Expert opinions

Magne Aarset

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Statcon as

Expert opinions

Expert knowledge

Expert opinion

History

The era of think tanks and expert oracles

The Second World War $\rightarrow$ The Vietnam War

The Scenario Analysis
The Delphi Method

Scenario Analysis

Scenarios are hypothetical sequences of events constructed for the purpose of focusing attention on causal processes and decision points.

They answer two kind of questions:

1. Precisely how might some hypothetical situation come about, step by step?
2. What alternatives exist, for each actor, at each step, for preventing, diverting, or facilitating the process.

Surprise-free scenario

Alternative futures (canonical variations)

The RAND Corporation

1946: The first space satellite to be launched in mid 1957.

Sputnik, October 1957

1960: On Thermonuclear War (Herman Kahn)

Dr. Strangelove

How I Learned to Love the Bomb

1967: The Year 2000 (Kahn & Wiener)

2001

A Space Odyssey

Decision Theory

Kahn: "a technological breaktrough in the art of doing System Analysis and Military Studies"

- Optimize a single objective
- Weight different objectives

Subjective probabilities and utility are only meaningful for an individual.

It is impossible for a committee to come to a decision on the basis of maximal expected utility.

Scenario analysis

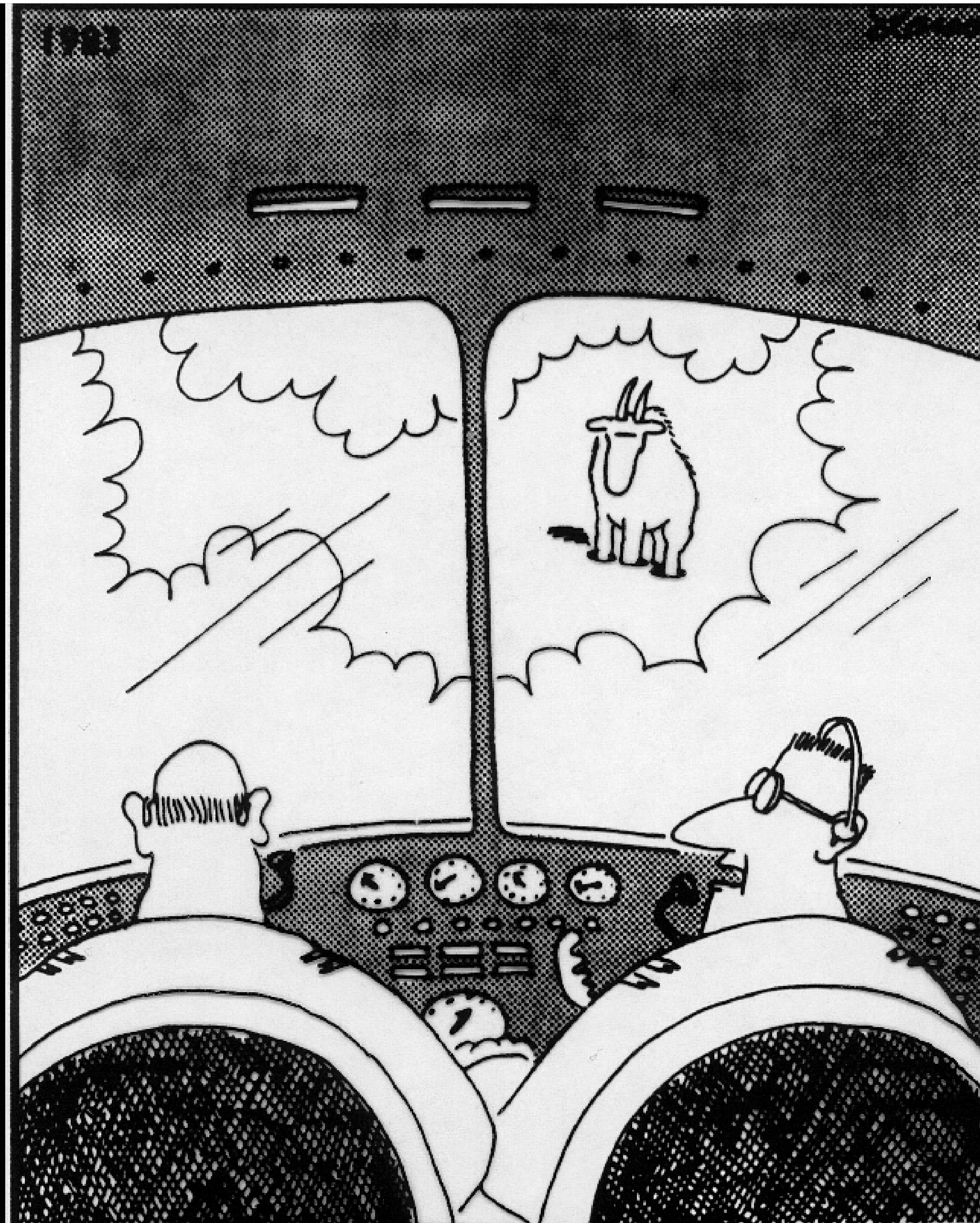
It is likely that we can handle radiation.
It is likely that we can handle death.
It is likely that we can handle destruction.

