The validity of stated risk estimates elicited via the Exchangeability Method: An experimental investigation of food safety perceptions

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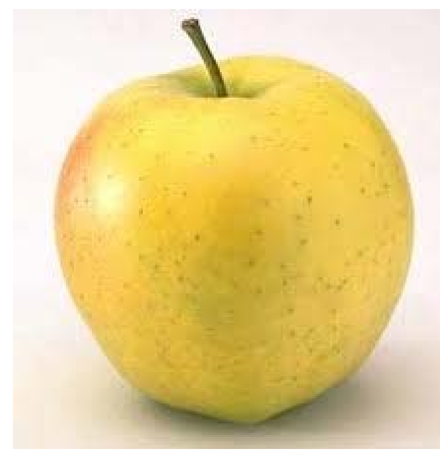
Aims - General

- Do perceived health risk related to food safety affect consumers' preferences for free-pesticide apples?

- Elicitation of perceived health risks – the presence of pesticide residue in apples produced in Trentino

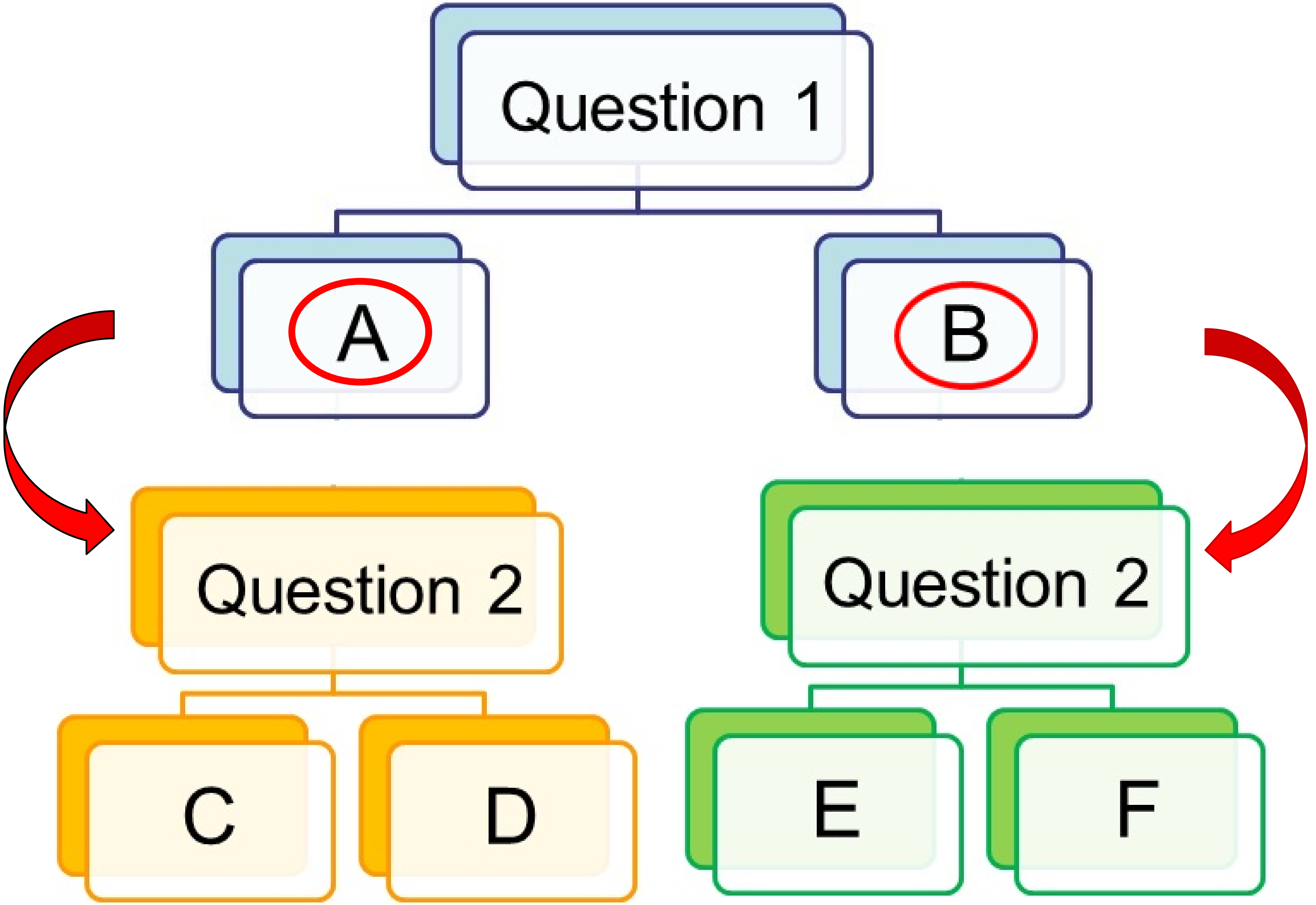
- Why apples?



