1 Parks and TV watching: one congestible, one not

Edward Morey, Dec 11, 2018

Our national parks, local parks (e.g. Boulder Mt. Park, Central Park in NYC), and everything in between, are often congested.

Is the amount of that congestion efficient, and, if not, should access be limited?

A congestion inefficiency typically results when access to a congestible resource is not limited; that is, when it is common property. The inefficiency results because when an individual decides to visit the park they do so to make themselves better off, but their presence in the park influences others, often negatively, and the individual does not take this into account because of the common-property nature of the park.[1]

Why does your presence affect others? One often visits a park to get back to nature and to get away from people - when you are in the park, you are one of the people everyone else wanted to get away from. You make parking more difficult and congest the trails and scenic wonders.

Alternatively, your presence might have a positive effect on others and their presence a postive effect on you. If someone gets hurt on the trail you might come along and help them. Maybe you like crowds, even in parks. Think a rock concert or a Shakespeare play in Central Park - the more the merrier. Or teenagers might want to go to a beach that is crowed with other teenagers—cool teenagers.

The utility you get from the visit is often greater if you are there with your friends or family; but the presence of other peoples' friends makes you worse off?

For simplicity, I am going to limit the remaining discussion to negative congestion effects.

We need to distinguish between congestion (a negative external effect) and an inefficient amount of congestion (too much or too little congestion).

[1] Some parks will not be too congested even if access is uncontrolled, for example, ugly parks in the middle of nowhere. A park on the North Slope of Alaska would likely not be too congested, at least for the present, because it is so expensive to get there. That said, more and more people are visiting places like Antartica.

While this note is only about congestion, when considering natural area the resource manager also needs to consider that visitors also cause long-term negative external effects: use causes degradation which decreases the value of the experience for those who will visit in the future, and decreases non-use values (the park is not as pristine).[2]

[2] So, there are actually two negative external effects: congestion in the present, and long-term injuries. We are ignoring here the second external effect.

2 A stylized Park

Assume there are two free-time activities in life: visiting the park and watching TV (Pro wrestling)

Assume watching TV is non-congestible (everyone can watch at the same time without negatively affecting the other watchers) and everyone get \$10 of benefits a day from sitting in front of the tube; assume this does not vary with how many days one watches TV, or who else watches. (Note that I have assumed away congestion effects in TV watching, and assumed every values TV watcing equally)

However, the benefits one gets from a day in the park depends on the number of other people in the park, the more people the less one enjoys a day in the park.

Assume average benefits from a day in the park is $ab_p(v)$ where v is the number of daily visitors, and $\frac{dab_p(v)}{dv} < 0$, average benefits decline the more people in the park.

Average benefits, $ab_p(v)$, is what an individual considers when they are deciding whether to visit the park or watch TV. If $ab_p(v) > 10$, they visit the park, if $ab_p(v) < 10$ they stay home and watch TV, and, if they are equal, they are indifferent between the TV and park.[3]

[3] Make sure you understand why the individual compares average benefits rather than marginal benefits.

Therefore, in common-property equilibrium, there will be v_{cp} people in the park, where

