

Masterclass Analyzing Risk in Agriculture



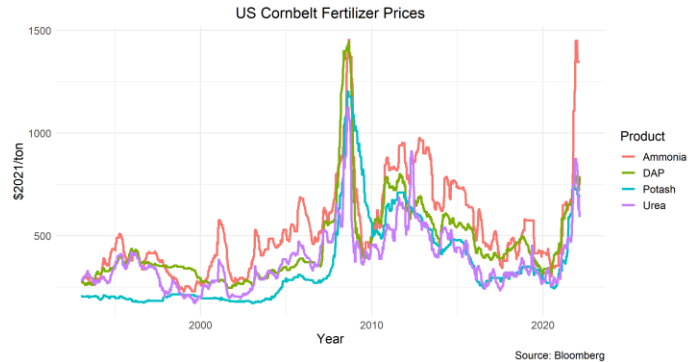
An overview of defining, measuring, and characterizing farm-level risk exposure

Tuesday September 24, 2024, 11:00-12:00

Yann de Mey



Motivation



European Review of Agricultural Economics

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1-20 of 1104

risk

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Journal Article

Estimating risk preferences in the presence of bifurcated wealth dynamics: can we identify static risk aversion amidst dynamic risk responses?

Travis J. Lybbert and others

European Review of Agricultural Economics, Volume 40, Issue 2, March 2013, Pages 361-377,
<https://doi.org/10.1093/erae/jbs027>

Published: 16 August 2012

...Travis J. Lybbert; David R. Just; Christopher B. Barrett The potential to misattribute a dynamic risk response to an innate risk preference has been raised recently in the literature. As demonstrated in Lybbert and Barrett (2011), when agents face known non-convex wealth dynamics, observed...

Abstract

Perform this

Journals Oxford Academic

Masterclass Overview

An overview of defining, measuring, and characterizing farm-level risk exposure

1. Defining Risk
2. Objective vs. Subjective Risk
3. Measuring Risk
4. Characterizing Farm-Level Risk Exposure

Focus on agecon, presenting bigger picture, and intuition

1. Defining Risk



"Risk is like love, we all know what it is, but we don't know how to define it"

Joseph Stiglitz



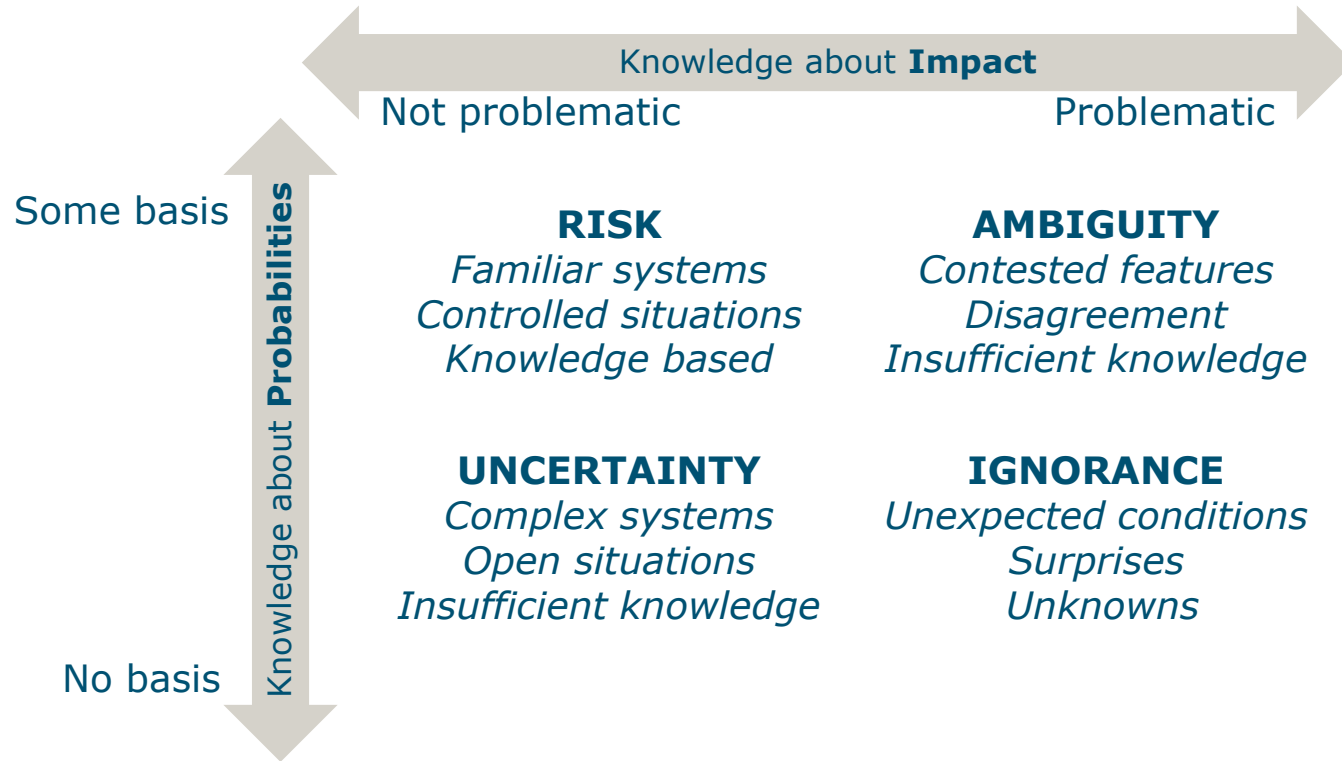
Definitions of Risk / Concepts

- Two main dimensions:
 - Probability (likelihood/chance/...)
 - Impact (outcomes/return/...)
- Most famous distinction made by Knight (1921) focusing on measurability



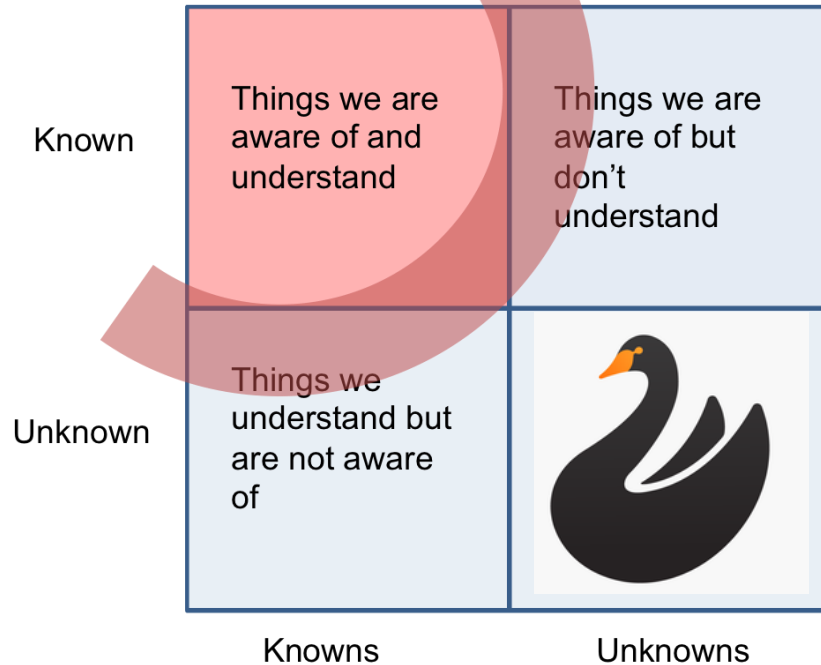
- However, this definition is narrow and at odds with daily language
- More recently, we use knowledge about both dimensions for further classification

