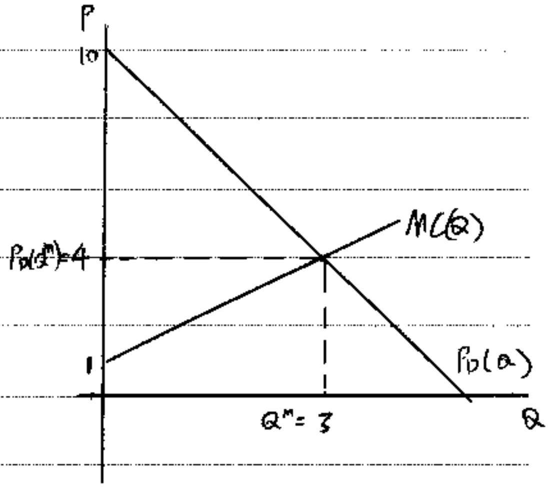
20th Section

1st Degree Price Discrimination



$P_D(Q) = 10 - 2Q$

$MC(Q) = 1 + Q$

Eq$^{\underline{m}}$ quantity : $P_D(Q^m) = MC(Q^m)$

$10 - 2Q^m = 1 + Q^m$

$Q^m = 3$

Price : Consumer who bought the Q^{th} unit pays $P_D(Q)$

Profit : $\pi(Q^m)$ = TS in competitive market

$= \frac{1}{2}[P_D(0) - MC(0)]Q^m$

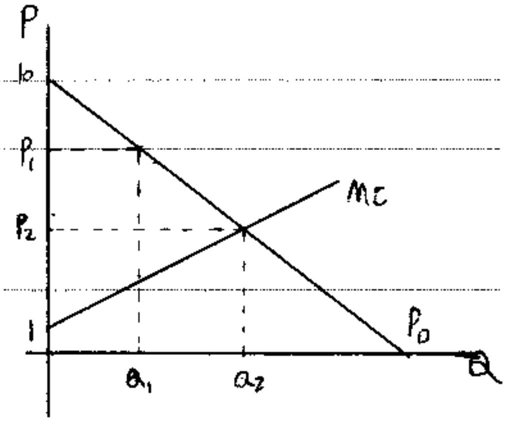
$= \frac{1}{2}(10 - 1)3$

$= 13.5$

CS : 0

Efficient outcome.

2nd Degree PD



Monopolist sets P_1, P_2, P_3, ...

Buy less than Q_1 pays P_1 each,

Buy less than Q_2 pays P_2 each, etc.

Suppose monopolist sets $P_1 = 6$, $P_2 = 4$

Eq^m quantity : $P_D(Q^m) = P_2$

$Q^m = 3$

Profit : $\pi = P_1 \cdot Q_1 + P_2 \cdot (Q_m - Q_1) - \underbrace{C(Q_m)}_{\text{area under MC}}$

$= 6 \cdot Q_D(6) + P_2 \cdot (3 - Q_D(6)) - \overbrace{(1+4) \cdot 3/2}$

$= 6 \cdot 2 + 4 \cdot (3-2) - 7.5$

$= 8.5$

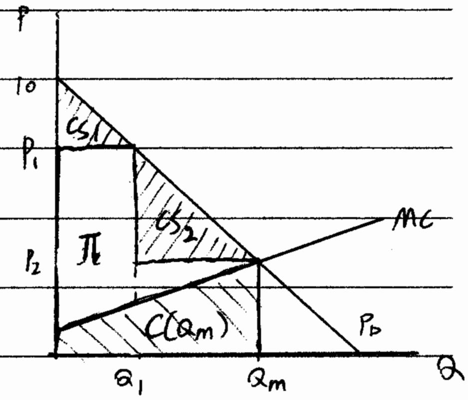
CS : $CS1 + CS2$

$= \frac{1}{2}(P_D(0) - P_1)\, Q_1 + \frac{1}{2}(P_1 - P_2) Q_2$

$= \frac{1}{2}(10 - 6)\, 2 + \frac{1}{2}(6-2) \cdot 1$

$= 4 + 2$

$= 6$



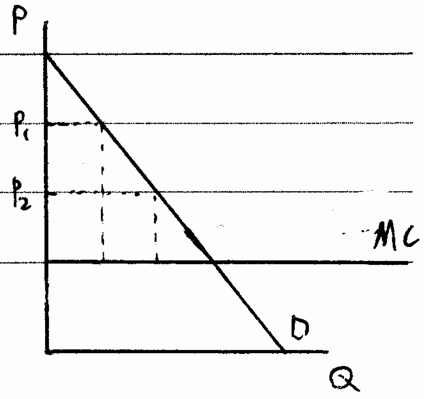
Efficiency : Depends on the last price (here is P_2) = MC or not. Efficient if yes; not efficient otherwise.