~~$\Downarrow$?~~

It is likely that we can handle
radiation, death and destruction.

Subjective assessments

How good are we to do assessments?



"Say … what's a mountain goat doing way up here in a cloud bank?"

Utilizing available information

Vi kan bruke tilgjengelig informasjon feil, og vi kan la være å bruke tilgjengelig informasjon.

- Vi lager oss kun et lite antall mulige diagnoser, gjerne basert på kun en begrenset del av den tilgjengelige informasjon.
- Vi avviser/ignorerer informasjon som peker i en annen retning.
- Vi velger ut informasjon som bekrefter de antagelser vi har.
- Vi har en selektiv og forsterkende oppfatning.

Stress

Keinan (1987)

Velg én av seks mulige beslutninger på 15 problemer.

– En gruppe som ble utsatt for kontrollérbar stress
– En gruppe som ble utsatt for ikke kontrollérbar stress
– En kontrollgruppe

- Beslutning ble valgt uten at alle alternativene ble studert (4 ganger så ofte).
- Mer usystematisk gjennomgang.
- Dobbelt så ofte gale svar.

Sinnstilstand

Johnson & Tversky (1983)

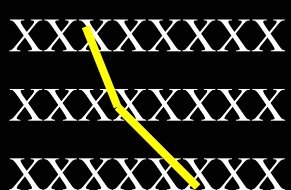
Etter at studenter hadde lest en historie om
en student på deres egen alder som var blitt drept
anslo de sannsynligheten for “alle mulige” farer
høyere enn en kontrollgruppe.

Motsatt for de i “godt humør”.

Availability

En sti forbinder et element i den øverste rekken
med et element i den nederste, og
går gjennom ett og bare ett element i hver rekke.

Hvor mange stier finnes det?



Median = 40

Median = 18

Riktig svar er
$8^3 = 2^9 = 512$.

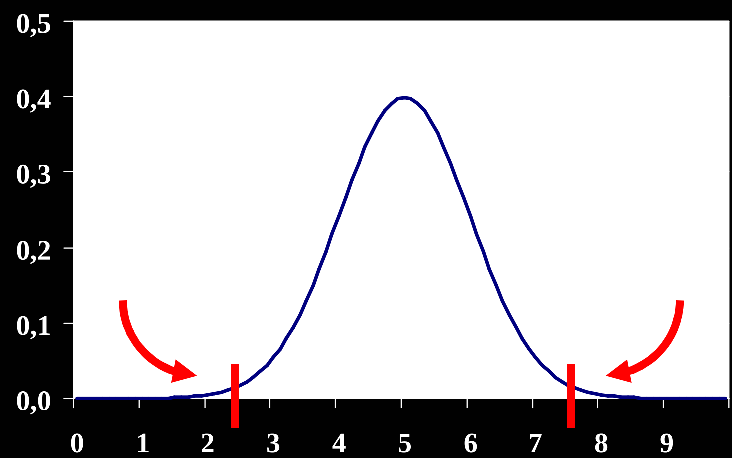
Det er lettere å tenke seg
stier mellom 3 enn 9 punkt.

Anchoring

Når vi skal anslå en sannsynlighet
går vi gjerne ut fra et første utgangspunkt
og så "justerer" eller "korrigerer" vi denne verdien.

Ofte er denne justeringen utilstrekkelig!

$P(X<k_1) = 0{,}05$



$P(X>k_2) = 0{,}05$

Anchoring

Hvor stor andel av landene i FN er afrikanske?

Gruppe 1 Median = 25%

10% ble "tilfeldig valgt" som utgangspunkt.

