Mesut SEZER
4801220298

ARA SINAV

ELMH7003
Enerji Sist. İşletilmesi

C 1) Problem 2.4 Consumer Surplus $= \frac{1}{2} \cdot Q_d \cdot \Delta P$

(Tüketici artığı/fazlası)

Q_d = Market dengesindeki talep miktarı

$\Delta P = P_{max} - P_d$ P_{max} = Alıcı ödemesi
P_d = Pazar fiyatı

then; Probem 2.3 formula,

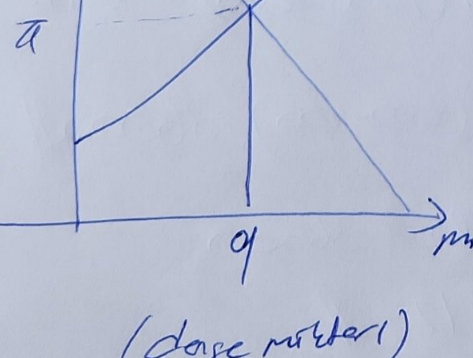
$\pi = 10q + 2000$ $q = 0.2\pi - 40$
$q = \underline{140}$

Talep miktarı $= \dfrac{2000 - 900}{10} = 110$

Miktar (transacted) $= 140 - 110 = 30$

a) $\pi = 900$ \$ Surplus formülünde yerine
$q = 110$ koyarsak,

Consumer's surplus $= \frac{1}{2} \cdot (2000 - 900) \cdot 110$
$= 60500$ \$



(denge miktarı)
(Arz talep grafiği)

producer's profit $= P \times Q$
(üretici geliri)

producer suplus = Total revenue − cost

Üretici artığı/fazlası = Gelir − maliyet

P.profit $= (150 \cdot 110) + \frac{1}{2} \cdot (750 - 200) \cdot 110$

Producers profit = 46.750 \$

Global Welfare = PS + CS
(Global Refah) 60500 + 46750
= 107,250 \$

1

b) En yüksek fiyat 600 $ dursa;

problem 2;s → $q = 0.2\pi - 40$

$q = 0.2 \cdot 600 - 40 = 80$ birim

"

Talep → $-10q + 200$, $= \frac{2000 - 600}{10} = 140$ birim

Therefore; Adet (transacted) $= 140 - 80 = 60$ birim olur.

Consumers Surplus $= 600 \cdot 80 + \frac{1}{2} \cdot 80 \cdot 800$

$= \underline{80000 \$}$

Producers Profit $= \frac{1}{2} \cdot 400 \cdot 80 = \underline{16000 \$}$

Global Welfare $= 80000 + 16000 = 96000 \$$

c) 450 $ vergi (tax)

Pazar fiyatı $= 800 + 450 = 1250 \$$ olur

$q = 0.2\pi - 40 = 120$ birim

$\pi = -10q + 2000$, then $q = \frac{2000 - 1250}{10} = \underline{75}$ birim

Adet (transacted) $= 120 - 75 = 45$

Consumers surplus $= \frac{1}{2} \cdot 75 \cdot (2000 - 1250) = \underline{28.125 \$}$

Producers profit $= \frac{1}{2} \cdot 120 \cdot (800 - 200)$ $\underline{36000 \$}$

Global welfare $= 28125 + 36000$

$= \underline{64125 \$}$

c2) Problem 2.5 The demand curve for a product

$q = 200 - \pi$ and $q = \frac{10000}{\pi}$

to find the price and price elasticity for demands which 0, 50, 100, 150, 200;

verilen talep sayıları için fiyat ve fiyat esnekliği,

price elasticity of demand (ε)

$$\varepsilon = \frac{\frac{\pi}{q} \cdot dq}{d\pi}$$

ε (at $q=0$)

Talep $= 0$ iken $= \frac{200}{0} \cdot (-1) = \infty$

Talep $= 50$ iken $= \pi = 150$ \$

$$\varepsilon = \frac{150}{50} \cdot (-1) = -3$$

Talep $= 100 \rightarrow$ $\pi = 100$ \$

$$\varepsilon = \frac{100}{100} \cdot (-1) = -1$$

Talep 200 $\rightarrow$ $\pi = 0$ \$

$$\varepsilon = \frac{0}{200} - 1 = 0$$

Talep 150 $\rightarrow$ $\pi = 50$ \$

$$\varepsilon = \frac{50}{150} (-1) = -1/3$$

for $q = \frac{10000}{\pi}$ also it's $\pi = \frac{10000}{q}$

so; $\frac{dq}{d\pi} = \frac{-10000}{q^2}$ for $q=0$ then, $\pi = \infty$

Take $q = 50$ $\pi = 200$ \$

$$\varepsilon = \frac{200}{50} \cdot \left(-\frac{10000}{50^2}\right) = -1$$

$$\varepsilon = \frac{dq}{d\pi} \cdot \frac{\pi}{q} = -10000\,\pi^{2} \cdot \pi \cdot q$$

$$= -10000 \cdot \pi \cdot q$$

$$= \frac{-q}{q} = -1$$

Thus, always remain -1 (herzaman esneklik -1'dir)

