## Extending the Problem



KENTSTATE

## A Golden Oldie

- Demand for the park:

$$
\begin{aligned}
& V_{C}=180,000-20,000 p_{c} \\
& V_{A}=120,000-10,000 p_{a}
\end{aligned}
$$

- Capacity $=200,000$

```
kENSTATE
```


## A Golden Oldie

- Demand for the park:

$$
\begin{aligned}
& V_{C}=180,000-20,000 p_{c} \\
& V_{A}=120,000-10,000 p_{a}
\end{aligned}
$$

- Capacity $=200,000$
- Adding Capacity $\$ 3$ a visit.
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## A Golden Oldie

- If demand is to be restricted to 200,000 what single fee would you recommend?


## A Golden Oldie

- If demand is to be restricted to 200,000 what single fee would you recommend?
- If children and adults can be charged a separate fee, what fees would you recommend?


## A Golden Oldie

- If demand is to be restricted to 200,000 what single fee would you recommend?
- If children and adults can be charged a separate fee, what fees would you recommend?
- Should the park expand capacity in that case?

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## Charging a Single Fee

- Demand for the park:

$$
\begin{aligned}
& V_{C}=180,000-20,000 p_{c} \\
& V_{A}=120,000-10,000 p_{a}
\end{aligned}
$$

- When $p=0$, demand is 300,000

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## Charging a Single Fee



## Charging a Single Fee

- Demand for the park:

$$
\begin{aligned}
& V_{C}=180,000-20,000 p_{c} \\
& V_{A}=120,000-10,000 p_{a}
\end{aligned}
$$

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## Charging a Single Fee



KENTSTATChildren

## Charging a Single Fee



KENTSTATChildren

## Charging a Single Fee



## Charging a Single Fee

To eliminate 100,000


KENTSTATChildren
Adults

## Charging a Single Fee



KENTSTATChildren

## Charging a Single Fee



## Charging a Single Fee

To eliminate 100,000
trips set $p=0$ But is there a $\Delta$ Trip $=-2$ ( better way of doing it, so as to $\Delta$ Trip minimize DWL? ${ }^{10 p_{a}}$


KENTSTATEhildren
Extending the Problem
Adults

## Charging a Single Fee




KENTSTATChildren
Adults

## Charging a Single Fee



KENTSTATChildren

Charging a Single Fee
Dead Weight Loss from Children is $(1 / 2)\left(20,000 p_{c}\right)\left(p_{c}\right)=$
$10,000 p_{c}{ }^{2}$


KENTSTATChildren
Extending the Problem
Adults

Charging a Single Fee
Dead Weight Loss from Adults is (1/2) $\left(10,000 p_{a}\right)\left(p_{a}\right)=$

$5,000 \mathrm{p}_{\mathrm{a}}{ }^{2}$


KENTSTATChildren

Charging a Single Fee

$$
D W L=10,000 p_{c}{ }^{2}+5,000 p_{a}{ }^{2}
$$



KENTSTATChildren Extending the Problem

Adults

Charging a Single Fee
$D W L=10,000 p_{c}{ }^{2+5,000 p_{a}{ }^{2}}$

$\Delta$ Trip $=-20000 p_{c}-10000 p_{a}$


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## Charging Separate Fees

- Many different adult and child's fees will cut demand


## Charging Separate Fees

- Many different adult and child's fees will cut demand
- But

$$
20,000 p_{c}+10,000 p_{\mathrm{a}}=100,000
$$

## Charging Separate Fees

- Deadweight loss is

$$
10,000 p_{c}{ }^{2}+5,000 p_{a}^{2}
$$

- The two prices are

$$
p_{a}=10-2 p_{c}
$$

- Deadweight loss is
$10,000 p_{c}{ }^{2}+5,000\left(10-2 p_{c}\right)^{2}$
KENTSTATE


