# R&R 7

K&K(21): unknown prob!

known prob: how l.n ⇒ no real risk.

Unique events. New ~~startin~~ risks!

~~1st Reply~~

de F, Ramsey, Savage:

(a) assign subj. prob$^s$ to events (quite ≥ risk)

(b) Then maximize EU.

→ Allais, PT 79. For risk: non EU
You know non EU for risk. But now, uncertainty)

Question: please invent your biu
to audience non EU for uncertainty.

replace EU in (b) by RDU/PT

Prob. soph + RDU!

$(E_1 : x_1, \ldots, E_n : x_n)$

$(p_1 : x_1 \ldots p_n : x_n)$

RDU

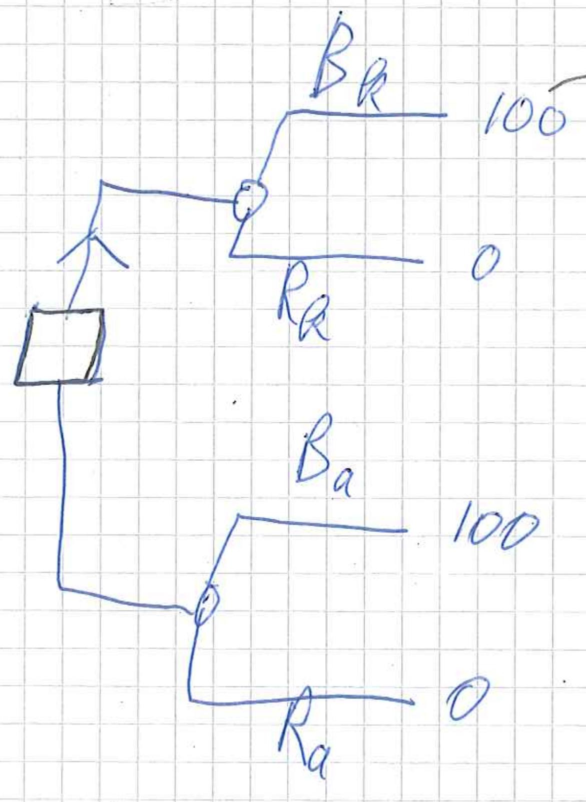
schreef ik niet.

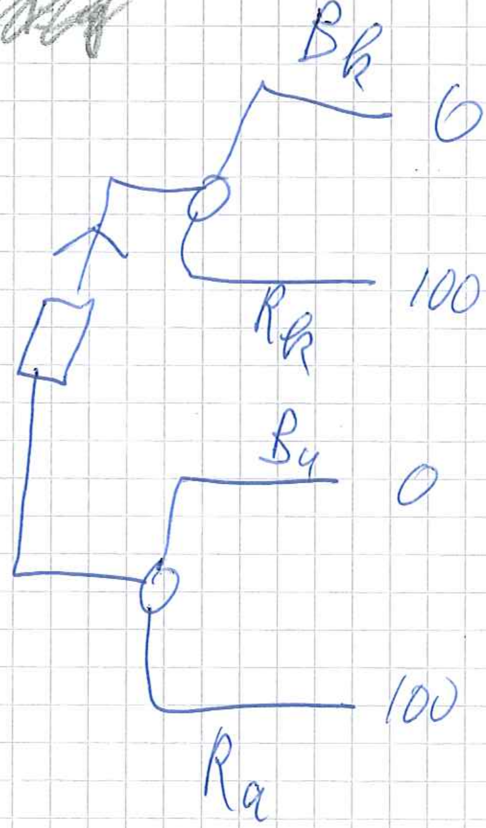
Trouble coming...

Ellsberg ...

K: 100 balls          A: 100 balls

50 R, 50 B          $\overbrace{R \quad B}^{100}$




$$
\begin{array}{ccc}
P(B_k) & > & P(B_a) \\
P(R_k) & > & P(R_a) \\
\hline
1 & \cancel{>} & 1
\end{array}
$$

No prob-soph!

Other example: Homebias

Need something more fundamentally different.

