

May 6 R77 Sem, Ripening

5-6-70, R77.

- 1 -

RIMS

2d session on this. First I reinvent the wheel, then spin it.

Almost 2 separate papers. Each can be considered alone.

Topic 2 - Capl. theory; problems of capl. costs.

Plan: Skip the lesser aspects & more formal, ^{theoretical} aspects. Conc. on most interesting & general interest problem, that of Ripening.

And preview some advance work in applying to tax policy.

1. Review. Last time, when to replace CIA by mass system.

DMB > DMC.

2. Staggering of CIAs, pp. 30-31.

If perfectly staggered, $\frac{1}{L}$ must be replaced yrlly.

Add to CIA costs. Not all capl. costs really are sunk. ~~the~~ $\sum C_0 \cdot \frac{1}{L}$ is yrlly cost. Add to SVC

3. Decay pp. 32 - ~~38~~³⁷. [Purpose of section is precautionary - to show micro is ok]

Since plants decay, deprecn. is larger in year zero than in case of Const. Service Flow (CSF.) So FC is max. in year zero, (offsetting lower VC).

This ^{avoids advancing} ~~delays~~ opt. R-date, bcs. rev. of yr. 0 must cover all costs of yr. 0.

p. 36 $d = SF - i \cdot PV$

$d + i \cdot PV = FC$

So higher SF , means higher d .

As to FC ,

$FC = SF$

(SF refers to input, regardless of output)

If S_T is input regardless of output, why does it rise with demand?

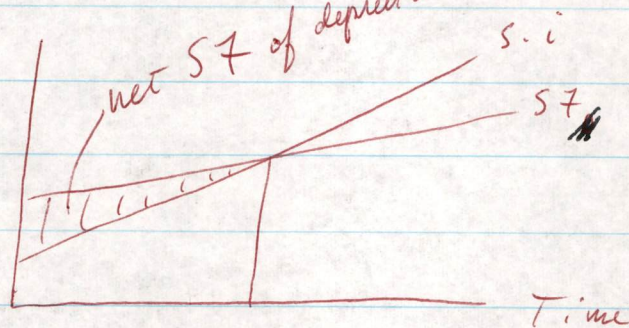
$$S_T = V_A \cdot i_A$$

The general upshot of looking at decay is that the TC allocated to yr. 0 are same as tho there were no decay, i.e. VC were const. over L.

Bes. lower VC, are offset by higher π .

4. Growing demand. Changes analysis. Also bears on new range of problems — ripening suburban land.

~~4.4A) L.O. (Beware using this approach!)~~



Unlike decay, LO is indep. of when you build. So is not a cost of yr. 0, argues for bldg. earlier.

Has unusual traits. Calls for separate treatment.

(LO ~~not~~ a cost of capt. in yr. 0; but maybe a cost of inputable to site? Dubious)

(LMC includes site cost? It includes o.c. of site in non-franchise use, at first. But then mass system yields surplus, a rent to site above other costs, which we seek to max. I do not call a cost, i.e., when cpg. MS vs. CIA, relative land costs are relevant. When cpg. G_1 vs G_2 , land costs are same, so just max. S.)

$$\frac{PV(R-c)}{1 - (1+i)^{-L}}$$

4.

B). Rise of attainable unit costs

Can hit LAC turn SAC only once. Plant is wrong size rest of the time. "Fits too soon."

Another discreteness. Due to ecs. of longevity.

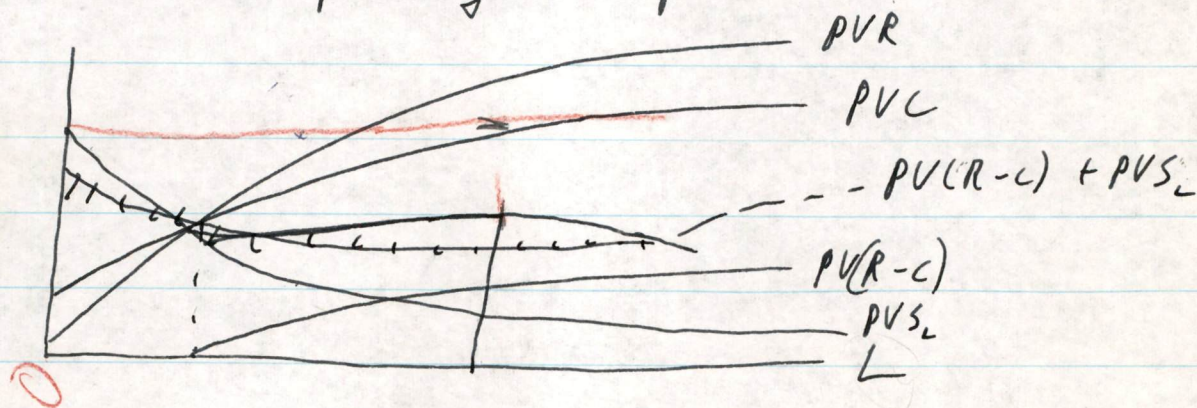
To ~~re~~ reduce this ~~cost~~ diseconomy, shorten L so SAC fits demand. Tradeoff: shorten L improves fit, but raises SAC curve.