## Charging Separate Fees

$10,000 p_{c}{ }^{2}+5,000(10-2 p)^{2}$ $10,000 p_{c}{ }^{2}+5,000\left(100-40 p_{c}+4 p_{c}{ }^{2}\right)$
$\qquad$


$$
\begin{gathered}
\text { Charging Separate Fees } \\
10,000 p_{c}{ }^{2}+5,000(10-2 p)^{2} \\
10,000 p_{c}{ }^{2}+5,000\left(100-40 p_{c}+4 p_{c}{ }^{2}\right) \\
10,000 p_{c}{ }^{2}+500,000- \\
200,000 p_{c}+20,000 p_{c}{ }^{2}
\end{gathered}
$$

Charging Separate Fees
$10,000 p_{c}{ }^{2}+5,000\left(10-2 p_{c}\right)^{2}$

| Charging Separate Fees |  |
| :---: | :---: |
| $\begin{gathered} 10,000 p_{c}{ }^{2}+5,000\left(10-2 p_{c}\right)^{2} \\ 10,000 p_{c}{ }^{2}+5,000\left(100-40 p_{c}+4 p_{c}{ }^{2}\right) \end{gathered}$ |  |
|  |  |
| $\begin{aligned} & 10,000 p_{c}{ }^{2}+500,000- \\ & 200,000 p_{c}+20,000 p_{c}{ }^{2} \end{aligned}$ |  |
| $\begin{gathered} D W L=500,000- \\ 200,000 p_{c}+30,000 p_{c}{ }^{2} \end{gathered}$ |  |
| KENTSTATE | Exeresting the Probem |

## Charging Separate Fees

$500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$

- In sum, we can achieve our objective with many different values of $p_{c}\left(\right.$ and $\left.p_{a}\right)$.


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## Charging Separate Fees

$500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$

- In sum, we can achieve our objective with many different values of $p_{c}\left(\right.$ and $\left.p_{a}\right)$.
- Lets find the one that minimizes DWL.
- To do that....


## Charging Separate Fees

$500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$

## KENTSTATE

## Charging Separate Fees

$500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$

- In sum, we can achieve our objective with many different values of $p_{c}\left(\right.$ and $\left.p_{a}\right)$.
- Lets find the one that minimizes DWL.


## KENTSTATE

## Charging Separate Fees

$$
500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}
$$

- In sum, we can achieve our objective with many different values of $p_{c}$ (and $p_{a}$ ).
- Lets find the one that minimizes DWL.
- To do that....
- Take the derivative
- Set it equal to zero

| Charging Separate Fees |
| :---: |
| $500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$ |
| • Differentiating |
| $-200,000+60,000 p_{c}$ |
|  |
|  |
| KENSTATE |
|  |

## Charging Separate Fees

$$
500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}
$$

- Differentiating

$$
\begin{aligned}
& -200,000+60,000 p_{c} \\
& p_{c}=\$ 3.33
\end{aligned}
$$

KENTSTATE

## Charging Separate Fees

$500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$

- Differentiating

$$
\begin{aligned}
& -200 \quad p_{\mathrm{a}}=10-2 p_{c} \\
& p_{c}=\$ 3.33
\end{aligned}
$$

## Charging Separate Fees

$500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$

- Differentiatino

$$
\begin{aligned}
& \quad p_{a}=10-2 p_{c} \\
& p_{a}=\$ 3.33 \\
& p_{c}=\$ 3.33
\end{aligned}
$$

KENTSTAT:

## The Dead Weight Loss

$D W L=500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$

## The Dead Weight Loss

$D W L=500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$ DWL = 500,000200,000(\$3.33)+30,000(\$3.33) ${ }^{2}$

## The Dead Weight Loss

$D W L=500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$ DWL $=500,000-$ 200,000(\$3.33)+30,000(\$3.33) ${ }^{2}$ DWL $=\$ 55,556$

## The Dead Weight Loss

$D W L=500,000-200,000 p_{c}+30,000 p_{c}{ }^{2}$ DWL $=500.000-$ 200,00 Cost 33)² $\frac{\operatorname{Cost}}{D W L}=$ ?

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Extending the Problem

End