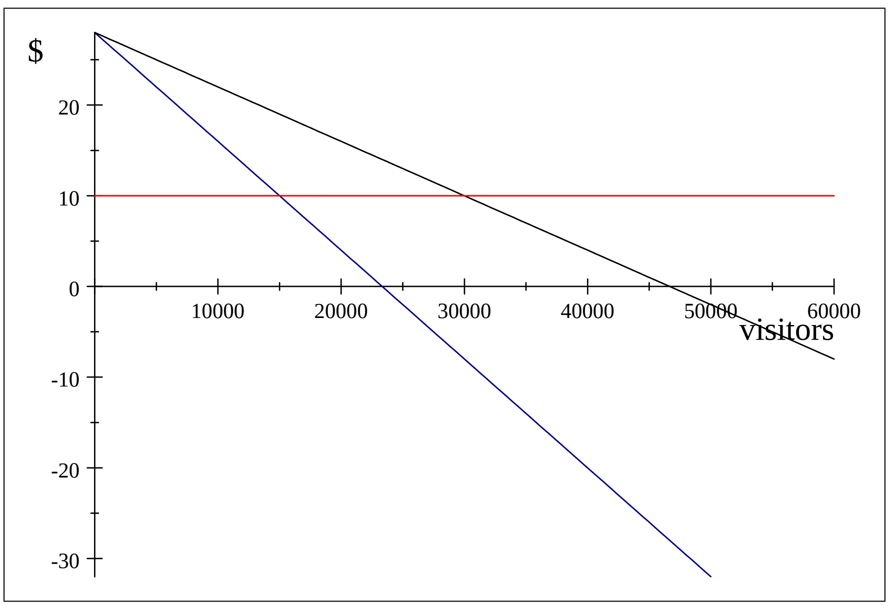
$$ab_p(v_{cp}) = 10$$

So, if the world consists of 100,000 people (the approximate population of Boulder) and if for Boulder Mt. Parks $ab_p(v) = 28 - .0006v$, what is the cp equlibrium?[4]

To get the CP equilibrium, solve $28 - .0006v = 10$, Solution is: 30000: thirty-thousand in the park (70,000 watching Pro wrestlilng). Is this the efficient allocation of people between the two activities? Or can total benefits to Boulder be significantly increased by limiting access to the park?

If $ab_p(v) = 28 - .0006v$, then total benefits from the park are $tb_p(v) = 28v - .0006v^2$ (I just multiplied average benefits by the number of visitors),

Marginal benefits from the park are $mb_p(v) = 28 - .0012v$. Graphing $mb_p(v)$ and $ab_p(v)$ along with $ab_{tv} = mp_{tv} = 10$



Red is TV ab=mb, Blue is mb park

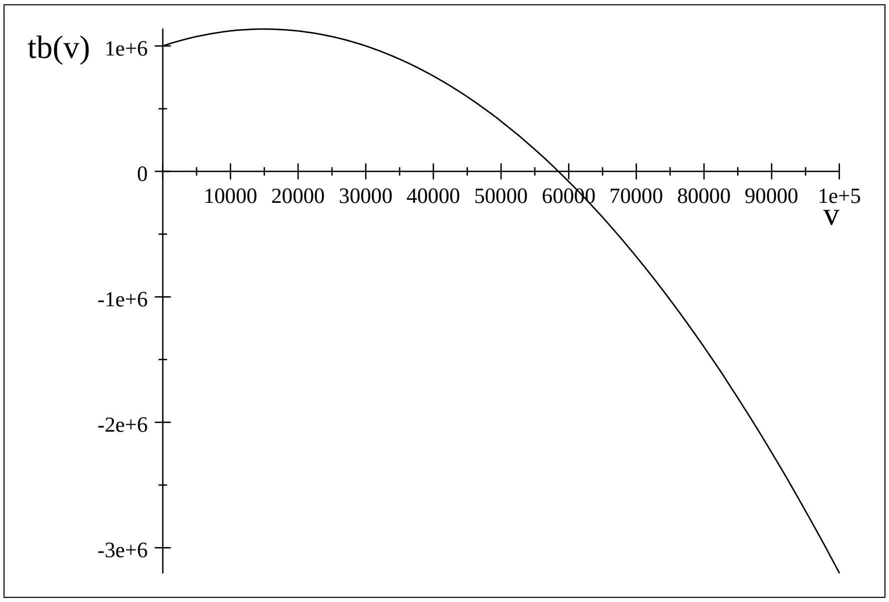
At 30,000 visitors $ab_p(v) = 10$ but at 30,000 visitors $mb_p(v) = 28 - .0012(30000) = -8.0$; at the common-property equilibrium the last vistor to

[4] Assume these estimates of \$10 for TV watching and \$$(28 - .0006v)$ for average park benefits were generated by an economist doing non-market valuation.

the park lost \$10 in TV benefits by swithing to the park and caused total benefits in the park, including his, to decline by \$8, not a wise move from the community's perspective.