In order to raise SAC much, get to $L \approx 20$ p. 40. Ecs. of longevity are ~~un~~ largely exhausted then. Implies rapid replacement of sewers desirable.

I did not explicitly say how to det. L, using

~~C) Pipelines~~

LO. There is a simple way to expound.



This model also applicable to bldgs, etc.

c) Ripening

Each yr., opt P_n is larger, yields higher rent & PV.

P_1 , first plant whose 1st yr. yields + PV.

But may be better to wait for P_2 ,

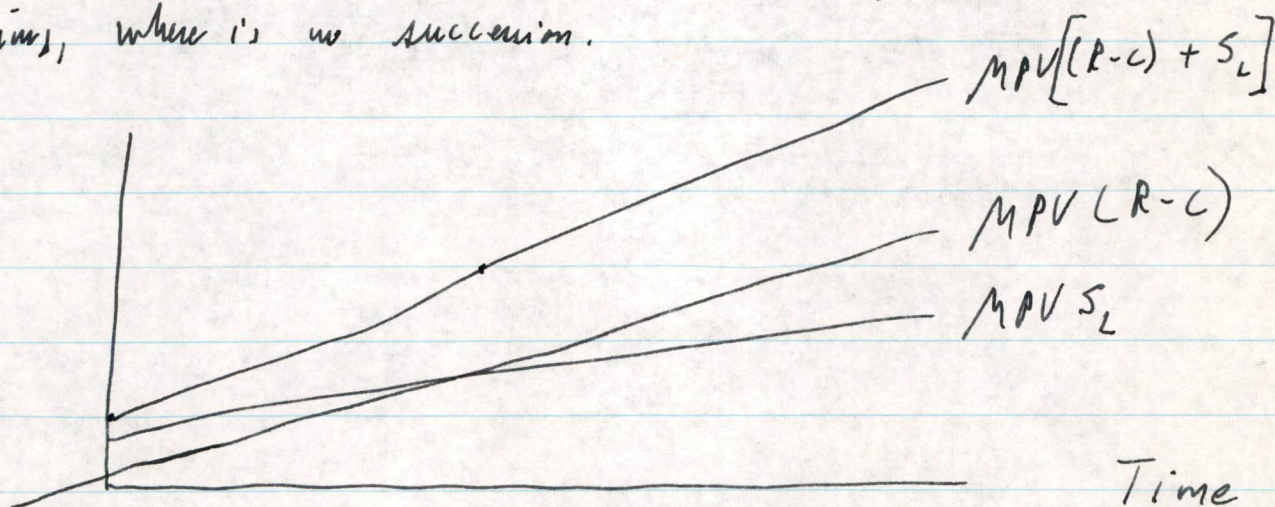
if $P_2 > P_1(1+i)$. Same as max. PV.

Ely.

~~Can't~~ Not ex. to bld. P_2 same yr. as P_1 . If build must wait. So what are gains & costs of waiting? p. 48 ff. (opt.)

Cost most likely to be overlooked is cost of deferring succession.

This is what distinguishes this from mineral ripening, where is no succession.



Important: why is $MPV S_L$ flattish? See p. 4a.

Why is $MPV S_L$ flattish?