So;

$q = 100$ $\pi = 100$ \$

$q = 150$ $\pi = 66{,}6$ \$

$q = 200$ $\pi = 50$ \$

Thus we can draw a table of values,

	$q = 200 - \pi$		$q = 10000/\pi$	
q	π	ε	π	ε
0	200	$-\infty$	∞	-1
50	150	-3	200	-1
100	100	-1	100	-1
150	50	$-1/3$	66,6	-1
200	0	0	50	-1

E3) Problem 3.2

a) producer NSPCo and consumer SALCo signed a deal of 16 $/MWh. The delivery is = 200 MW

> When the pool price is 16 $ everything is ok and the amount of 3200 $ ok both companies

> When the pool price is 18 $ the total amount is then 3600 $ but NSPCo pays 400 $ to other.

> When it is 13 $ it will be 2600 $ and this time NSPCo will get 600 $ from SAICo

b) if NSPCo can only produce 50 MWh then;

NSPCo can get → 50.18 = 800 $ from market

buth they have to pay 400 $ to SAICo

Because; SAICo needed 200 MWh and they paid 3800 $ = (18.200) for it

so the actual agreement was 16 $ and 3200 $ so they have rights to have 400 $ of

c) The consumer only need for 100 MWh but agreement is 200 MWh so;

NSPCo will produce 200 MWh for 13 $ and it will cost 2600 $ but;

they have rights to want extra $600 from consumer (SAICo) to sum it to 3200 $.

C4) Problem 3.5

SATIŞLAR

a) Industrial customer 50 x 19 = 950 $
Other customers 1150 x 21,75 = 25012,50 $
Future contract 200 x 21 = 4200 $
Put option 200 x 23,50 = 4700 $

34862,50 $

ALIŞLAR

Long term contract (Uzun dönem) 600 x 20 = 12000 $
Future contract 100 x 22 = 2200 $
Call option 150 x 20,5 = 3075 $
Generation 300 x 21,25 = 6375 $
Spot piyasa 450 x 21,50 = 9675 $

33975 $

Dengeleme = 34862,5 − 33975
= 887,5 $ kazanç

b) Eğer spot piyasa fiyatı 23,47 $ dursa, spot piyasadan alınan 450 MWh kârı dengelerdi. 20,5 $ alım ve 23,50 $ satım opsiyonu yine kârlı olur. Ama 24 $ olursa o zaman marjı aşılmış olur.

c5) Problem 43

The input-output curve of gas unit,

$$H(P) = 120 + 9,3P + 0,0025P^2 \ MJ/h$$

We can calculate the output of unit which works at different power levels.

Gaz türbinin denklemi ile 6 saatlik periyodda çalıştırma maliyetini bulabiliriz. Maliyet = 1,2 $/MJ

$$C_1(P_1) = 120.f + 9,3.f.P_1 + 0,0025.f.P_1^2 \ (\$/h)$$

$$C_1(P_1) = 144 + 11,16.P_1 + 0.003.P_1^2$$

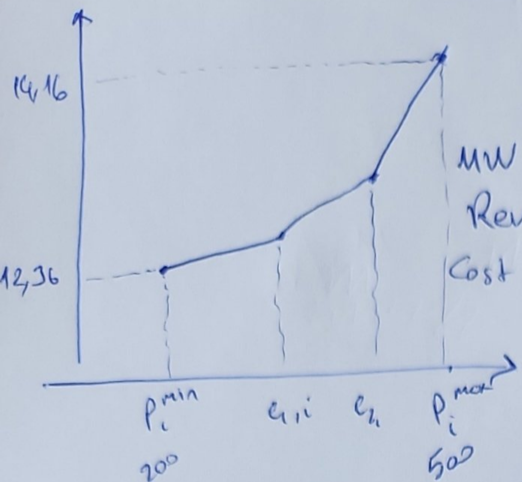
$$\frac{dC_1(P_1)}{d(P_1)} = 11,16 + 0,006P_1$$

$$\left.\frac{dC_i(P_i)}{dP_i}\right|_{500MW} = 11,16 + 0,006.500 = 14,16 \ \$/MWh$$

$$\left.\frac{dC_i(P_i)}{dP_i}\right|_{200MW} = 11,16 + 0,006.200 = 12,36 \ \$/MWh$$