Aims - Methodological

- Investigate the validity of stated risk estimates elicited via EM
- Effect of monetary incentives on the validity of stated risks – real payments vs. hypothetical payments
- Effect of chained questions on the validity of stated risks – chained questions vs. unchained questions

Chained questions



Health Risk Elicitation

Qualitative:

- ➢How much do you concern about the presence of pesticide residue in apples?

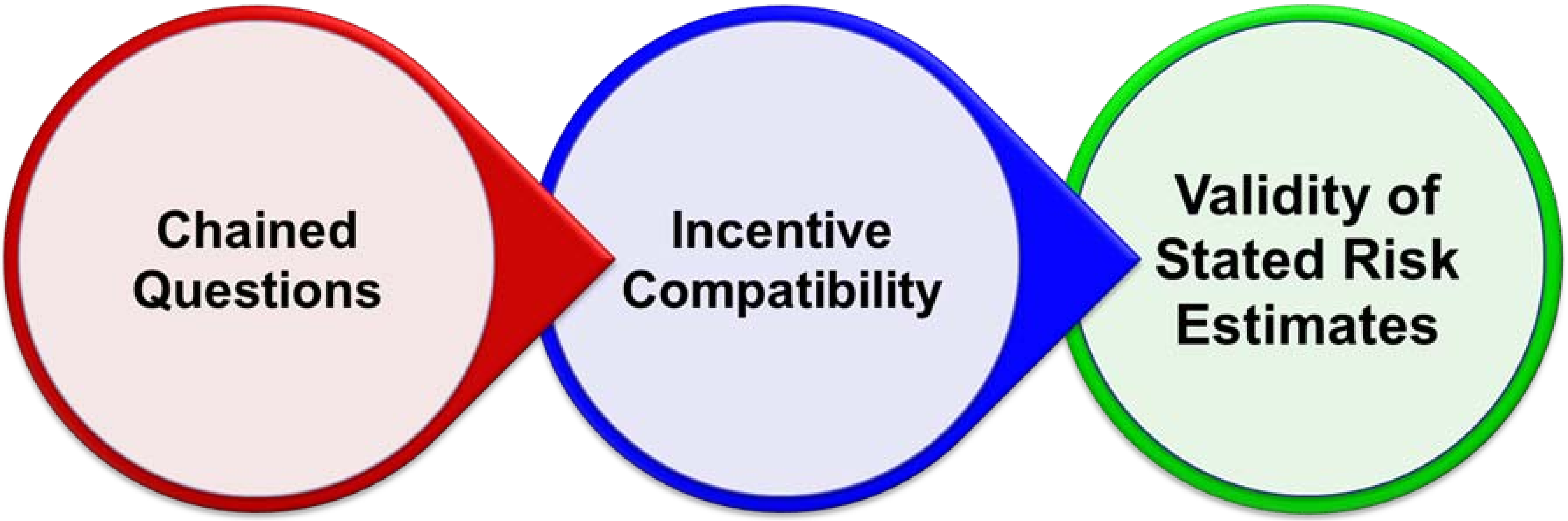
Quantitative:

- ➢Direct methods
  - Just ask a point estimate (in “chance” terms)
- ➢Indirect methods
  - Lotteries, gambles etc.