1. Each succeeding higher P_n has longer L , so $PV S_L$ is heavier discounted.
2. Ecs. of scale get largely exhausted after a while.
3. Density peaks after a while, so demand growth slows.
4. Congestion raises costs of renewal

How big is PVS_L relative to PVS_i ? p. 55

1. Equal successions

$$S_0 = \frac{G}{1 - (1+i)^{-L}}$$

$$\frac{S_0 - G_i}{S_0} = 1 - \frac{G}{S} = 1 - 1 + (1+i)^{-L} = (1+i)^{-L}$$

$$(1+i)^{-L} \approx \frac{1}{4}$$

2. p. 56 Superior successions,

$$1 - \frac{G}{S} = (1+i)^{-L} (1+g)$$

5. Effect of taxes

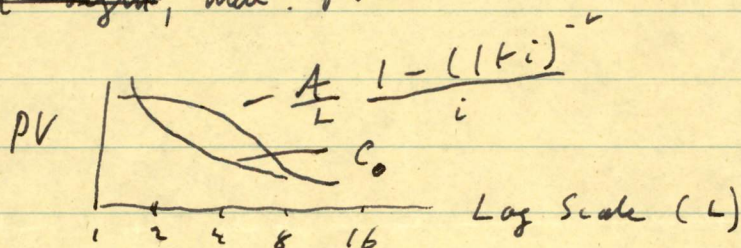
A. On Life.

Walsh Sem., Colo. S.U.

Ripening

I. Mines

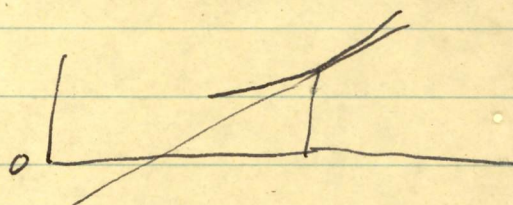
A. ~~When begin~~, max. PV



Show how to derive PV formula
Approaches $\frac{1}{i}$ asymptotically.

B. When begin?

MPV keeps rising



II. Urban land (assume no prior use; or let ~~0~~ be equator be farm use value)

Same anal. ok for any mgnt. land, e.g. when start farming, or irrigat'g. Mining is a special case

If land use involves no durable ~~in~~ capl., ~~is~~ is ripe as soon as yrlly rent is positive. [This may be will be later than when $MPV \geq 0$, bcs. fee develops a value as soon as future inc. antic. So land has a value normally long before it is usable.]

If land use involves durable capl., get an in-between situation where you want to defer bldg. somewhat -- wait a few years in order to get higher PV.

If G_1 were the only one ever, analysis wd. resemble mine -- site treated as tho exhaustible, Irreversible resembles inexhaustible.

But G_1 followed by $G_2 \dots$. Site not exhaustible. Deferring G_1 defers later gens. too.

This ~~lowers the AMV from waiting~~, and Δ s the base which must grow $> i$.

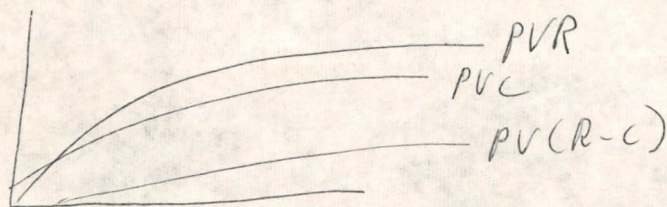
So if $P_{G_1} > P_1(1+i)$, it is likely that $P_2(G_1 \dots G_n) < P_1(G_1 \dots G_n)(1+i)$

III. Effect of taxes

Mine case, defer ripening.

Same in genl. case.

Begin by det'g L of G_1 .



Unlike mine, PVR rises w. Life.
 Getting Rev. in later years is not at expense
 of earlier years, in general (It cd. be
 in some cases, e.g. if character of demand
 is changing & you built for later
 years.)

Getting rev. in later yrs. is at
 expense of rev. from G_2 . Max $PV(R-C)$
 is not normalized for diff. lives. Longer
 L always better. In fact by def. to

2-6

consider only G_1 is not to consider L at all, bcs. L leads to G_2

Want to max. net return per yr,
then move to next, G_2 , to
maintain a Δ level of net return.

Viewed ingrd., this means replac-
ing when ingrd. or current net yield of G_1
falls below its own mean, which is mean
of G_2 . (or, if $G_2 > G_1$, below mean of
 G_2)

Viewed overall, this means max PVP -
which must entail winning all ingrd.
tradeoffs.

To max, $PV(R-L) \times i + P_1$. Denom. As w. L , max comes earlier.

This is same as, (or a sneaky way of) max'g PVP .

When begin?

As long as $MPVP$ grows faster than i .