Gruppe 2 Median = 45%.

65% ble "tilfeldig valgt" som utgangspunkt.

Anchoring

Svar i løpet av 5 sekunder.

Gruppe 1: Hva er $8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$?

Median = 2 250

Gruppe 2: Hva er $1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8$?

Median = 512

Korrekt svar = 40 320

Representativeness

Løgndetektor

Hva er P(Sant | MaskinUsant) ?

P(MaskinSant | Sant) = 0,8

P(MaskinUsant | Usant) = 0,8

P(Sant) = 0,9

$$P(S \mid MU) = \frac{P(S \cap MU)}{P(MU)} = \frac{P(S)P(MU \mid S)}{P(MU \cap S) + P(MU \cap U)}$$

P(Sant | MaskinUsant) = 0,7

Control

Kjøp lodd for $ 1. Gevinst $ 50.

Gruppe 1 Median = $ 8.67

Velg ditt eget lodd.

Gruppe 2 Median = $ 1.96

Motta lodd fra selger.

Vil du selge loddet ditt?

Elicitation and scoring

Step 1: Indicate a best estimate.

Step 2: Indicate "how certain" you are.

Calibration

Uncertainty (Informativeness)

Expert opinions

Expert no. 1 2 ... e ... E

Each expert asesses N quantities

$X_1, X_2, \ldots, X_N$

of interest.

State of nature
Non-observable

Each expert asesses M quantities

$Y_1, Y_2, \ldots, Y_M$

known to the analyst.