Definitions of Risk / Concepts



Definitions of Risk / Concepts

1975 to 1977 United States Secretary of Defense Donald Rumsfeld



Definitions of Risk / Concepts

- Note that Risk should not be defined as

Probability **x** Impact

- This is expected value (EV), a risk metric (see part 3), not risk per se
- In fact, this is a risk metric that is informative in some cases but in most cases not (e.g. different combinations leading to same value):

$$1/4 \times 2 = 0.5 \quad \text{versus} \quad 3/4 \times 2/3 = 0.5$$

- According to risk science, risk is defined as a triplet (Kaplan & Garrick, 1981):

< Scenario **+** Probability **+** Impact >

Formal Definitions of Risk

-  *The possibility of something bad happening at some time in the future; a situation that could be dangerous or have a bad result*
- Hardaker et al. (2015): *Uncertainty that matters*
- Society for Risk Analysis (2020):
 - A future activity
 - In relation to the consequences and some reference values
 - Related to something that humans value
 - Focus is often on negative, undesirable consequences (always at least one outcome considered negative or undesirable)



Formal Definitions of Risk

Society for Risk Analysis Glossary



1. Risk is the possibility of an unfortunate occurrence
2. Risk is the potential for realization of unwanted, negative consequences of an event
3. Risk is exposure to a proposition (e.g., the occurrence of a loss) of which one is uncertain
4. Risk is the consequences of the activity and associated uncertainties
5. Risk is uncertainty about and severity of the consequences of an activity with respect to something that humans value
6. Risk is the occurrences of some specified consequences of the activity and associated uncertainties
7. Risk is the deviation from a reference value and associated uncertainties

Formal Definitions of Risk

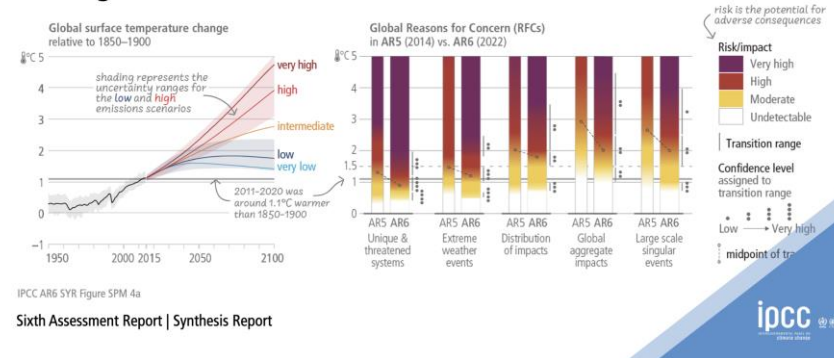
- Even though various definitions exist, they agree/converge on:
 - Covering < Scenario + Probability + Impact >
 - Being distinct from risk measurement (which warrants diverse approaches)
- Our level of confidence is also a highly relevant aspect

Risk

The potential for adverse consequences for human or ecological systems, recognising the diversity of values and objectives associated with such systems. In the context of *climate change*, *risks* can arise from potential *impacts* of *climate change* as well as human responses to *climate change*. Relevant adverse consequences include those on lives, *livelihoods*, *health* and *well-being*, economic, social and cultural assets and investments, *infrastructure*, services (including *ecosystem services*), *ecosystems* and species.

Risks are increasing with every increment of warming

High risks are now assessed to occur at lower global warming levels



Intermezzo: Can we compare all risks?

Tweet by Kim Kardashian West that earned "International Statistic of the Year" 2017

 **Kim Kardashian West** ✓
@KimKardashian

Follow

Statistics

Number of Americans killed annually by:	
Islamic jihadist immigrants ¹ :	2
Far right-wing terrorists ¹ :	5
All Islamic jihadist terrorists (including US citizens) ¹ :	9
Armed toddlers ² :	21
Lightning ³ :	31
Lawnmowers ⁴ :	69
Being hit by a bus ⁴ :	264
Falling out of bed ⁴ :	737
Being shot by another American ⁵ :	11,737

¹10-year average of terrorist attacks. "Deadly Attacks Since 9/11," New America, <http://securitydata.newamerica.net/extremists/deadly-attacks.html>
²www.snopes.com/toddlers-killed-americans-terrorists/
³10-year average of deaths by lightning, NOAA, www.nws.noaa.gov/om/hazstats/resources/weather_fatalities.pdf
⁴10-year average, Underlying Cause of Death 2014, CDC, <http://wonder.cdc.gov/>
⁵10-year average 2005-2014, CDC, Injury Prevention & Control: Data & Statistics (WISQARSTM)
www.cdc.gov/injury/wisqars/fatal_injury_reports.html

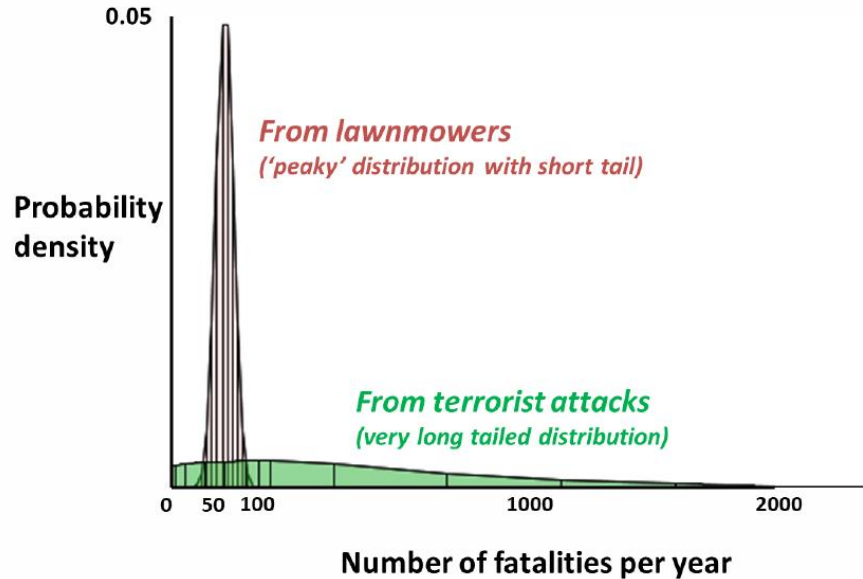
Tweet in response by disruptive thinker Nassim Taleb