$MPVG_1$ will grow so long as demand is growing. There must be some limit placed $\therefore$ on ripening rationalists - costs of waiting to balance gains.

(Some might say, why not build P_2 earlier, thus use site in early yrs. & also have P_2 later. Answer of course is you lose in early yrs., don't cover int. & ~~principles~~ deprecn.)

(But note temptation when combined w. incentives. One wants to capture territory. Or establish early right to intensive use, e.g. apts. or commerce in developing areas. Where have dec'g. costs, temptation greatest to sink premature capt. in big chunks, instead of tokens to preempt.)

Dividing by $[1 - (1+i)^{-L}]$ reduces advantage of P_2 over P_1 because:

- P_2 has a longer L
- Denom. < 1 , so $PVP > PV$.

If all G_n of P_2 grew same as G_1 , no diff. But more likely the gain ends with G_1 .

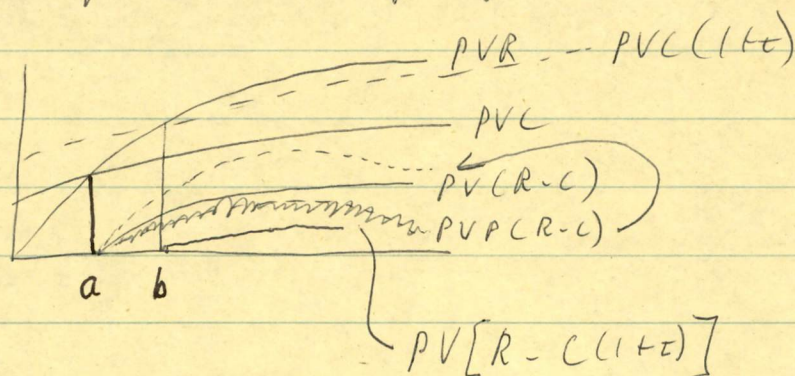
The ^{share} ~~contribution~~ of G_1 ⁱⁿ to PVP is:

$$\Delta V_1 = \frac{P_0}{\Delta V_1} \frac{G_1}{\frac{G_1}{1-(1+r)^{-N}}} = 1 - (1+r)^{-N}$$

If only the G_1 share grows, & the rest of the base remains const., % growth rate falls.

By requiring ΔPV to earn a return on $G_{>1}$, we are taking full acct. of deferral of $G_{>1}$.

III. Effect of taxes on ripening.



A. Effect of tax on opt. life.

($C(1+t)$ is not a good statement of bldg. tax, wrt to longevity. Bcs. the longer the bldg., the more deferred the tax. Return to this.)

Bldg. tax may lengthen opt. L. It obviously shifts break-even pt. from a to b . ~~And it obviously shifts max~~ It slows down ^{abs.} growth of net PV. If net PV reached a max. it wd. shift it to left, & shorten L. But net PV keeps growing anyway. What brings a max. is growth of denom.

Now the abs. growth of $PV[R - C(1+t)]$ is slower than abs. growth of $PV[R - C]$. But % growth is higher, since base is much lower. So it peaks later. Esp. if PVC becomes horiz., as it does, so slopes of ~~the~~ $PVC(1+t)$ is same as λ of PVC.

✓ Then, bldg. tax tends to longevity!

One must add other adjustments. PVC & PVR are much lower. Do this later.

III, B. Effect of ^{bldg.} tax on when to build.

$PV(R-C)$ is cut by tax αC . % growth is Δd .
Bldg. date is deferred.

But note that bldg. tax & c. instns. that extend L
~~also~~ by so doing reduce yrlly. deprecn. & allow earlier bldg.
Thus stretching out longevity at both ends.

Expect excitement like moon travellers who cd. lose power. I use talks to try new approaches.

Ripening: when to build what. Timing of land improvement.

- Why "land"? Bes. implies mutually exclusive choices. There's a highest use; also a highest & best time.

Also a burning issue. Pref. asmt., re pub. land. When extend utilities, a public decision. When build dams. Best here we're only concerned w. perfecting theory of subject.

- Why a problem? Why a choice to make? Bes. durable capl. is committed, freezing capacity & specifying over many years while demand changes. And you can't build bigger plant prematurely.

a. If no durable capl., no problem. Use land as soon as bears rent.

Not same as having value -- has value before bears rent.

b. Other extreme, mine.

One time is totally exclusive.

