Sequence 3 : Representing risk in agricultural economics models

Unit 1 : Agriculture, a risky activity

Lesson 21 : Modelling risk

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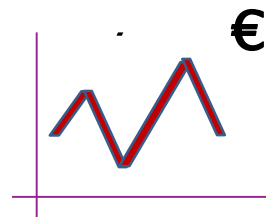
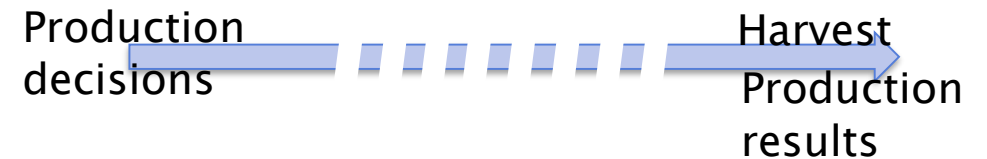# Introduction

➢ Risky economic decisions ----> consequences

➢ Agriculture

Climate

Price €

Production decisions - - - - - - - > Harvest Production results

➢ Behaviour in the face of risk cannot be ignored

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Some definitions

- Hazard : « Unexpected events or changes »
- Risk : « possible danger », « dangerous chance occurrence », « non-desirable effect of hazards »

- Risk : set of probabilistic possible events

$$\neq$$

- Uncertainty : when the objective quantification of probabilities is impossible

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Representing risk in agricultural economics models

In order to model the behaviour of the farmer in the face of risk,
it is essential to

▸ Identify :

  ◦ The sources of risk

    • e.g. : climatic risks, price risks, human risks, …

  ◦ The perceptions of risk

    • The way that risk is perceived

    • Distribution of the states of nature and the subjective
      representation of their probability

  ◦ Attitude in the face of risk = risk aversion

    • Preferences in the face of risk

Model data

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Representing risk in agricultural economics models

In order to model the behaviour of the farmer in the face of risk,
it is essential to

▸ Understand the decisions of the farmer in the face of risk :

　◦ Risk management decisions

　◦ e.g. : diversification of activities, financial savings, insurance,

　　…

▸ Describe his behaviour in the face of risk

　◦ e.g. : Absolutely avoid risk ? Minimize effects ?

Equations and
solutions of the
model

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Choices in a risky environment

$$Z = 450\, X_1 + 1000\, X_2$$

State of nature	Probability	Gross margin of wheat	Gross margin of maize
S1	0.2	460	2000
S2	0.2	440	500
S3	0.2	450	300
S4	0.2	430	1400
S5	0.2	470	800
AVERAGE		450	1000

Will knowing about the variability of gross margins modify the choice of the farmer ?

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Choices in a risky environment

Model

$$\text{Max } RM = 450 X_1 + 1000 X_2$$
$$X_1 + X_2 \leq 50$$
$$25 \ast X_1 + 50 \ast X_2 \leq 2000$$

$$Z_1 = 460 X_1 + 2000 X_2$$
$$Z_2 = 440 X_1 + 500 X_2$$
$$Z_3 = 450 X_1 + 300 X_2$$
$$Z_4 = 430 X_1 + 1400 X_2$$
$$Z_5 = 470 X_1 + 800 X_2$$

Solution

$$X_1 = 0, X_2 = 40; AI = 40000$$

$$S_1 : Z_1 = 80000$$
$$S_2 : Z_2 = 20000$$
$$S_3 : Z_3 = 12000$$
$$S_4 : Z_4 = 56000$$
$$S_5 : Z_5 = 32000$$

$$AI = 40000$$
$$SD = 24915$$

AI : average income
SD : standard deviation

How can the fact that the farmer takes into account the variability of gross margins in order to make his choice be shown in the model ?

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Modelling behaviour in the face of risk – Different approaches

▶ Behaviour in the face of risk is seen as :
  ◦ an objective of minimum income,
  ◦ which will be expressed as an income security constraint

▶ Behaviour in the face of risk is seen as :
  ◦ an objective of low income variability
  ◦ which will be expressed as a minimization of income variability
  ◦ or a maximization of the expected utility of income

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Modelling behaviour in the face of risk – Different approaches

▸ Income security constraint

  ◦ $\Pr\{\tilde{Z} \leq Z_0\} \leq \alpha$

▸ Minimization of income variability or maximization of the expected utility of income

$$\text{Min SD}(\tilde{Z})$$
$$\text{with} \quad \text{AI} \geq Z_0$$

$$\text{Max AI}$$
$$\text{with} \quad \text{SD}(\tilde{Z}) \leq \beta$$

$$\text{Max AI - } \phi\text{SD}(\tilde{Z})$$