 **Nassim Nicholas Taleb** ✓
@nntaleb

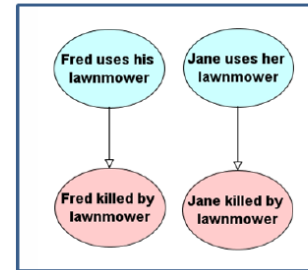
Following

1) Look at head statistician from the Royal Society promoting that BS. No, the 2 variables are NOT comparable statistically.
Your lawnmower is not trying to kill you.

Intermezzo: Can we compare all risks?



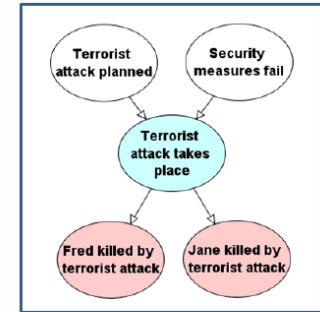
Lawnmowers



If Fred and Jane are killed their deaths are essentially ‘independent’

Idiosyncratic risk

Terrorist attacks



If Fred and Jane are killed their deaths may be the result of the same terrorist attack or same group.

correlated/systemic risk

Various Aspects of Risk Matter

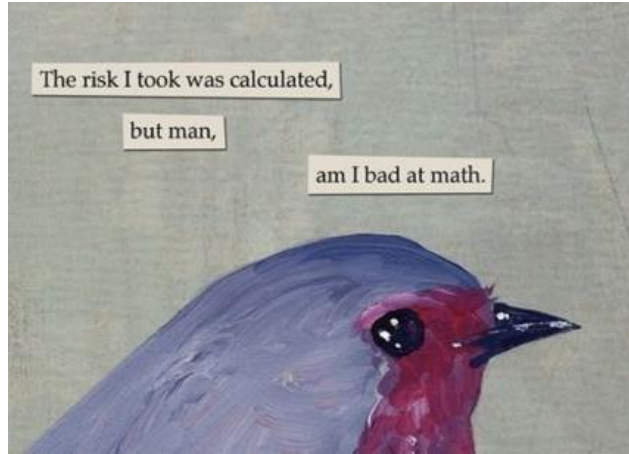
- **Idiosyncratic** (impacting a single entity, e.g. landslide) vs **covariate** (correlated between various entities, e.g. hailstorm)
- **Catastrophic**? Unanticipated, crippling organizations and often leading to ruin (e.g. terrorist attack)
- **Systemic**? Leading to collapse of an entire system, with an important role for interlinkages (e.g. financial crises)
- **Single shock** versus **repeated stressor** (time dimension)
- **Upside risk** (potential) versus **downside risk** (focus on negative)

*A lot of these concepts overlap or are used interchanged
Make sure to characterize your risk of interest well*

2. Objective vs. Subjective Risk



Objective vs. Subjective Risk



Objective Risk (real risk)

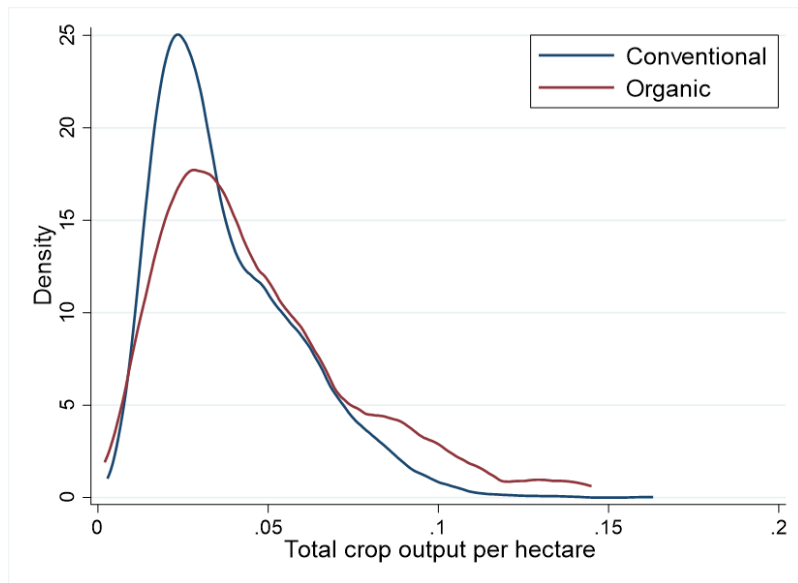
VS.

Subjective Risk (risk as-feelings)
(Loewenstein et al., 2001)

- Risk is always subjective, depends on your definitions
- We often treat risk as being objective, we have to, but be aware this introduces model risk
- Risk is inherently human, probability (theory) its language

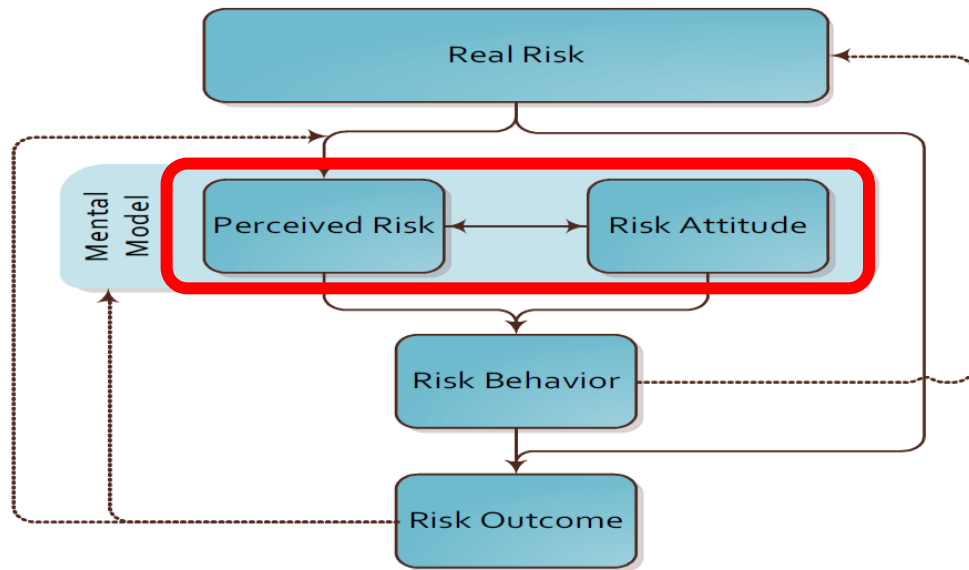
Objective vs. Subjective Risk

Risk Characterization



Ex-Post / Understanding

vs. Decision Making Under Risk



vs. Ex-ante / Prediction

Objective vs. Subjective Risk

Probabilities for decision analysis in agriculture and rural resource economics: The need for a paradigm change