I skipped all this. Too long for oral

To prepare, RDU + prob-soph.

$$x_1 \geq \dots \geq x_n$$

$$E_1 : x_1, \dots, E_n : x_n \qquad p_j = P(E_j)$$

$$\downarrow$$

$$p_1 : x_1 \quad \dots \quad p_n : x_n$$

$$\downarrow$$

$$\sum \pi_j U(x_j)$$

$$\pi_j = w(p_j + \dots + p_1) - w(p_{j-1} + \dots + p_1)$$

$$= w(P(E_j \cup \dots \cup E_1)) - w(P(E_{j-1} \cup \dots \cup E_1))$$

$$= w \circ P(\underset{\substack{\downarrow \\ \text{outcome} \\ \text{event}}}{E_j} \cup \dots \cup E_1) - w \circ P(\underbrace{E_{j-1} \cup \dots \cup E_1}_{\text{(gain) rank (event)}})$$

$$W = w \circ P$$

$$= W(E_j \cup \dots \cup E_1) - W(E_{j-1} \cup \dots \cup E_1)$$

Take $W: 2^S \to [0,1]$ Generalized prob 4

W satisfies:

(*) $W(\emptyset) = 0$; $W(S) = 1$; $A \supset B \Rightarrow W(A) \geq W(B)$

skip { Now generalize: take any such W, also if no underlying P

W is <u>(event) weighting function</u> if $W: 2^S \to [0,1]$, satisfies (*).

I said earlier already { No P need exist. } skip

Could P still always exist?

No! almost never! } skip

$E_j^{E_{j-1} \cup \dots \cup E_1}$: ranked event

generic: $E^R$

$\pi(E^R) = W(E \cup R) - W(R)$ } skipped

5

RDU: $\exists$ an incr. contr.

$U : \mathbb{R} \to \mathbb{R}$,

$\exists$ weighting fion $W$,

st.

$x_1 \geq \cdots \geq x_n$,

$(E_1 : x_1, \ldots, E_n : x_n) \to$

$\sum \pi_j U(x_j)$

marginal contribution of outcome event $E_j$ to rank $(E_{j-1} \cup \cdots \cup E_1)$

$\pi_j = W(E_j \cup \cdots \cup E_1) - W(E_{j-1} \cup \cdots \cup E_1)$

$= \pi(E_j^{E_{j-1} \cup \cdots \cup E_1})$

$E^R$: ranked event, $\pi(E^R) = W(E \cup R) - W(R)$

E.g. $\pi_1 = \pi(E_1^{\emptyset}) = W(E_1)$. $\pi_2 = \pi(E_2^{E_1}) = W(E_2 \cup E_1) - W(E_1)$

Exercise: Assume $U$ linear

How elicit $W(E)$?

Recall P(E)-measurement (1st session)

$\alpha \sim 1_E 0 \Rightarrow \alpha = W(E)$

(they did not find. 2017: They did!

2017: 10:33 - 10:44

Because I explained $\pi(E_1)$, $\pi(E_2)$

Ellsberg accommodated:

Book p. 281 Fig 10.1.1 → screen!?
take before you

U linear.

$W(B_k) = W(R_k) = 0.4$

$W(B_a) = W(R_a) = 0.3$

Done!

Ellsberg accommodated

Not "explained."
W too general ...

more laxer

10:15 – 10:25 Break

First, we consider where RDU uncertainty $\hat{=}$ risk 7

"big" $R$ is bad.

Pessimism ask

$$R' \supset R \Rightarrow \pi(E^{R'}) \geq \pi(E^{R})$$

Optimism : $\leq$

define conv this way

trivial Thm: Pessimism $\Leftrightarrow$ $W$ convex. Or $W(A \cup B) \geq W(A) + W(B) - W(A \cap B)$

explain

llh | ins:

define $\pi \succeq$ on events.

$$\pi(E^{b}) \geq \pi(E^{R}) \text{ on } [\phi, W_{rb}]$$

$$E \cup R \preceq W_{rb}$$

$$(p * r \leq w_{rb})$$

c.f.

$$\pi(E^{w}) \geq \pi(E^{R}) \text{ on } [B_{rb}, S]$$

$$R \geq B_{rb}$$

$$(r \geq b_{rb})$$

c.f.

P.

Fig 10.4.1, p. 293
($\exists$ s.th pr. $\Rightarrow$ opt/pess)

TO $\Rightarrow$ ut measurement.
Put up fig. 4.1.1 & say.

