**AIRCO Case Study**

**Decision Variables**

xij -> units produced at i (i=P1,…,P4) and shipped to j (j=A,….,F) (regular production)

Especially for P2 let xP2D and xP2E to denote the number of units produced and shipped using the regular transportation/shipping mode, similarly let wP2D and wP2E to denote the number of units produced and shipped using the premium transportation/shipping mode.

yij -> units produced at i (i=P1 and P4) and shipped to j (j=A,…,F) (overtime production units)

zi -> binary variable to indicate whether overtime production is used at i (i=P1 and P4), or not

qP2D and qP2E -> binary variables to indicate if the premium transportation mode is used for shipping products from P2 to D and E respectively.

**Objective Function**

min Z = GREV - REGPRODCOST – OVERPRODCOST – REGTRANSCOST - PREMTRANSCOST

GREV - Gross Revenue

20(xP1A + xP2A + yP1A + xP3A + xP4A + yP4A) + 30(xP1B + xP2B + yP1B + xP3B + xP4B + yP4B) + 25(xP1C + xP2C + yP1C + xP3C + xP4C + yP4C) + 40(xP1D + xP2D + wP2D + yP1D + xP3D + xP4D + yP4D) + 38(xP1E + xP2E + wP2E + yP1E + xP3E + xP4E + yP4E) + 42(xP1F + xP2F + yP1F + xP3F + xP4F + yP4F)

Regular Production Cost

10.80(xP1A + xP1B + xP1C + xP1D + xP1E + xP1F) + 12.00(xP2A + xP2B + xP2C + xP2D + xP2E + xP2F) + 10.50(xP3A + xP3B + xP3C + xP3D + xP3E + xP3F) + 11.20(xP4A + xP4B + xP4C + xP4D + xP4E + xP4F)

Overtime Production Cost

(12.00 + 1.00)\*(yP1A + yP1B + yP1C + yP1D + yP1E + yP1F) + (11.20+1.00)\*(yP4A + yP4B + yP4C + yP4D + yP4E + yP4F)

Regular Transportation Cost
6xP1A + 15xP1B + 25xP1C + 21xP1D + 24xP1E + 33xP1F + 13xP2A + 14xP2B + 8xP2C + 6xP2D + 8xP2E + 12xP2F + 19xP3A + 21xP3B + 19xP3C + 10xP3D + 19xP3E + 26xP3F + 5xP4A + 12xP4B + 9xP4C + 8xP4D + 10xP4E + 19xP4F

Premium Transportation Cost

33xP2D + 14.5xP2E

**Constraints**

Regular production capacity constraints

xP1A + xP1B + xP1C + xP1D + xP1E + xP1F ≤ 8900

xP2A + xP2B + xP2C + xP2D + xP2E + xP2F + (wP2E + wP2D) ≤ 2700

xP3A + xP3B + xP3C + xP3D + xP3E + xP3F ≤ 1250

xP4A + xP4B + xP4C + xP4D + xP4E + xP4F ≤ 4750

Overtime production capacity constraints

yP1A + yP1B + yP1C + yP1D + y1E + yP1F ≤ 0.2\*8900\*ZP1

yP4A + yP4B + yP4C + yP4D + yP4E + yP4F ≤ 0.2\*4750\*ZP4

Minimum and Maximum Sales per DC

2305 ≤ xP1A + xP2A + yP1A + xP3A + xP4A + yP4A ≤ 3216

1278 ≤ xP1B + xP2B + yP1B + xP3B + xP4B + yP4B ≤ 2878

2915 ≤ xP1C + xP2C + yP1C + xP3C + xP4C + yP4C ≤ 4065

84 ≤ xP1D + xP2D + wP2D + yP1D + xP3D + xP4D + yP4D ≤ 117

3699 ≤ xP1E + xP2E + wP2E + yP1E + xP3E + xP4E + yP4E ≤ 5160

3708 ≤ xP1F + xP2F + yP1F + xP3F + xP4F + yP4F ≤ 5172

Shipping Capacity Constraints for P2

xP2A ≤ 1400

xP2b ≤ 1400

xP2C ≤ 1400

xP2D ≤ 1000(1-qP2D)

xP2E ≤ 500(1-qP2E)

wP2D ≤ 2700qP2D

wP2E ≤ 2700qP2E

wP2D ≥ 1000qP2D

wP2E ≥ 500qP2E