t1) –

sum(t=1 to t1), XP(t) - XINV(0)}\*CSHT(t1)] (9)

sum(1 to t1), DEM(t) + XINV(t1) - sum(t=1 to t1), XP(t) - XINV(0) >= 0 (7)

sum(t=1 to T), XP(t) = sum(1 to T), DEM(t) (8)

plus we have (2), 5(a) and 5(b).

XINV(t), XP(t) >= 0 for all t and y(t) = (0,1) (10)

Thus we have eliminated real variable XSHT(t). Thus the reduced problem RP has less number of variables. It is expected to yield computational advantages. Binary variables are not eliminated as they are required to ensure adequate capacity utilization.