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ABSTRACT

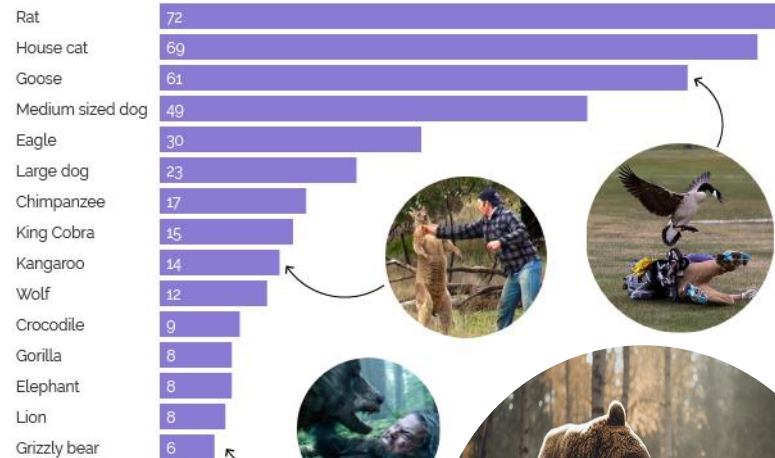
The notion that we can rationalize risky choice in terms of expected utility appears to be widely if not universally accepted in the agricultural and resource economics profession. While there have been many attempts to assess the risk preferences of farmers, there are few studies of their beliefs about uncertain events encoded as probabilities. We may attribute this neglect to scepticism in the profession about the concept of subjective probability. The general unwillingness to embrace this theory and its associated methods has all too often caused researchers to focus on problems for which frequency data are available, rather than on problems that are more important where data are generally sparse or lacking. In response, we provide a brief reminder of the merits of the subjectivist approach and extract some priorities for future research should there be a change of heart among at least some of the profession.

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Intermezzo: Does subjective risk matter?

6% of Americans think they could beat a grizzly bear in a fight

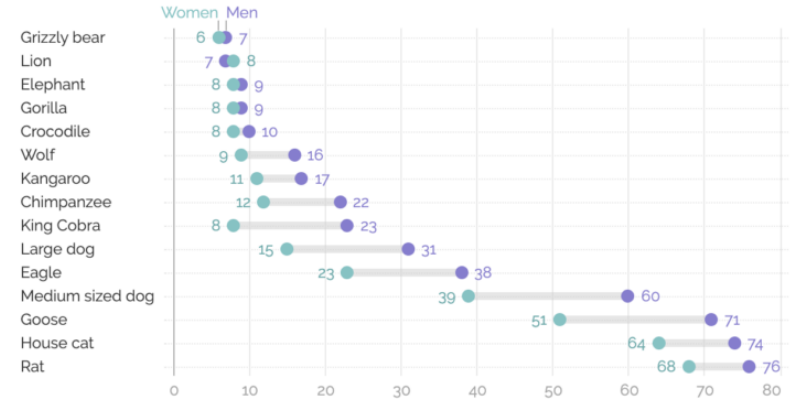
Which of the following animals, if any, do you think you could beat in a fight if you were unarmed? %



YouGov

What animal could you beat in a fight? Compared to women, men feel most able to take on medium-sized dogs and geese

Which of the following animals, if any, do you think you could beat in a fight if you were unarmed? %



YouGov

April 12-13, 2021

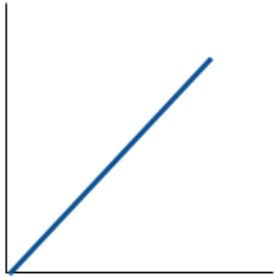
See also Wilson, R. S., Zwickle, A., & Walpole, H. (2019). Developing a broadly applicable measure of risk perception. *Risk Analysis*, 39(4), 777-791.

Objective vs. Subjective Risk

- In essence: both approaches/perspectives matter depending on the application
- When modelling or approaching from “rational” or data-driven perspective we treat it as objective
- When used for decision making it always involves some level of subjectivity (see also Cerroni and Rippo, 2023)
- Note that at the core of the leading theories used to model economic decision making, assumptions are made regarding risk (perception) and risk preferences

