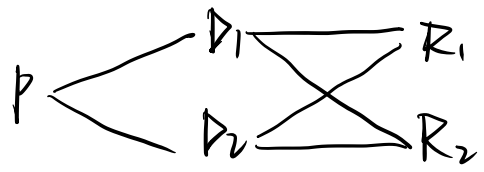
Q1. (a)



Let route (P, D1, R1) be a
route (P, D1, R2) be b
route (P, D2, R1) be c
route (P, D2, R2) be d

then objective function (minize ~~total~~ shipping costs)

Min $8a + 13b + 9c + 11d$

subject to $a + b + c + d = 1000$ (production capacity)

$a + b \leq 400$
$c + d \leq 700$
} capacity constraints for D1 & D2

$a + c = 750$
$b + d = 250$
} demand constraints

$0 \leq a + b \leq 550$
$0 \leq c + d \leq 650$
$0 \leq a \leq 350$
$0 \leq b \leq 250$
$0 \leq c \leq 550$
$0 \leq d \leq 450$
} shipping quantity constraints

(b) change production capacity constraint from 1000 to 800

$a + b + c + d = 800$

New info needed: How the 800 units allocate between R_1 and R_2.

Q3. (1) Let unit of production for Model A be x,
unit of production for Model B be y,

Objective function (maximize unit contribution)

Max $70x + 40y$

Subject to $0 \le x \le 2000$
$0 \le y \le 4000$ (max demand)

$0 \le 1.5x \le 2500$
$0 \le y \le 4500$ (production capacity)

(2) only change in production capacity constraint:

$0 \le 1.6x + 1.1y \le 7000$

(3) Let unit of dedicated production for Model A be m,
unit of flexible production for Model A be n,
unit of dedicated production for Model B be p,
unit of flexible production for Model B be q,

Objective function (maximize unit contribution)

Max $70(m+n) + 40(p+q)$

Subject to $0 \le m+n \le 2000$
$0 \le p+q \le 4000$ (max demand)

$0 \le 1.5m \le 900$
$0 \le p \le 1100$ (production capacity)

$0 \le 1.6m + 1.1q \le 5000$

(4) Max $70(M+N)+40(P+Q)-7000\,1_N-5000\,1_Q$

Subject to $0 \le M+N \le 2000$ (max demand)

$0 \le P+Q \le 4000$

$0 \le 1.5M \le 900$

$0 \le P \le 1100$ (production capacity)

$0 \le 1.6N+1.1Q+100\,1_N+75\,1_Q \le 5000$

where $1_n = \begin{cases} 1, & \text{if } n>0 \\ 0, & \text{if } n=0 \end{cases}$