Exchangeability method: Pros

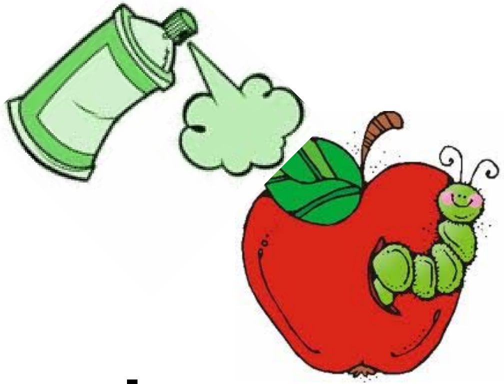
- Not affected by source dependence bias
- Straightforward for respondents
- Elicit estimates of each subject’s cumulative distribution function (CDF) of the random variable under study

Exchangeability method: Cons



Baillon, 2008; Abdellaoui et al., 2011

Case Study: Food Security



- the number of apples ***A*** that contains **at least one** pesticide residue in a sample of 100 apples in 2030
- the number of apples ***R*** that contains **multiple pesticide** residue in a sample of 100 apples in 2030
- estimates of 25^{th} , 50^{th} and 75^{th} percentiles of each subject's CDF of ***A*** and ***R***

Elicitation 50th percentile $A_{1/2}$ (1)

The random variable is

A = the number of apples ***A*** containing **at least one** pesticide residue in a sample of 100 apples in 2030

The range of state space *A* is defined by the respondent:

$A_0 = 60$ ⟶ $A_1 = 76$

Elicitation 50th percentile $A_{1/2}$ (2)

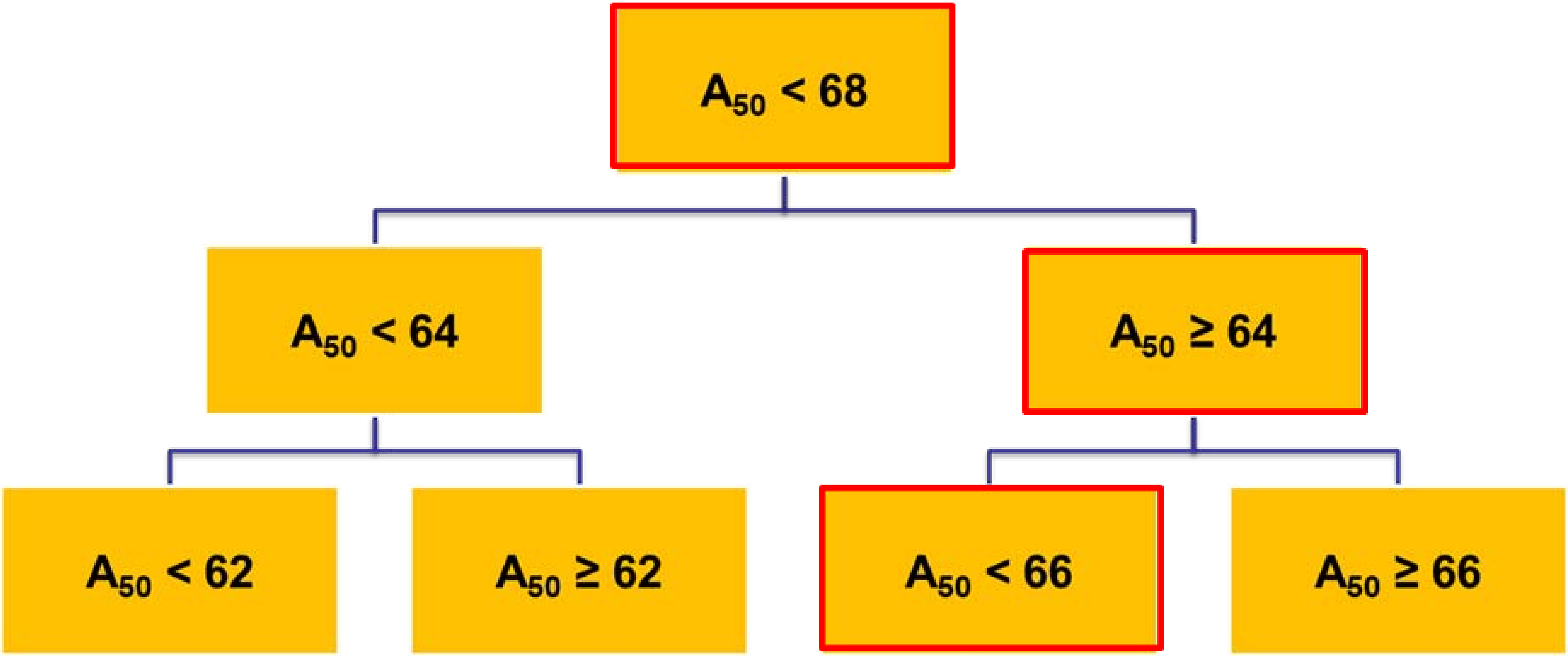
The state space is split in two prospects by using a benchmark value equal to