Rule-of-Thumb Pricing Rule for 2nd Degree PD

- Equally space the prices along the vertical intercept of demand and the free-market eq^m price P^c (given by $P_D = MC$).

i.e. $P_D(0) - P_1 = P_1 - P_2 = P_2 - P_3 = \dots = P_{n-1} - P_n = P_n - P^c = \frac{P_D(0) - P_c}{\#\text{ of } P + 1}$

$P^c = MC(Q\text{ free market}) = P_D(Q\text{ free market})$



Not efficient but better than single pricing.
As # of prices $\to \infty$ its efficient

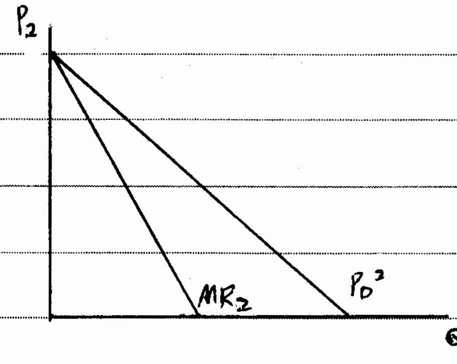
I think this holds for constant marginal cost only.

3^{rd} Degree Price Discrimination

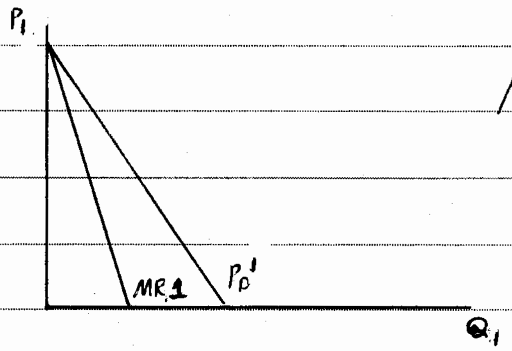
Monopolist can separate consumers into different groups.
Each group has its own demand curve and can be charged a different price (single price)
Cost depends only on total output

Optimal Condition : $MR_1 = MR_2 = MC$

e.g. $P_D^2 = 10 - Q_2$ $\qquad$ $P_D^1 = 10 - 2Q_1$



Market 2



Market 1

Total cost : $C(Q_1+Q_2) = (Q_1+Q_2) + \dfrac{(Q_1+Q_2)^2}{2} + 5$ ← fixed cost

$MC(Q_1+Q_2) = 1 + (Q_1+Q_2)$

$MR_1 = 10 - 4Q_1$, $MR_2 = 10 - 2Q_2$

$MR_1 = MR_2 = MC$

$10 - 4Q_1^m = 10 - 2Q_2^m = 1 + (Q_1^m + Q_2^m)$

1. $10 - 4Q_1^m = 10 - 2Q_2^m$

$2Q_1^m = Q_2^m$

2. $10 - 4Q_1^m = 1 + (Q_1^m + Q_2^m)$

$10 - 4Q_1^m = 1 + (Q_1^m + 2Q_1^m)$

$Q_1^m = \dfrac{9}{7}$

3. $Q_2^m = \dfrac{18}{7}$

Profit : $\pi = R_1 + R_2 - C$

$$= P_D^1(Q_1^m)\cdot Q_1^m + P_D^2(Q_2^m)\cdot Q_2^m - C(Q_1^m + Q_2^m)$$

$$= \left[10 - 2\left(\tfrac{9}{7}\right)\right]\cdot \tfrac{9}{7} + \left[10 - \left(\tfrac{18}{7}\right)\right]\cdot \tfrac{18}{7} - \left[\left(\tfrac{9}{7} + \tfrac{18}{7}\right) + \frac{\left(\frac{9}{7}+\frac{18}{7}\right)^2}{2} + 5\right]$$