Seed variables
To seed
the model

Expert opinions

We assume that the expert's performance on the seed variables

$$Y_1, Y_2, \ldots, Y_M$$

is indicative of their performance of the variables of interest

$$X_1, X_2, \ldots, X_N.$$

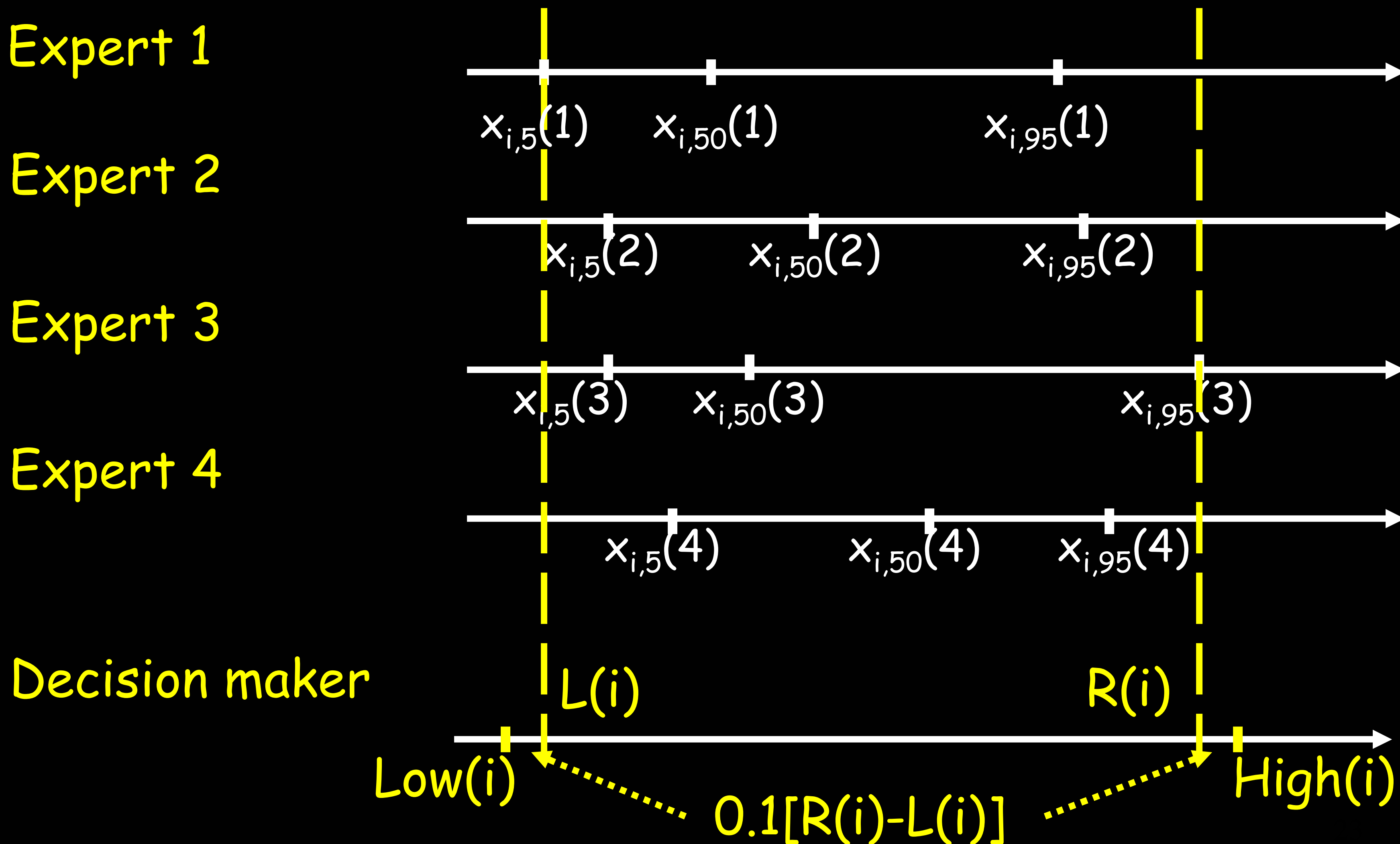
Expert opinions

Each expert assess each quantity by stating the 5%, 50% and 95% quantiles of his subjective probability distribution.