$$[A_0 + (A_0 – A_{100})/2] = 68$$

The first binary question is

$$A_{1/2} < 68 \text{ or } A_{1/2} \geq 68$$

Elicitation 50th percentile $A_{1/2}$ (3)



until respondent's choices converge at a point estimate! For instance $A_{1/2} = 66$

Results - Stated Risk Estimates

Variable	Description	Mean Value
$a_{1/4}$	First Quartile	65.6
$a_{1/2}$	Median	69.2
$a_{3/4}$	Second Quartile	71.2
$r_{1/4}$	First Quartile	42.4
$r_{1/2}$	Median	44.9
$r_{3/4}$	Second Quartile	47.7

Considering that the number of apples containing **at least one** pesticide residue is **63/100** in **2009**

Considering that the number of apples containing **multiple** pesticide residue is **31/100** in **2009**

Italian Ministry of Health, 2010

Valid stated risks

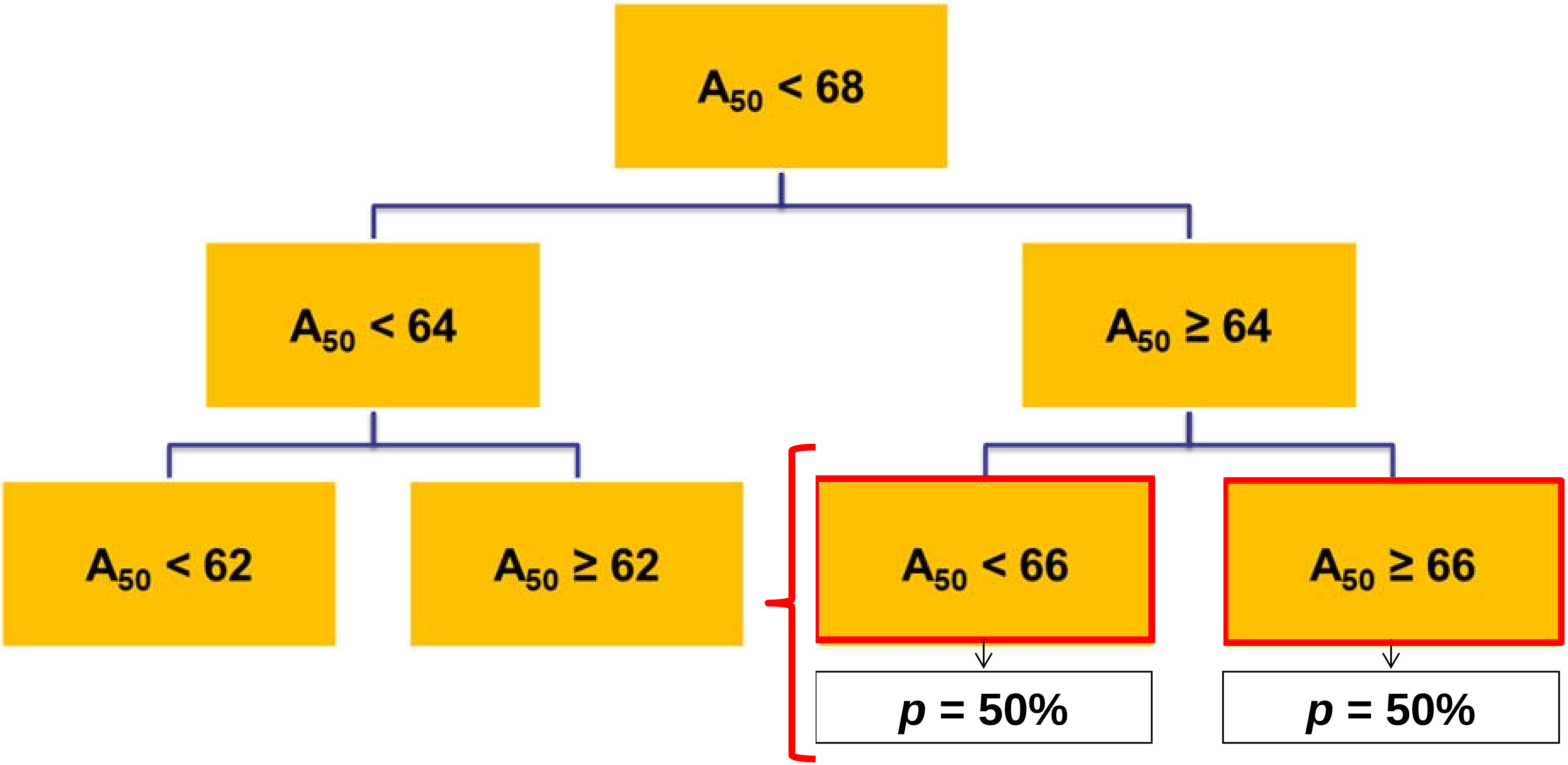
"…a complete class of incompatible events E_1*,* E_2*,...,* E_n *being given, all the assignments of probability that attribute to* p_1*,* p_2*,...,* p_n *any values whatever, which are non-negative and have a sum equal to unity, are admissible assignment: each of these evaluations corresponds to a coherent opinion, (…), and every individual is free to adopt that one of these opinions (...) which he feels".*

(de Finetti, 1937)

Valid stated risks elicited via EM

Stated risk obeys to all axioms and theorems of probability theory if they satisfy the **exchangeability assumption**

