EV and Insurance Premiums

EV also shows the premium needed to buy an **actuarially fair** insurance policy

Actuarially fair:
- Premium charged = expected claim
- Insurance company breaks even on average

Very useful when evaluating Pareto efficiency

Example:

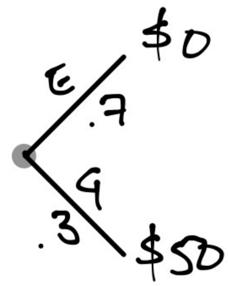
Two people:	Alice (A), Bob (B)
Different times:	A lives now, B lives in the future
One good:	Barrel of oil **owned by B**
Interest rate:	r=0% for simplicity

A's WTP now:
$20

B's WTA in future depends on future car technology:

State	Probability	WTA
Electric cars (E) in use	70%	$0
Gas cars (G) in use	30%	$50

Graphing:



Dilemma: should A use the oil?

State	WTP_A	WTA_B	ΔSS	
E	20	0	+$20	**Gain** if A uses
G	20	50	-$30	**Loss** if A uses

Now add an insurance company

Offers policy that pays out **if G occurs**

Insures against the risk that gas cars are still in use

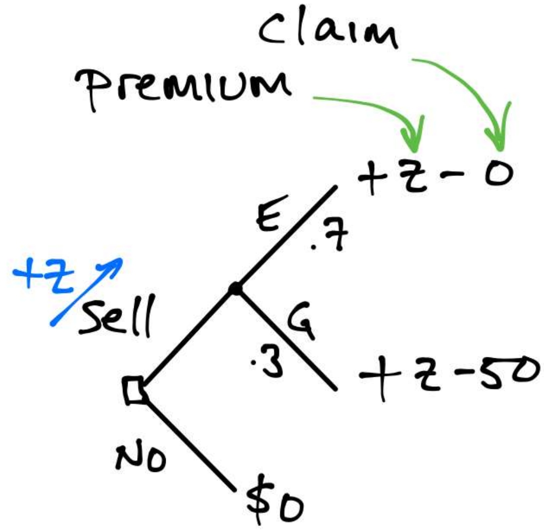
Price:	Z	*premium*
Pays if G:	$50	*coverage* or *claim* if G occurs
Pays if E:	$0	claim if E occurs

Expected claim: $0.7 * (\$0) + 0.3 * (\$50) = \$15$

Solve for company's WTA:

- Minimum Z for which it would sell the policy

Insurance company's decision tree:

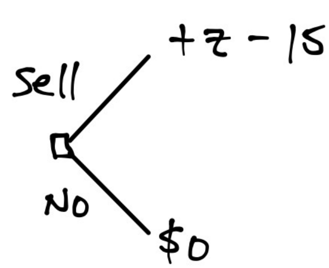


Evaluating the right-most node:

$$EV \ = \ 0.7 * (Z - 0) + \ 0.3 * (Z \ - \ 50)$$

$$EV = (0.7 + 0.3) * Z - (0.7 * 0 + 0.3 * 50)$$

$$EV = Z - 15$$



Minimum Z to sell the policy (WTA):

$$Z - 15 = 0$$

$$Z = 15$$

Premium equals the *expected claim*

Aside on backing out the probability implicit in a premium:

Z	Premium

C	Coverage if the event occurs, pays 0 otherwise

ρ	Probability of the event

$Z = \rho C + (1 - \rho) * 0 = \rho C$ Premium for fair insurance

$$\rho = \frac{Z}{C}$$

SU supplemental life insurance

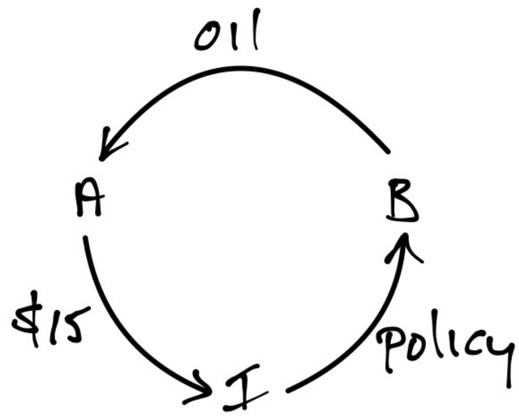
Z = annual cost per $1000 coverage

Age	Z	$Z/1000$	Implied ρ, %
30	$0.61	0.00061	0.06
40	$0.92	0.00092	0.09
50	$2.08	0.00208	0.21
60	$5.59	0.00559	0.56
70	$17.29	0.01729	1.73

Back to oil example:

With insurance, an efficient trade is possible

1. Alice buys policy for $15 and names Bob as the beneficiary
2. Alice trades policy to Bob for the oil



Welfare impacts?

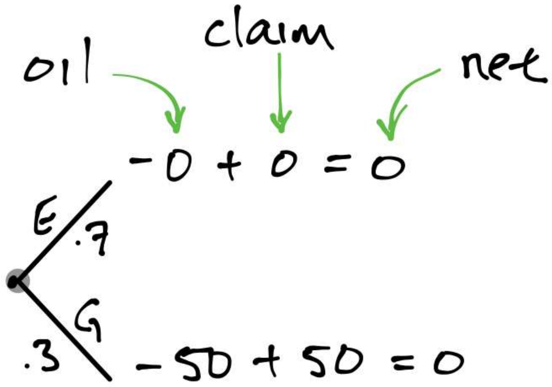
Alice: $WTP = \$20, P = \$15$ $CS_A = \$5$

Insurer: $P = \$15, WTA = \$15$ $PS_I = \$0$

Bob's payoff is more complicated since it depends on the state:

Variable	State E	State G
Payment for oil	\$0	\$0
Insurance claim	\$0	\$50
Total payments, P_T	**\$0**	**\$50**
WTA	\$0	\$50
$\boldsymbol{PS_B = P_T - WTA}$	**\$0**	**\$0**

Graphing:



Bob *comes out even either way*:

No change **in either state of the world**

Overall:

$$\Delta SS = CS_A + PS_I + PS_B$$

$$\Delta SS = \$5 + \$0 + \$0 = \$5$$

Summary:

- EV shows the premium for a fair insurance policy
- Can use to evaluate efficiency under uncertainty

Daily exercise