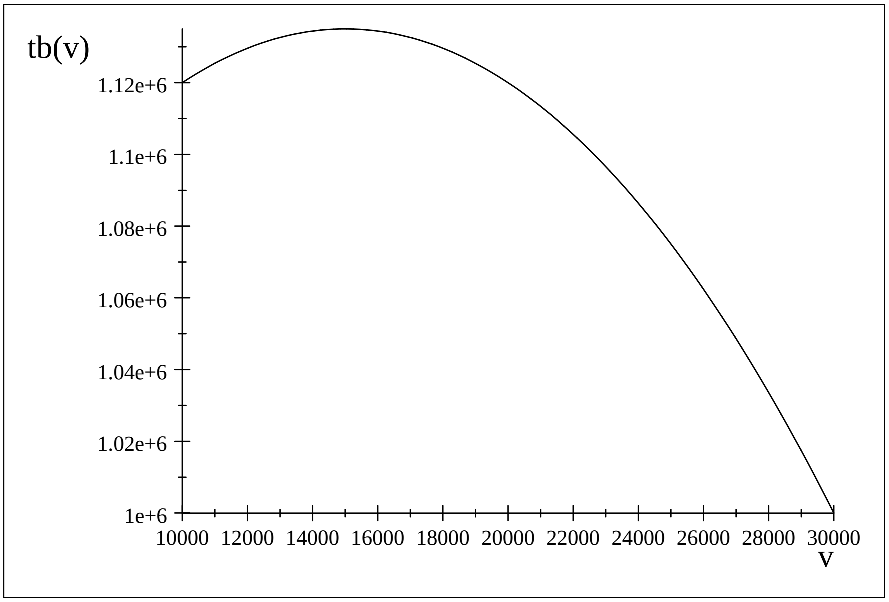
The efficient number of people in the park is achieved when $mb_p(v) = 10$, solving $v_{eff} = 15,000$. The CP nature of the park causes too many people to use the park, 15,000 to many (in this case, twice as many)[5]

That total benefits to the community are maximized at 15,000 visitors ($85K$ watching TV) is confirmed by examining total social benefits from the allocation. It is $tb(v) = 28v - .0006v^2 + 10(100000 - v) = 18v - 0.000\,6v^2 + 1000\,000$



Or, on a smaller scale near the max,

[5] I keep coming up with examples where the efficient amount is half the CP amount. This typically will not be the case.



Visually, we see the max is $15,000$.

One can find the same answer using calculus. $tb(v)$ is maximized wrt v at that v where $msb(v) = \frac{dtsb(v)}{dv} = 18 - .0012v$ is equal to zero. Setting $18 - .0012v = 0$, Solution is: 15000.0

What are total benefits to the residents with the CP allocation and with the efficient allocation?

To determine total benefits of $30,000$ visitors, plug 30000 into $tsb(v) = 18v - 0.000\,6v^2 + 1000\,000$. $tsb(30000) = 18(30000) - 0.000\,6(30000)^2 + 1000000 = \$1.0 \times 10^6$, a million bucks.

To determine total benefits if $15,000$ use the park, plug in $15,000$: $tsb(15000) = 18(15000) - 0.000\,6(15000)^2 + 1000000 : \ \$1.\,135 \times 10^6$

one hundred and thirty-five thousand dollars **more** benefits, per day, if we allocate use efficiently.

Figure out a **regulatory** scheme that would achieve the efficient allocation of residents between TV and the park, and that would be a Pareto Improvement over the CP allocation.

One idea: Randomly (or non-randomly) give $15,000$ residents of Boulder park passes, and ban everyone else. Why would this be a Pareto Improvement? The $100000 - 15000 = 85000$ people who are destined to always watch wrestling are no worse off because they are banned from the park, and the 15000 residents who get the passes are made better off.[6]

How would you enforce this???