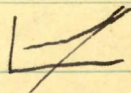
Work out, as intro. to cap. theory, warm up.

$$i. \quad PVR = \frac{A}{L} \cdot \frac{1 - (1+i)^{-L}}{i}$$

$$PVC = C_0$$

$$\max PV(R-C)$$

ii. MPV



Is ec. to hold resource idle, tho supra-marg.

c & d. The in-between cases. I'll treat them together, to save time. More complex.

e. Offstreet lot. Eby case.

d. Intersite capt., distrib. network.

Diff. of c & d is desig. costs for d. So case for deferral is stronger for d.

Some apply simple analogy of mine. "Vacancy" is flexibility, an exhaustible resource. Irreversible same as exhaustible.

These differ from mine case in that there are future generations involved. Deferring G_1 implies deferring $G_2 - \infty$ (henceforth $G_2 \dots$). This adds to cost of waiting, w/o nearly adding to gains.

(G_2 is deferred ^{both} ~~not only~~ by deferring G_1 & adding to life of G_1) So if (over)

~~So if $MPV(P_1, G_1) < MPV(P_2, G_1)(1+i)^{-1}$, that's not enough to warrant waiting.~~
 ~~$MPV(P_1, G_1) < MPV(P_2, G_1)(1+i)^{-1}$~~ is very.

As to flexibility, it is regained w. each renewal.
 (Except as some subdim. is irreversible.)

So mine analogy only partially applies. This will be my main theme.

Some apply simple reasoning of no durable capt.

They wd. use land as soon as rent bearing. They overlook durability of capt.

Or, one is tempted to ask, why not build P_2 now? Bes. if you are going to build bigger plant, is better to build it later. Bes. first years must cover int. plus deprecn. If they don't, are doing poorer than you might.

So in every passing yr., best plant to build gets larger. Issue resolves self into gains & costs of waiting.

If ~~A~~ $P_2(MPVG_i) > P_1(MPVG_i)(1+i)$, site might still be
ripe, but maybe

$$P_2(MPVS) < P_1(MPVS)(1+i)$$

To be green, MPVS must rise faster than i .

Weakness of case for considering only G_1 .

Mine analogy case is, only G_1 counts. Future uses so deferred, of no account.

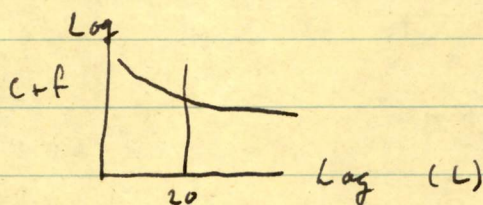
On demand side, grow's, shifting demand is a postulate. So this argues for frequent replacement to match bldg. to grow's demand. If there were no ec. of longevity, wd. replace yly.

On cost side, what is cost argument for not replacing? It is need to amortize C_0 over many yrs. Ec. of longevity.

So how much is FC lowered by Δg L ? Table on p. 40.

At 890:	<u>L</u>	<u>$C + f$</u>
	20	10.290
	25	9.490
	30	8.990
	40	8.490

As an elasticity, graph on double log scale.



Flatten out. Showing after $L > 20$, minor declines in FC possible from any ΔL . I.e., spreading C_0 over time is of limited benefit.

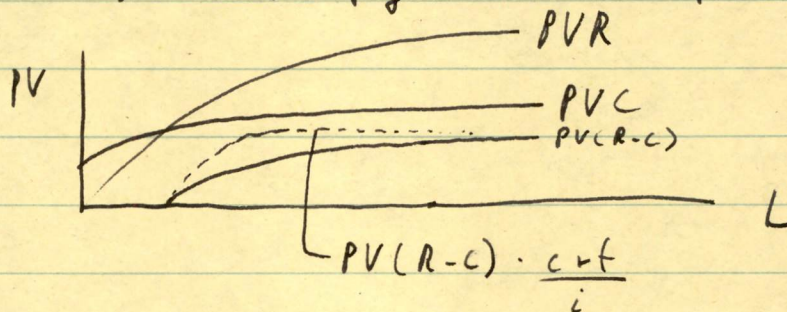
This suggests weakness of case for long life; need to consider G_2 There is no point in deferring higher rents of G_2 unless this materially lowers rents of G_1 . So opt. is to advance G_2 until it does so, or begins to. This implies quite short life.