Objective vs. Subjective Risk

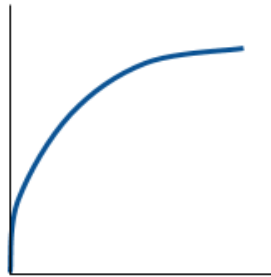
Expected
Value



Outcome x
 $EV = px$

Risk neutrality

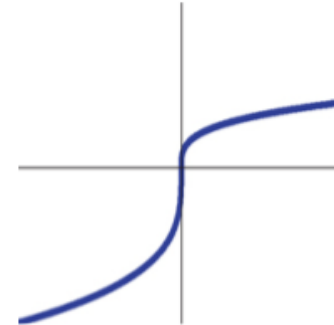
Neoclassical
Economics



Utility $u(x)$
 $EU = pu(x)$

Risk Aversion
Risk Neutrality
Risk Loving/Seeking

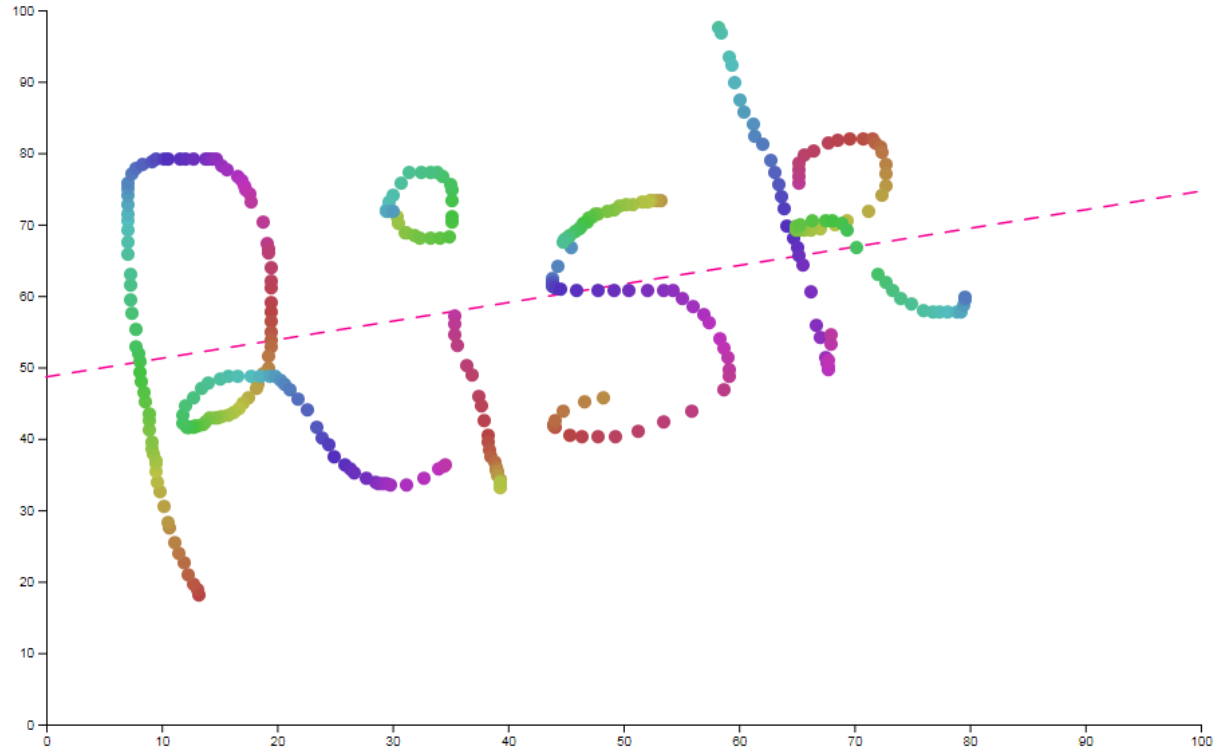
Prospect
Theory



Value $v(x)$
 $EP = pv(x)$

Risk Aversion
Loss Aversion
Probability Weighting

3. Measuring Risk

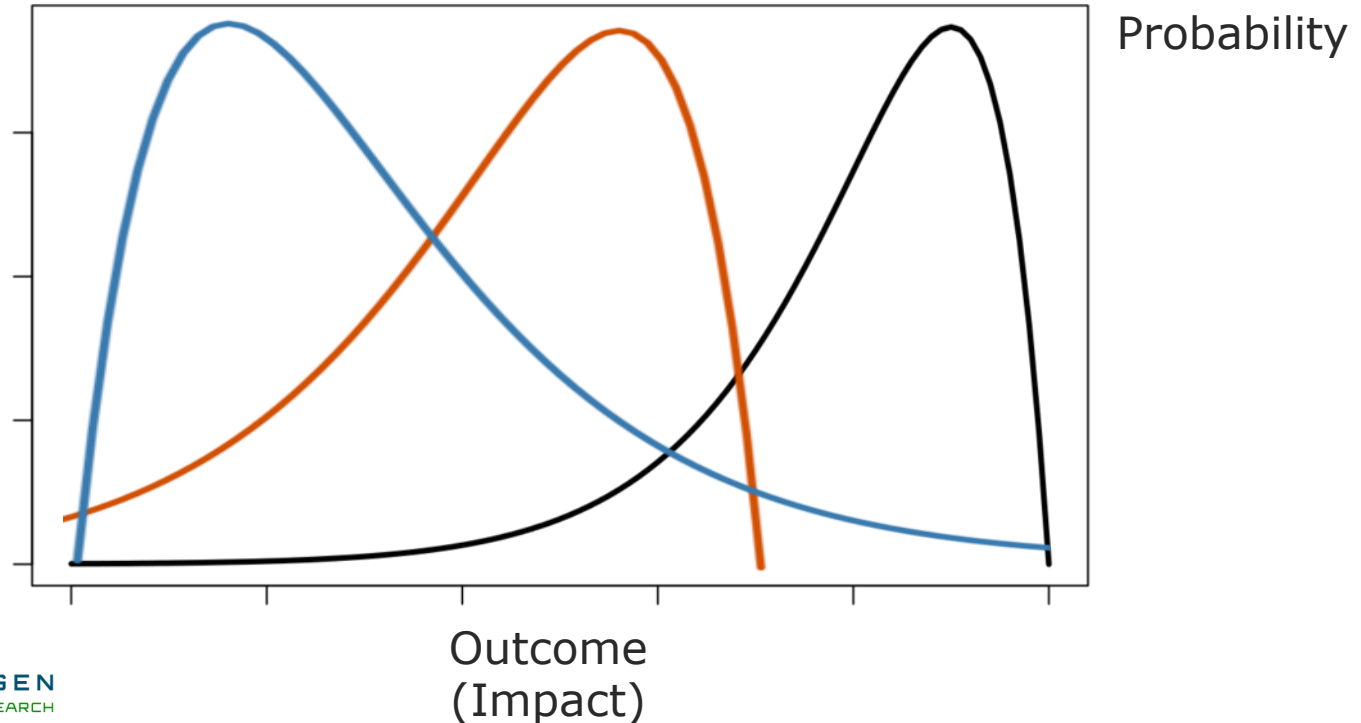


From Risk Definition to Risk Measures

- Hardaker (2000) identifies 3 major views on risk that help classify different measures of risk:
 - I. Uncertainty of outcomes
 - II. Variability of outcomes
 - III. Chance of bad outcomes
- Although seemingly similar, these three views imply quite different ways of measuring risk
- When formally defined, they can be seen to be mutually inconsistent...

From Risk Definition to Risk Measures

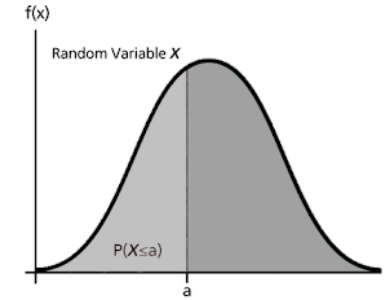
A starting/reference point is thinking in terms of distributions



I. Uncertainty of Outcomes

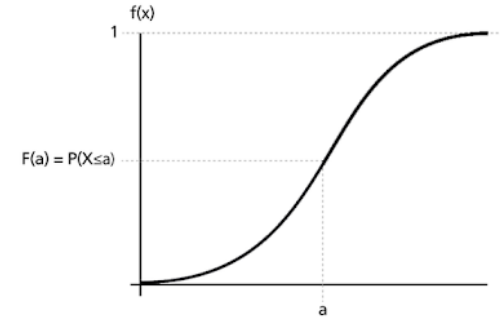
- Probability density function (PDF)