Elicitation 50th percentile A_{50} (3)



The Median estimate is $A_{1/2} = 66$

Certainty Equivalent Game – Lottery 1

<table>
<tr><th></th><th colspan="2">Option A</th><th colspan="2">Option B</th></tr>
<tr><td>Question 1</td><td>✖</td><td rowspan="6">You win 100€ if the number of apples containing at least one pesticide will be less than $A_{1/2}$ = 66</td><td></td><td>1€</td></tr>
<tr><td>Question 2</td><td>✖</td><td></td><td>25€</td></tr>
<tr><td>Question 3</td><td></td><td>✖</td><td>49€</td></tr>
<tr><td>Question 4</td><td></td><td>✖</td><td>51€</td></tr>
<tr><td>Question 5</td><td></td><td>✖</td><td>75€</td></tr>
<tr><td>Question 6</td><td></td><td>✖</td><td>99€</td></tr>
</table>

Certainty Equivalent Game – Lottery 2

	Option A		Option B	
Question 1	✖	You win 100€ if the number of apples containing at least one pesticide will be **greater than or equal to** **$A_{1/2}$ = 66**		1€
Question 2	✖			25€
Question 3			✖	49€
Question 4			✖	51€
Question 5			✖	75€
Question 6			✖	99€

Hypotheses: Exchangebility

At **sample** level:

H$_0$: median(CE_{L1}) = median(CE_{L2})

At **individual** level:

H$_0$: $CE_{L1} = CE_{L2} = 49$

The **Validity Rate** is the number of stated risks which are valid

Factors influencing the validity

- Real monetary incentives?
- Chained Questions?
- Joint effect?