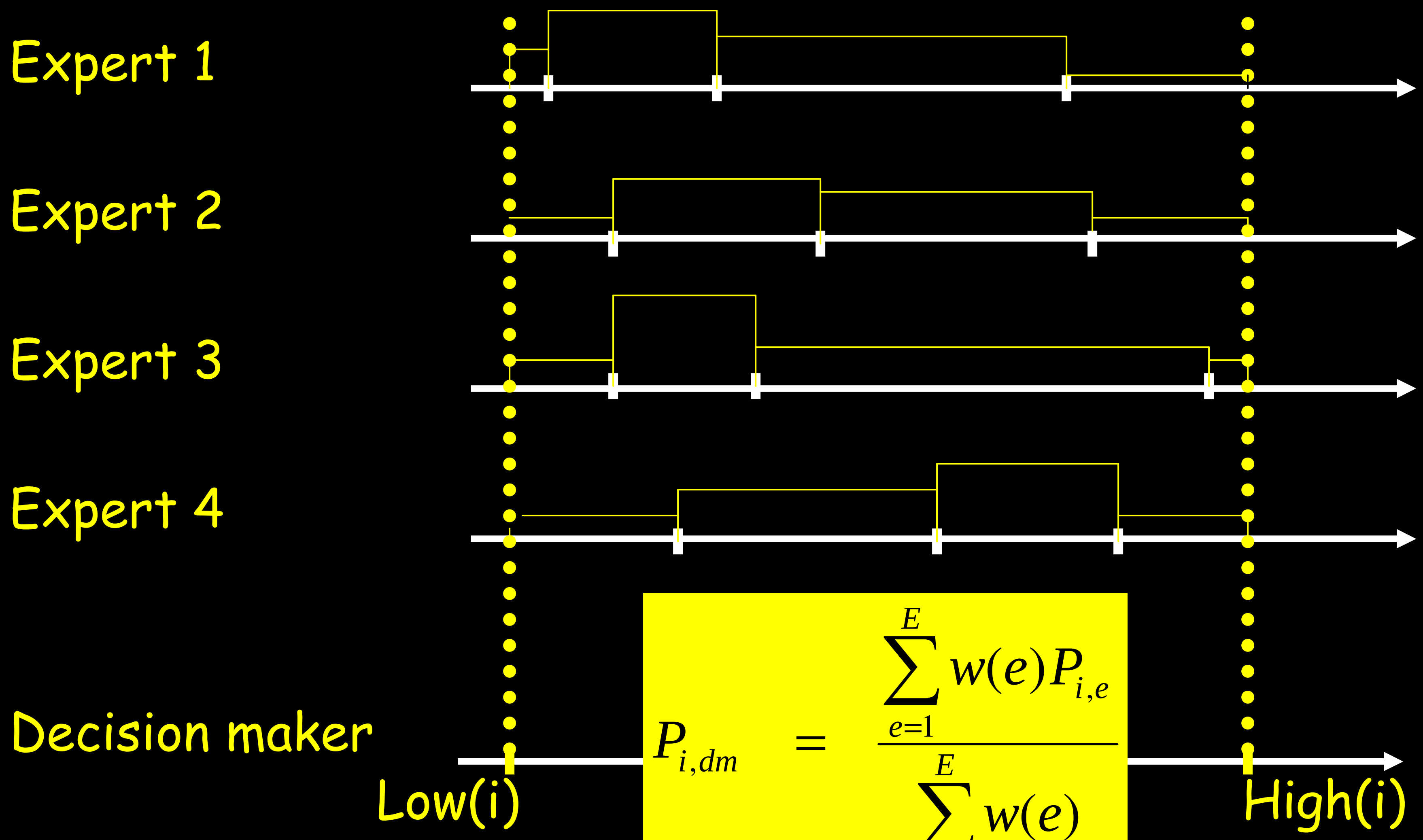
For variable i and expert e

$x_{i,5}(e)$ $x_{i,50}(e)$ $x_{i,95}(e)$.

Variable i


Expert 1
$x_{i,5}(1)$ $x_{i,50}(1)$ $x_{i,95}(1)$
Expert 2
$x_{i,5}(2)$ $x_{i,50}(2)$ $x_{i,95}(2)$
Expert 3
$x_{i,5}(3)$ $x_{i,50}(3)$ $x_{i,95}(3)$
Expert 4
$x_{i,5}(4)$ $x_{i,50}(4)$ $x_{i,95}(4)$
Decision maker
L(i)
R(i)
Low(i)
High(i)
0.1[R(i)-L(i)]