Probability that random variable X will take a value equal to a



- Cumulative density function (CDF)

Probability that X will take a value less than or equal to a

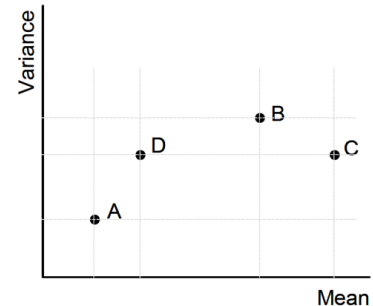


- In essence looking at the (distribution of) the data across all relevant scenarios

II. Variability of Outcomes

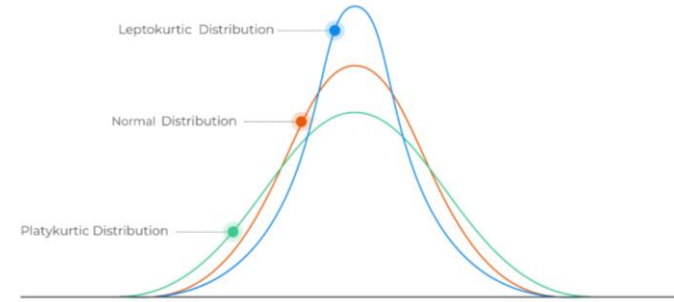
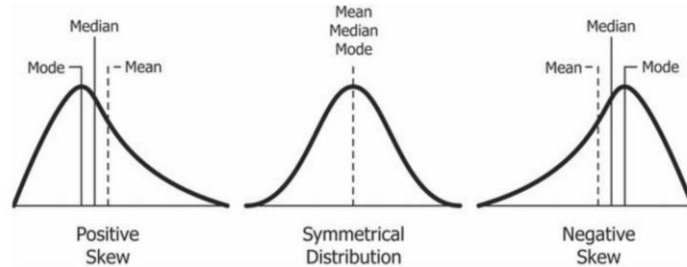
- Ranges
 - Range of possible values: [Min – Max]
 - Percentiles of values: P01, P05, P50, P99, P90
 - Variability measures
 - Variance, Standard Deviation (SD) versus Mean
- $$\text{Var}(X) = \frac{1}{n} \sum_{i=1}^n (x_i - \mu)^2 \quad \sigma = \sqrt{\frac{1}{N} \sum_{i=1}^N (x_i - \mu)^2}$$
- Coefficient of Variation (CV) = SD/Mean
 - Often used to depict volatility, symmetric measures

$$\bar{x} = \frac{1}{n} \left(\sum_{i=1}^n x_i \right)$$



II. Variability of Outcomes

- Skewness and Kurtosis (higher moments of distribution)

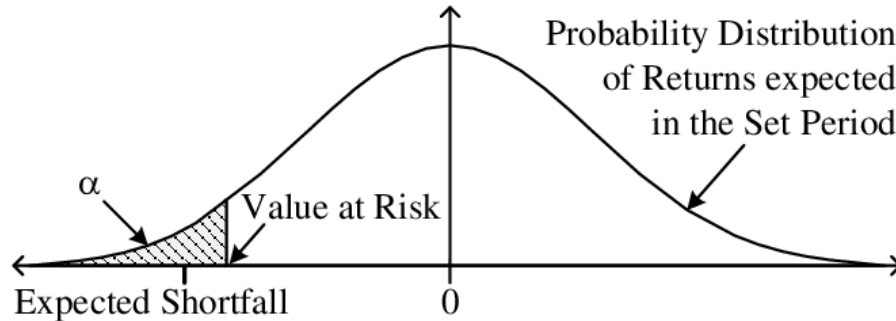


- Partial moments: Semi-variance, Semi-standard deviation (Downside risk)

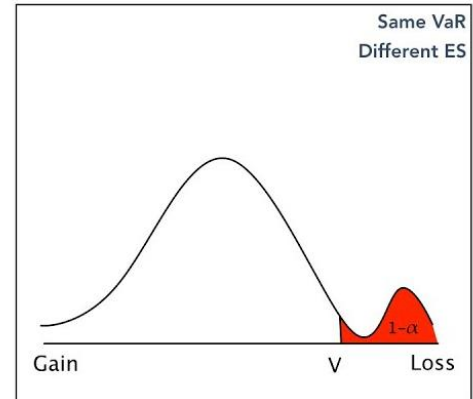
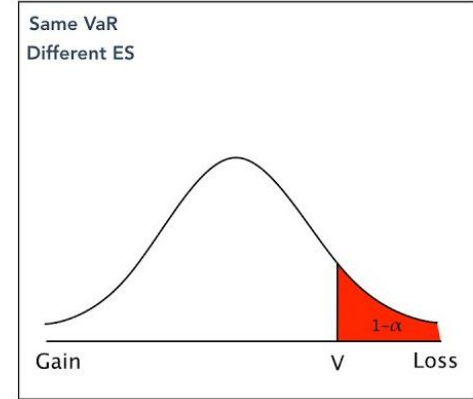
$$SV_{lower}(X) = \frac{1}{n-1} \sum [(X - \bar{X})^2 \cdot IF(X \leq \bar{X})]$$

III. Chance of Bad Outcomes

- $P(X < X^*)$ with $X^* =$ minimally acceptable outcome (0?)
- Value At Risk: $\text{VaR}_{\alpha\%}$ (threshold loss value)
- Expected Tail Loss (ETL) or Expected Shortfall (ES)