Treatments

1. Hypothetical incentives-chained questions (THC)

2. Hypothetical incentives-unchained questions (THU)

3. Real incentives-chained questions (TRC)

4. Real incentives-unchained questions (TRU)

Results – Sample Level

H_0: median(CE_{L1}) = median(CE_{L2})

	Wilcoxon matched-pairs signed ranks test	Binomial sign test
Treatment	Z	P>Z
Real incentives-Chained questions	-3.713*	0.0027
Real incentives-Unchained questions	-1.513	0.3049
Hypothetical incentives-Chained questions	-1.283	0.0886
Hypothetical incentives-Unchained questions	-3.005*	0.0000

Results – Individual Level

$H_0: CE_{L1} = CE_{L2}$

Treatment	Observations	Valid Observations	Validity Rate (%)
Real incentives-Chained questions	192	52	26,26
Real incentives-Unchained questions	207	81	39,13
Hypothetical incentives-Chained questions	171	37	21,64
Hypothetical incentives-Unchained questions	144	43	29,86

Results - Valid vs. Not Valid (1)

	Sample Level		Individual Level	
Variable	Valid	Not Valid	Valid	Not Valid
$a_{1/4}$	62.7	66.8	60.4	69.9
$a_{1/2}$	67.3	69.9	60.8	73.5
$a_{3/4}$	69.7	71.8	72.9	68.2
$r_{1/4}$	38.8	43.8	35.5	48.9
$r_{1/2}$	41.8	46.1	38.1	48.7
$r_{3/4}$	45.6	48.5	48.7	46.4

Results - Valid vs. Not Valid (2)

Kolmogorov-Smirnov test		
Null Hypotheses	**Sample Level**	**Individual Level**
H_0	**P-value**	**P-value**
$a_{1/4,\ valid} = a_{1/4,\ notvalid}$	0.567	0.445
$a_{1/2,\ valid} = a_{1/2,\ notvalid}$	0.664	0.059
$a_{3/4,\ valid} = a_{3/4,\ notvalid}$	0.534	0.791
$r_{1/4,\ valid} = r_{1/4,\ notvalid}$	0.444	0.018
$r_{1/2,\ valid} = r_{1/2,\ notvalid}$	0.844	0.164
$r_{3/4,\ valid} = r_{3/4,\ notvalid}$	0.755	0.676

Conclusions (1)

- Respondents believe that the number of apples containing **at least one** pesticide residue will not significantly increase by the year 2030.

- They predict that the number of apples containing **multiple** residues will significantly increase by the year 2030.

Conclusions (2)

- In general, the valid risk estimates are slightly smaller than the not valid ones.

- There is the risk of overestimating subjective perceptions!

- Warning: This result is not always statistically significant

Conclusions (3)

- Real Incentives and Unchained Questions increase the EM performances in terms of validity rate

- At the best, only 39% of stated risk estimates can be considered valid!

What Next?

- Investigate the effect of risk perceptions on consumers' preferences for free-pesticide products

- Include stated risk estimates elicited via the EM in a Choice Experiment application

- Individual specific status quo alternatives by using a Pivot CE

Thank you!!!

ENVIROCHANGE

http://www.envirochange.eu/

	2009	**2030**
At least one residue (A)	63	58
More than one residue (R)	31	43
One residue (O)	32	15

$$R_{2030} \leq A_{2030}$$