Is imp't. to consider G_2 ... but a showdown based only on $P_1 G_1$ vs $P_2 G_1$ is badly biased for P_2 , a later plant of larger capacity.

- W. growing demand, P_2 geared to growth, looks better
- Assume equal lives. Forces P_1 into Procrustean post retirement career beyond capacity, compares badly w. larger P_2
 - Let P_2 last longer. Worse, but PV & L.

Better is to find PV by cap's. yrlly. rent from P_1 & P_2
 Normalized to adjust for diff. L. A sort of
 yrlly. mean of net benefits, adjusted for time.

$PV(R-C) \cdot crf. = \text{yrlly. rent. Then capze.}$



But this is a sneaky way of introducing G_2 ...
 "Cap's." assumes perpet. annuity, i.e. infinite repetition of G_1
 from L det. by max's. rent.
 Note it limits L of G_1 , which otherwise
 has no limit.

Note it max's. PVP, same as $\sum$ of $G_1 (1+(1+i)^{-t} \dots)$

$$= G_1 \frac{1}{1-r} = \frac{G_1}{1-(1+i)^{-L}}$$

Note it involves same logic as p. S-3, a means of spreading C_0 over time. Converts everything to a level annuity.

Note, excess of cash line over $PV(R-C)$ is value of $G_2 \dots$

$$\frac{G}{1-(1+i)^{-L}} - G = \frac{G(1+i)^{-L}}{1-(1+i)^{-L}} \left[= \frac{G}{(1+i)^L - 1} \right]$$

or discounted PVS beginning w. G_2 . It is the decline of this value that limits L of G_1 .

The share of $G_2 \dots$ in PVS is

$$\frac{\frac{G(1+i)^{-L}}{1-(1+i)^{-L}}}{\frac{G}{1-(1+i)^{-L}}} = (1+i)^{-L} \approx \frac{1}{4}$$

But that share based on identical successors. Superior successors is present postulate.

$$PVS = G_1 \left[1 + \frac{(1+g)(1+i)^{-L}}{1-(1+i)^{-L}(1+g)} + \frac{(1+g)^2(1+i)^{-2L}}{1-(1+i)^{-L}(1+g)} + \dots + \infty \right] = \frac{G_1}{1-(1+i)^{-L}(1+g)}$$

Share of $G_2 \dots$ in PVS is now:

$$\frac{\frac{G_1(1+g)(1+i)^{-L}}{1-(1+i)^{-L}(1+g)}}{\frac{G_1}{1-(1+i)^{-L}(1+g)}} = (1+i)^{-L}(1+g)$$

If $g = 100\%$, $1+g = 2$, and share of $G_2 \dots = \frac{1}{2}$

(over)

Now, revert to MPV idea. But use MPVS, not of G_i alone.

This brings ripeness sooner. Lowers % growth rate. Res.

PV of $P_2(G_2 \dots)$ is a deadweight. If ~~$P_2(G_2) > P_1(G_1)$~~ ~~$P_2(G_2) > P_1(G_1)$~~ ~~$P_2(G_2) > P_1(G_1)$~~

$$P_2(MPVG_2) > P_1(MPVG_1)(1+i)$$

$MPV(P_2 G_2) > P_1 G_1 (1+i)$, might seem green. But cd. be that

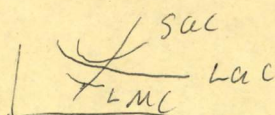
$$P_2(MPVS) < P_1(MPVS)(1+i) \text{ at same time.}$$

Concln. Site is green while PVS grows faster than i.

But ~~this is materially~~ MPVS grows materially slower than $MPVG_1$. So beware overstatement of ripening doctrine, which is common.

Future use of model. Effect of taxes. They defer ripening. Another lecture.

Seattle



1. Problem defining LMC , where Δ capt. required ∂LAC & rent.
How much capt. alloc. to Δ each yr.
Must a. Set life C mgul. equality at R-deter is implicit in using.)
b. Set how to spread over L.
2. Purpose of ~~paper~~ - talk.
Show correct solution
~~Show~~ ^{Scout} several potential errors
3. Min cost? No, max -- but what?
Max. p.v. inadequate
4. Is max. p.v. same as fee grow's $> i$? No, but.
if we now, value of fee may grow anyway. Growth of demand does not depend on non-use. Relevance of growing demand is, it helps later, larger bldg. more than earlier, smaller one.