- Specify $\alpha\%$ (threshold loss value) and reference period

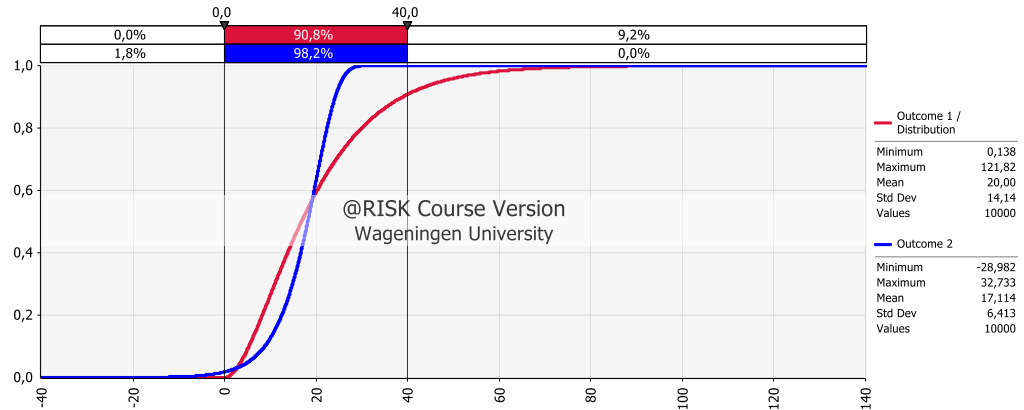
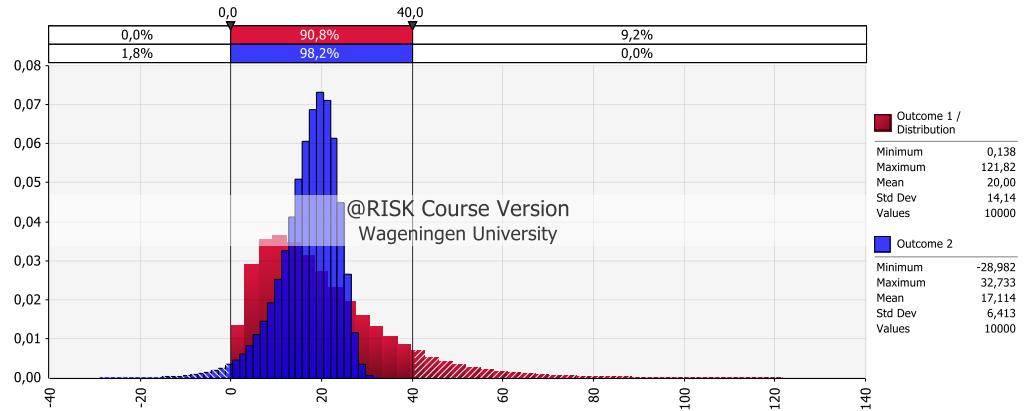


How to Select a Risk Measure?

Which distribution would you prefer?

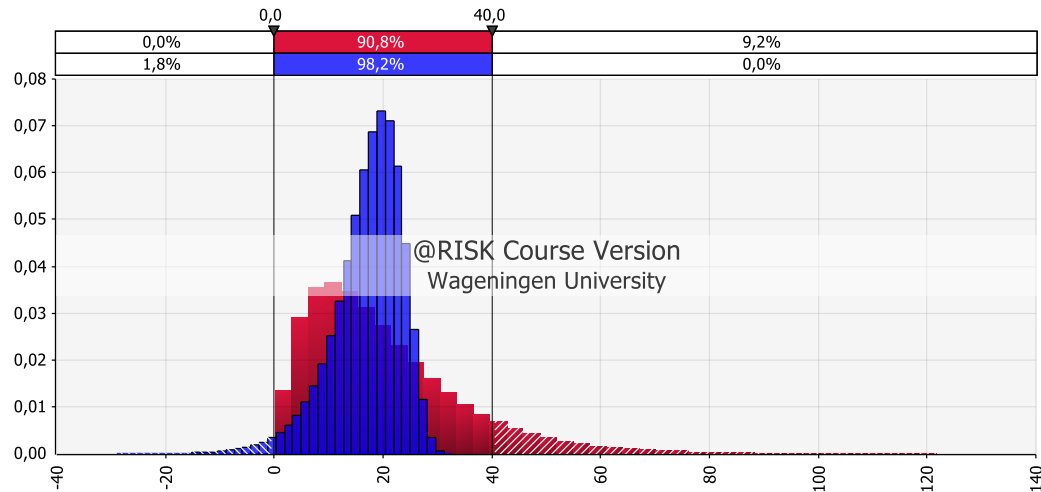
Assume this is a positive outcome you care about (e.g. income)

Alternatively: which distribution is more risky in your view?



How to Select a Risk Measure?

	Min	Max	Mean	SD	CV	Skewness	Kurtosis	P<0	P<10	VaR _{5%}	ETL _{5%}
RED	0.14	121.82	20.00	14.14	70.69%	1.407	5.908	0.00%	26.43%	3.55	20.00
BLUE	-28.98	32.73	17.11	6.41	37.47%	-1.137	5.363	1.82%	12.66%	5.14	17.11



How to Select a Risk Measure?

- *"Aiming for consensus on the definition of risk based on risk metrics is not meaningful"* (Aven, 2023)
- Depending on your view on risk (always define it!)
- In line with your theory, for example
 - Portfolio analysis using mean-variance approach
 - Goal: company minimizing probability of making a loss
- Depending on its properties
 - Symmetric measure? (e.g. volatility matters)
 - Downside risk or not?
- Consider a combination of measures
- General risk measures, axiomatic view, convex/coherent risk measures

Coherent Risk Measures

- Theory from financial economics/ mathematical finance
- Introduced by Artzner et al. (1999)
- Set of properties that matter for risk measures:
 - Normalization (The risk of nothing is zero)
 - Monotonicity (a security that always has higher return in all future states has less risk of loss)
 - Sub-additivity (diversification is risk reducing)
 - Positive homogeneity (if a portfolio doubles, the risk will also be doubled)
 - Translation invariance (if a certain amount is added to a portfolio, then the risk is reduced by that amount)
 - ... *(more have been developed)*

Coherent Risk Measures

- No single risk measure meets all of these properties!
- A risk measure captures only some of the characteristics of risk, every risk measure is incomplete.
- Any sensible risk measure needs to obey at least normalization, monotonicity and translation invariance
- Coherent risk measures also in addition meet sub-additivity, and positive homogeneity
- This underscores the importance of using diverse risk measures
- For examples
 - Variance is not coherent (not sub-additive), yet SD is
$$\text{var}(X + Y) = \text{var}(X) + \text{var}(Y) + 2\rho(X, Y)\text{sd}(X)\text{sd}(Y) \quad \text{sd}(X + Y) \leq \text{sd}(X) + \text{sd}(Y)$$
 - VaR is not a coherent (not sub-additive), ES is

4. Characterizing Farm-Level Risk Exposure



How to approach this?