Period	1	2	3	4	5	6
Price	12,5	10	13	13,5	15	11

devam →



	1	2	3	4	5	6
	12,5	10	13	13,5	15	11
MW	223,33	200	306,66	390	500	200
Rev.	2786	2496	3848,5	4953	6474	2496
Cost	2786	2436	3844,5	5265	7500	2200

So the cumulative profit is, will be 690.06 $

and if we turn to the question which asked it as quadratic function of 200, 300, 400, 500 MW

	1	2	3	4	5	6
Price	12.5	10	13	13,5	15	11
MW	200	200	300	400	500	200
Gelir	2500	2000	3900	5400	7500	2200
Maliyet	2496	2496	3762	5088	6474	2496
Startup	0	0	0	0	0	0
Toplam	4	-496	138	312	1026	-296
Kümülatif Toplam	4	-492	-354	-42	984	688 $

C6) Problem 4.4

Nobody want to lost his money so the producer dont want to start the unit untill price > min cost so plant start when the price is above 12,3 $/MW It's period 3 and shut down the unit end of period 4

	1	2	3	4	5	6
	12.5	10	13	13.5	15	11
MW	0	0	300	400	500	0
Gelir	0	0	3900	5400	7500	0
Startup	0	0	500	5088	6474	0
Gelir	0	0	-362	312	1026	0
Kümülatif Toplam	0	0	-362	-50	976	976 $

C7) Problem 4.6

Unit A: $15 + 1,4 P_A + 0,04 P_A^2$ \$/h

Unit B: $25 + 1,6 P_B + 0,05 P_B^2$ "

Unit C: $20 + 1,8 P_C + 0,02 P_C^2$ "

The problem can be solved wiht Lagrangian formula

$$\ell = C_A(P_A) + C_B(P_B) + C_C(P_C) + \lambda(L - P_A - P_B - P_C)$$

λ = cost (fiyat)

L = talep gücü = 350 MW

$$\frac{\partial \ell}{\partial P_A} \equiv 1,4 + 0,08 P_A - \lambda = 0$$

$$\frac{\partial \ell}{\partial P_B} \equiv 1,6 + 0,1 P_B - \lambda = 0$$

$$\frac{\partial \ell}{\partial P_C} \equiv 1,8 + 0,04 P_C - \lambda = 0$$

$1,4 + 0,08 P_A = 1,6 + 0,1 P_B$

$1,4 + 0,08 P_A = 1,8 + 0,04 P_C$

$$P_A = \frac{20 + 10 P_B}{8}$$

$$P_C = \frac{0,1 P_B - 0,4}{0,04}$$

$P_A = 85$ MW, $P_B = 74,2$ MW $P_C = 180,5$ MW

If we put the values into the function

Unit A = 511,70 \$/h

Unit B = 419,002 \$/h

Unit C = 996,505 \$/h

1927,211 \$/h saatlik maliyet

9

c8) Problem 4.8

The company has the opportunity to sell electricity to market price of 10,20 $/MWh

Production costs of the units was;

Unit A: $15 + 1,4 P_A + 0,04 P_A^2$ $/h

Unit B: $25 + 1,6 P_B + 0.05 P_B^2$ "

Unit C: $20 + 1,8 P_C + 0,02 P_C^2$ "

In order to do exact values of power according to 10,20 $/MW

$$\frac{d C_A(P_A)}{d CP_A} = 1,4 + 0,08 P_A$$ then ⇒ $(10,2-1,4)/0,08 = 110$

$$\frac{d C_B(P_B)}{d CP_B} = 1,6 + 0,1 P_B$$

$$\frac{d C_C(P_C)}{d CP_C} = 1,8 + 0,04 P_C$$

so, A = 110 MW

B = 86 MW

C = 210 MW

	unit A	Unit B	Unit C	
MW	95.3	74.2	180,5	
New MW	110	86	210	
Additional MW	~~44,2236~~ 14,7	~~50,842~~ 11,8	~~30,505~~ 29,5	56 MW the sum
New costs	653	532,4	1280	
old costs	511,70	419.	996,5	Zer
Fark	141,29	113,39	283,49	538,18
ilave gelir	149,94	120,36	300,9	571.2

Profit 33,02 $

10