$$= 12.36$$

CS : $CS_1 = \frac{1}{2}\left[P_D^1(0) - P_D^1(Q_1^m)\right]\cdot Q_1^m$ (Consumer Surplus in Market 1)

$$= \tfrac{1}{2}\left[10 - \tfrac{52}{7}\right]\cdot \tfrac{9}{7}$$

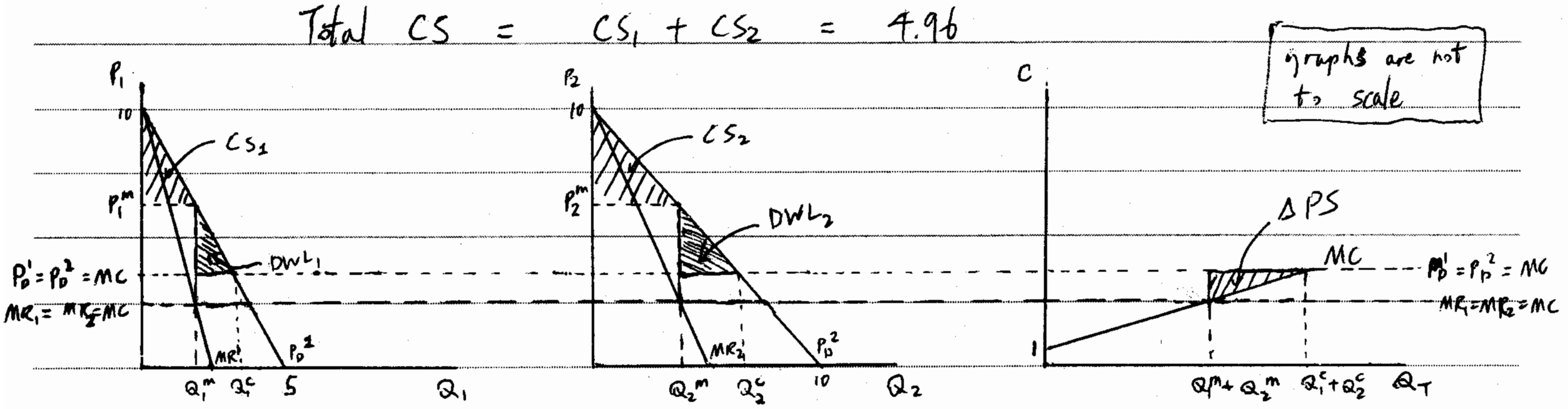
$$= 1.65$$

$CS_2 = \frac{1}{2}\left[P_D^2(0) - P_D^2(Q_2^m)\right]\cdot Q_2^m$ (Consumer Surplus in Market 2)

$$= \tfrac{1}{2}\left[10 - \tfrac{52}{7}\right]\cdot \tfrac{18}{7}$$

$$= 3.31$$

Total CS $= CS_1 + CS_2 = 4.96$



Deadweight loss $= DWL_1 + DWL_2 + \Delta PS = \frac{1}{2}\left[P_1^m - MC(Q_1^c + Q_2^c)\right]\cdot(Q_1^c - Q_1^m)$

$$+ \tfrac{1}{2}\left[P_2^m - MC(Q_1^c + Q_2^c)\right]\cdot(Q_2^c - Q_2^m)$$

$$+ \tfrac{1}{2}\left[MC(Q_1^c + Q_2^c) - MC(Q_1^m + Q_2^m)\right]\cdot\left[(Q_1^c + Q_2^c) - (Q_1^m + Q_2^m)\right]$$

$$= 0.264 + 0.529 + 1.190 = 1.984$$

Inefficient, but still better than single-pricing.

Note that since $\frac{P_i - MC}{P_i} = -\frac{1}{\varepsilon_d^i}$, $P_1/P_2 = \frac{1 + 1/\varepsilon_d^2}{1 + 1/\varepsilon_d^1}$.

In our case $\frac{P_1}{P_2} = 1$, but this is a special case. In general,

lower demand elasticity $\varepsilon_d^i \Rightarrow$ higher price P_i^m