Variable i



$$P_{i,dm} = \frac{\sum_{e=1}^{E} w(e) P_{i,e}}{\sum_{e=1}^{E} w(e)}$$

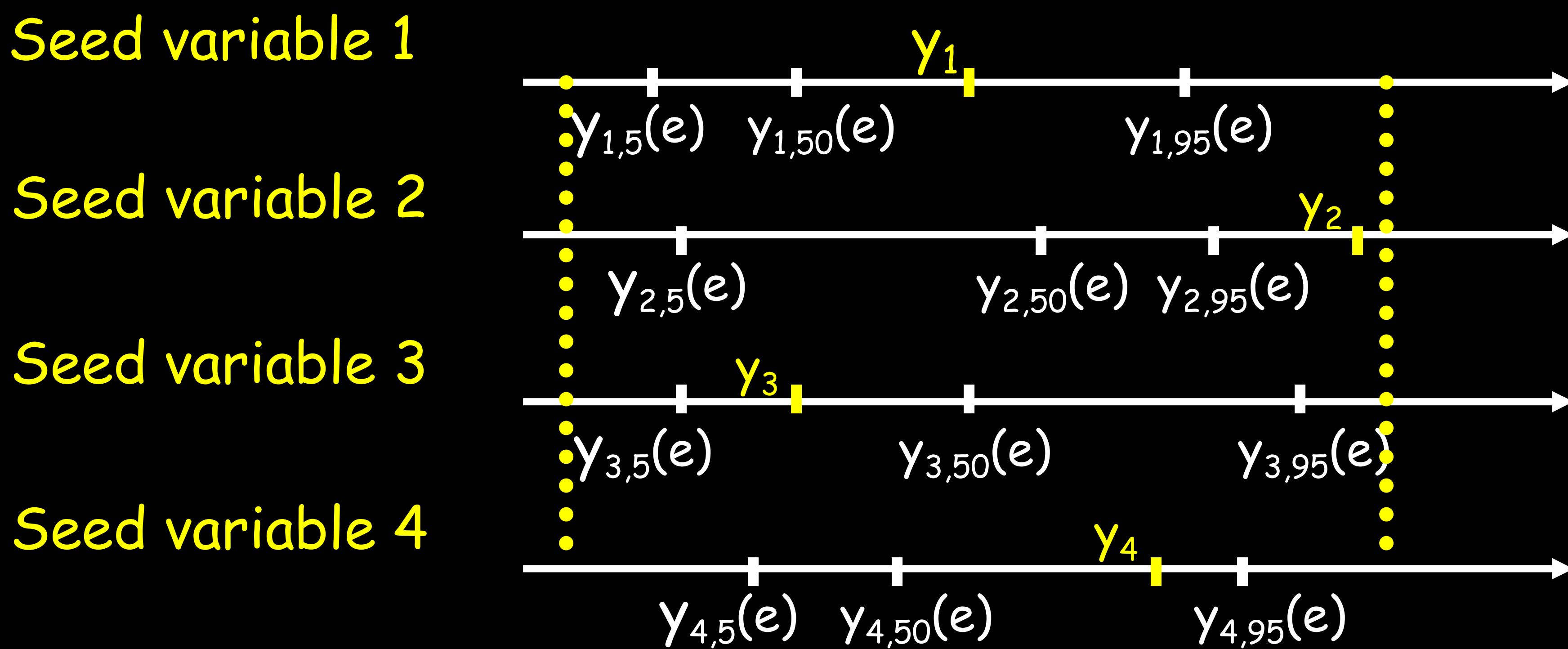
Weight of expert e

w(e) = Calibration • Informativeness

$$w(e) = Cal(e, \alpha) \cdot I(e)$$

$$P_{i,dm} = \frac{\sum_{e=1}^{E} w(e) P_{i,e}}{\sum_{e=1}^{E} w(e)}$$

Expert e



$p = \{0.05, 0.45, 0.45, 0.05\}$

$S(e) = \{0, 0.25, 0.5, 0.25\}$

$n(e,1) = |\{i \mid y_i \leq y_{i,5}(e)\}| = 0$

$n(e,2) = |\{i \mid y_{i,5}(e) \leq y_i \leq y_{i,50}(e)\}| = 1$ (y_3)

$n(e,3) = |\{i \mid y_{i,50}(e) \leq y_i \leq y_{i,95}(e)\}| = 2$ (y_1 og y_4)

$n(e,4) = |\{i \mid y_{i,95}(e) < y_i\}| = 1$ (y_2)

Calibration of expert e

H_0: $p_1 = \pi_1$ … $p_k = \pi_k$

Likelihood ratio test: Reject H_0 if

$$\Delta = \frac{\sup_{H_0} L(p)}{\sup_{H_0+H_A} L(p)} < crit$$

Chi(e) = $-2 \ln\Lambda \sim \chi^2_{k-1}$ when M is large

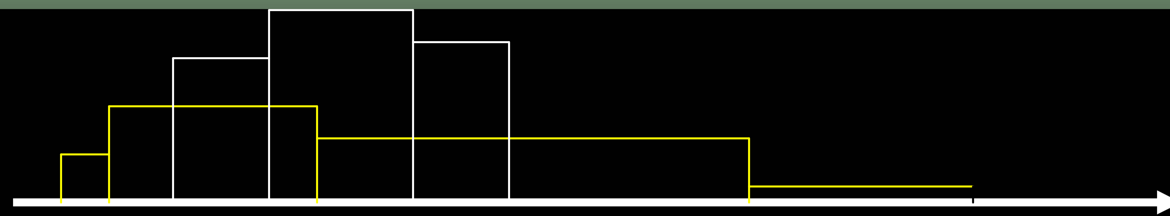
Calibration of expert e

$$Chi(e) = -2\ln\Delta$$

$$Chi(e) = -2\ln\frac{\pi_1^{n(e,1)}\pi_2^{n(e,2)}\pi_3^{n(e,3)}\pi_4^{n(e,4)}}{\left[\frac{n(e,1)}{M}\right]^{n(e,1)}\left[\frac{n(e,2)}{M}\right]^{n(e,2)}\left[\frac{n(e,3)}{M}\right]^{n(e,3)}\left[\frac{n(e,4)}{M}\right]^{n(e,4)}}$$

$$Chi(e) = 2\sum_{j=1}^{4} n(e,j)\ln\left[\frac{n(e,j)}{M\pi_j}\right]$$

Informativeness



$$SD(X) = \sqrt{E[X - E(X)]^2}$$

- Depends on the scale of the variable

$$Varcoef = \frac{SD(X)}{E(X)}$$

- Dimensionless
- Sensitive to the tails of the distribution.
- Depends on the mean.

$$H(q) = -\sum_{i=1}^{n} q_i \ln(q_i)$$

- Sensitive to changes of scale.

$$I(P_{i,e}, U) = H(U) - H(P_{i,e})$$

- Invariant to changes of scale.
- Relative insensitive to choice of "cut-off points".

Decision maker

w(e) = Calibration • Information

$$P_{i,dm} = \frac{\sum_{e=1}^{E} w(e) P_{i,e}}{\sum_{e=1}^{E} w(e)}$$

Expert opinions

Takk for meg!