[6] For equity reasons one might want to randomly reallocate the passes every week or year. Further note that this random allocation generating efficiency is criticall dependent on eveyone having the same TV/Park preferences.

This point could be the basis of a question. How would this plan be effected if one could buy or sell passes. Answer: overall efficiency would increase if you could buy and sell passes.

Now come up with a scheme that achieves efficiency and makes **everyone** better off.

Could we do it with an entry fee for the park? Yes, if it is feasible to collect the fee.

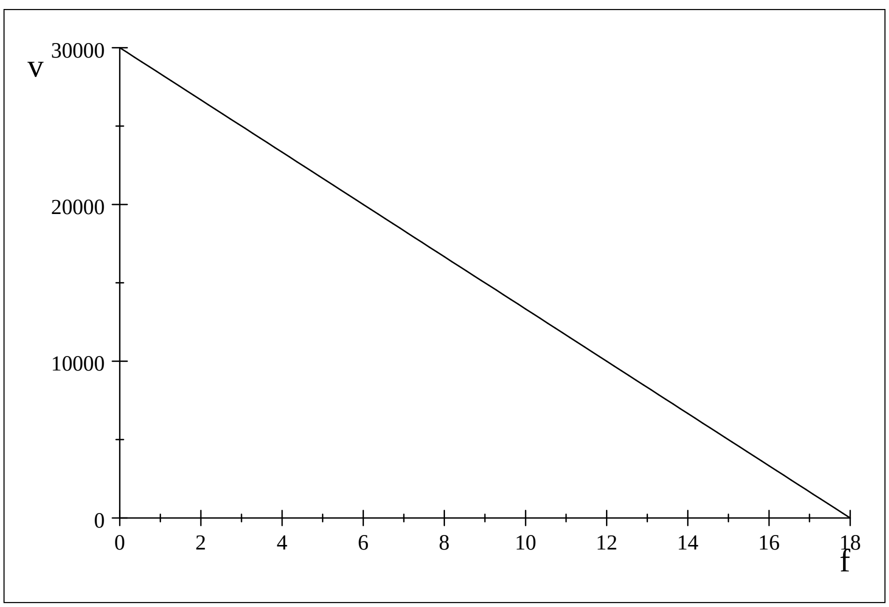
What fee would achieve efficiency: get only 15000 residents choosing to go to the park. Residents will choose to pay the fee and visit the park if average benefits from the park minus the fee is great than the benefits of staying home and watching wrestling. That is if

$$28 - .0006v - f > 10$$

they will choose the park, with the fee. If $28 - .0006v - f < 10$, they will stay home.

So in equilibrium $28 - .0006v - f = 10$, solution is: $v(f) = 30000.0 - 1666.7f$ - this is the **demand function** for the visits to the park as a function of the fee.[7]

In explanation, demand is $30,000$, the CP equilibrium, with no fee and drops by 1666.7 people every time the fee is increased by a dollar.



Demand for visits to the park as a function of the fee

[7] Make sure you know how to derive demand as a function of a fee (toll) from the equilibrium condition.

In equilibrium, we want demand to be 15000, so $15000 = 30000.0 - 1666.7f$, Solution is: 8.9998; a fee of \$9; that is, if \$9 is charged, exactly 15000 residents will visit the park.