Was-there Exercise 9.4.2

If know U:

$$\alpha \sim 1_E 0 \Rightarrow W(E) = \frac{U(\alpha) - U(0)}{U(1) - U(0)}$$

$$\alpha^j \sim \alpha^4{}_E\, \alpha^0 \Rightarrow W(E) = j/4$$

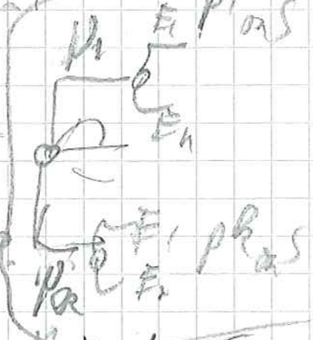
~~Kan CCCI tot AT~~. Beter niet. Wat moeten ze ermee?

file is niet updated

Literature on ambiguity

tell de maxmin
Tell smooth

Strange: Only normative.



I too Bayesian
I only descriptive

only aversion (like KDU in 1980s)

Insensitivity ...? amb is too rich!

New phenomena under uncertainty

hanging in your minds:
(+ : W too general
+ : no graphs, no indexes)

New phenomenon:
Source dependence

Different kinds of events ⇒ different attitudes

Risk: one source. So no source dependence.

Source: group of events generated by same random mechanism.

<u>Known urn</u> <u>Unknown urn</u>

<u>Df</u> <u>NK</u>

smooth bekruiseren !?

E: Dutch Rutte still prime minister in 2 months

skip x too subtle!?

H: Fair coin Heads

skipped for too subtle for short time

Ask E:100 vs H:100

They:

E:100 ≻ H:100

amb. seeking?

No! E more likely

Beliefs! Not amb ~~s~~

Should control for beliefs.

skipped

Ellsberg urns: symmetry controls for beliefs

Other way } skip

Sources $\mathcal{A}$, $\mathcal{B}$ define

$A \succsim B$ & $A^c \succ B^c$ (*)

suggests pref of $\mathcal{A}$ over $\mathcal{B}$.

Formally: <u>Source pref of $\mathcal{A}$ over $\mathcal{B}$</u>:

(*) may be, but never

$B \succsim A$ & $B^c \succ A^c$

Source pref. of $\mathcal{A}$ over $\mathcal{B}$:

$W(B) \geq W(A) \Rightarrow W(B^c) \leq W(A^c)$

More sensitive wrt $\mathcal{A}$ than w.r.t. $\mathcal{B}$ and so it.

How get tractability?

Source method:

Take <u>uniform</u> sources.

$A$ uniform: $W(A) = w_A\, P(A)$

Fig 10.1.1 p.281

skipped

Accommodate Ellsberg with source method:

$U_k$ $\quad$ $U_a$

$P(B_k) = \frac{1}{2}$ $\quad$ $P(B_a) = \frac{1}{2}$

$W_k(\frac{1}{2}) = 0.4$ $\quad$ $w_a(\frac{1}{2}) = 0.3$

Bring back prob$^{s}$ in Ellsberg!

DO formula for source-method

# Taking stock.

$x_1 \geq \dots \geq x_n$

$(E_1 : x_1, \dots, E_n : x_n)$

W, U, RDU ~

Take source $S_0$ of $E^{\Sigma}$

Take $W(E) = w_{S_0} P(E_j)$

$$\sum_{j=1}^{n} \left( w_{S_0} P(E_j \cup \dots \cup E_1) - w_{S_0} P(E_{j-1} \cup \dots \cup E_1) \right) U(x_j)$$

Have to measure U, P, $w_{S_0}$

TO

source function

W via Abdellaoui (PE) maar dan met events)

$W_{S_0} P^{-1} = w_{S_0}$

much less work than W!

Nice thing:

Can draw graphs

$W_{SD}$ capturing ambiguity attitudes.

Can calculate indexes.
(you did it for us)

Show graphs of AER

pessimism: amb. av.
insensitivity: a-insensitivity

# PT:

put everything together:

$U$

$W^+$

$W^-$

$x \quad x_1 \geq \dots \geq x_k \geq 0 \geq x_{k+1} \geq \dots \geq x_n$

$x = [E_1 : x_1, \dots, E_n : x_n]$

$$x \longmapsto \sum_{j=1}^{k} \pi_j \, U(x_j) + \sum_{i=k+1}^{n} \pi_i \, U(x_i)$$

$W^+$ $\qquad W^-$ loss weights

Empirical findings:

Amb. amplifies risk

amb. seeking for losses

show annotated bill.
on internet

Did not say:

Rich between source variation.
many emotions; many kinds of info

"One risk attitude for
all nonmonetary outcomes"
is as absurd as
"one ambiguity attitude"