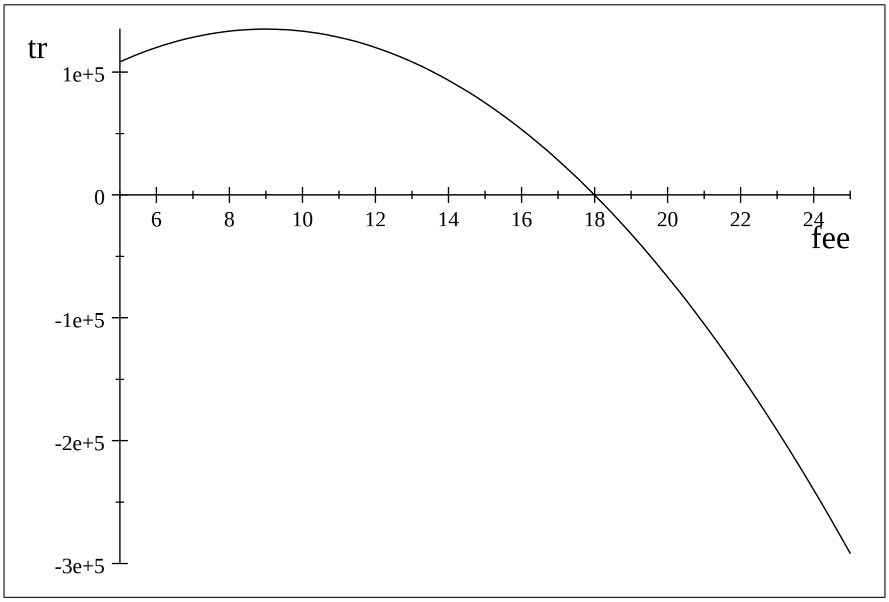
How would we enforce the fee?
Is everyone made better off?

It depends on what is done with the fee revenues. If the fee revenues are not used (the money is burned), no one is better nor worse off than they were in the cp equilibirum: before the fee everyone's benefits were \$10, independent of whether they watched TV or went to the park. After the fee, the $85,000$ residents who watch TV still get benefits of \$10, Those 15000 who visit the park get average benefits of $28 - .0006(15000) = 19.0$, which is more than \$10, but after they pay the \$9 fee it drops to \$10.

So, if the revenues are squandered ,no one is better off, and no one is worse off. However, if the fee revenues ($15000(9) = 1.35 \times 10^5$) are used to send every resident a check, we each would get \$1.35 a day, which is $1.35(365) = \$492.75$ a year, so everyone's benefits increase by \$493/year because we solved the CP problem in the park.

What if the city sold Boulder Mt. Parks to the Disney Corporation? They would just want to maximize fee revenues.[8] Fee revenues are

$$tr(f) = v(f)f = (30000.0 - 1666.7f)f$$



Disney wants to choose the fee to maximize this. Take the derivative

$$\begin{aligned} \frac{dtr(f)}{df} &= \frac{d((30000.0 - 1666.7f)f)}{df} \\ &= 30000.0 - 3333.4f \end{aligned}$$

This is how much revenues increase (or decrease) when the fee is marginally increased. So, we are looking for the point where $30000.0 - 3333.4f = 0$, Solution is: \$8.9998 How many people will visit the park if this is the fee $30000.0 - 1666.7(8.9998) = 15000.0$.

So, efficiency is achieved in the allocation of between park visits and TV watching.

What is different about these different ways of achieving the efficient allocation of everyone's free-time? The yearly benefits of limiting access go to the Disney corporation in terms of increased profits. However, the City gets the proceeds from selling the park. In theory, if the city gets the correct price for the park, and the city invests the money, the interest earned should be just be enough to send each resident \$493 a year.

[8] I am assuming, for simplicity, that maintenance costs are fixed. In which case maximing revenues maximizes profits. This assumption is untrue in many cases.

Would it be possible to have a fee to visit Boulder Mt. Parks? Yellowstone? Yellowstone currently has an entry fee, but is it set at the efficient amount? Probably way too low. Does Boulder Mt. Parks have a fee?

Is it technically feasible to restrict access with a fee? And, if so, how?

The answer depends on the physical configuration of the park. One reason that congestion pricing is more difficult for parks than roads is that it there is often a porous border and that people would object to chips that tracked when and if they crossed a park boundary.

GPS and cars. GPS and people

Central London and an access fee.

Of one chould have random checks and one would pay a big fine if one did not buy a ticket.