Subjective vs Objective

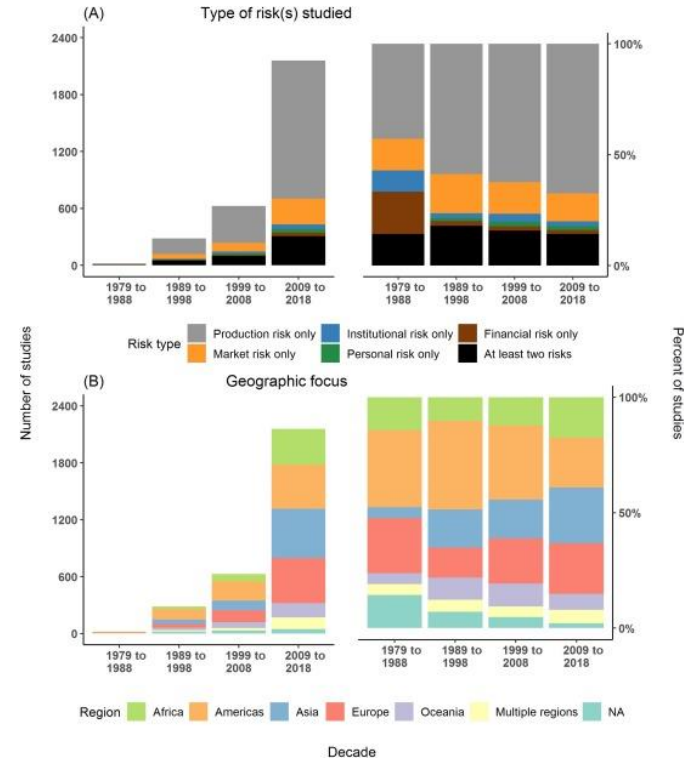
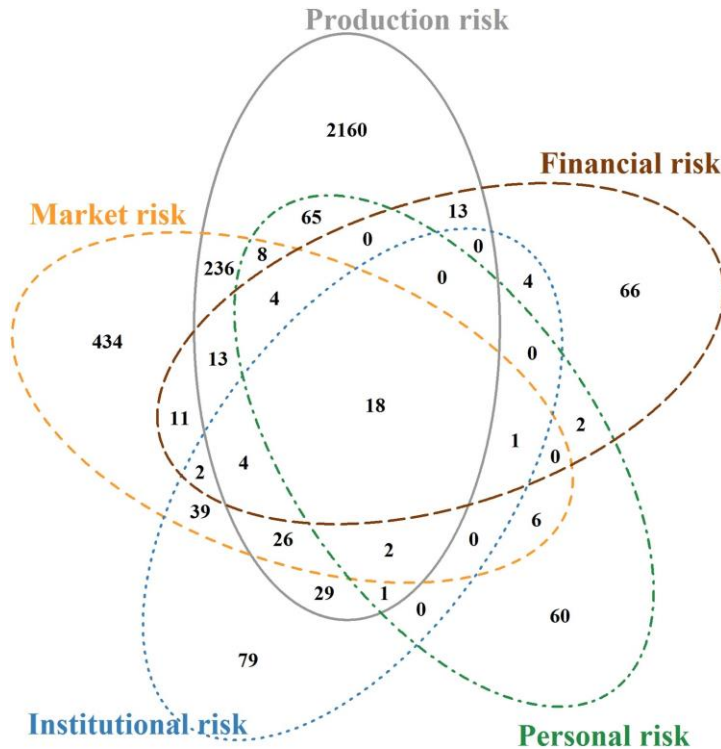
Data availability/source

- Primary (survey) data vs. secondary data
- Sparse data <> abundant data <> too much data?

Types of risk

- Market, Production, Financial, Institutional and Personal (+more!)

Different Types of Risk



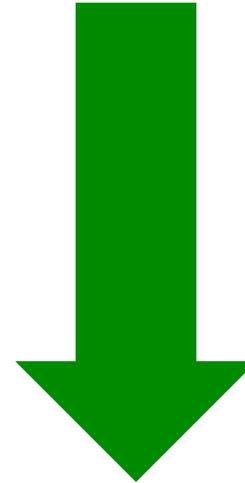
3 Main Approaches

I. Direct Elicitation

II. Simulation

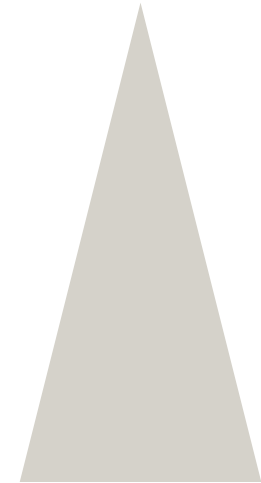
III. Data-driven / Econometrics

Subjective



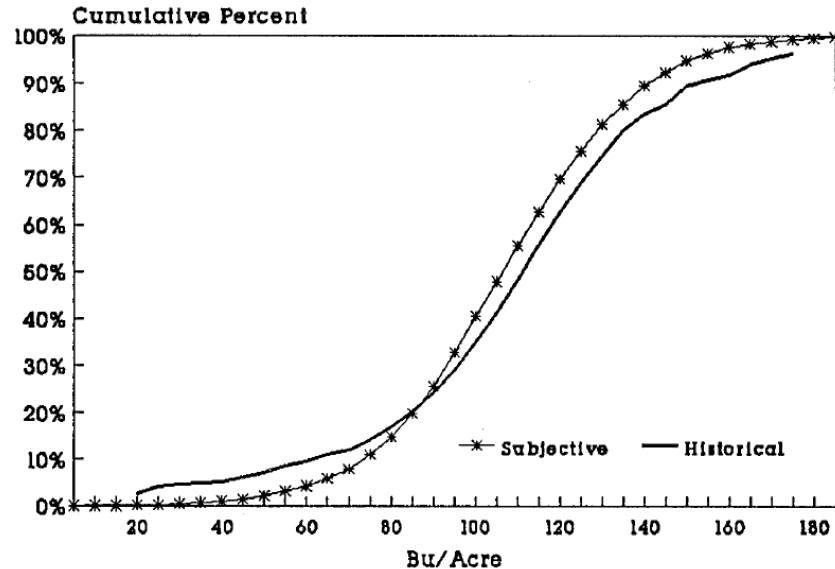
Objective

Data availability



I. Direct Elicitation

Elicit with decision maker full CDF

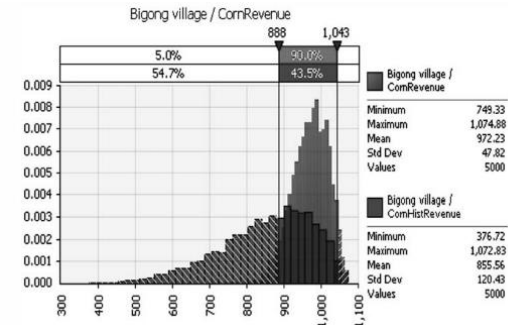


Pease, J. W. (1992). A comparison of subjective and historical crop yield probability distributions. *Journal of Agricultural and Applied Economics*, 24(2), 23-32.

... Or parts of it to construct it

If you grow corn or wheat, identify the lowest yield you believe possible, the yield that you believe is most likely to be received, and the highest possible yield you believe possible (jin/mu) in the next crop year (2010/11) If you do not recall exacts, please answer to nearest within 10 jin/mu

Crop	Lowest possible yield (<u>j</u> in/mu)	Most likely yield (<u>j</u> in/mu)	Highest possible yield (<u>j</u> in/mu)
1 Corn			
2 Wheat			



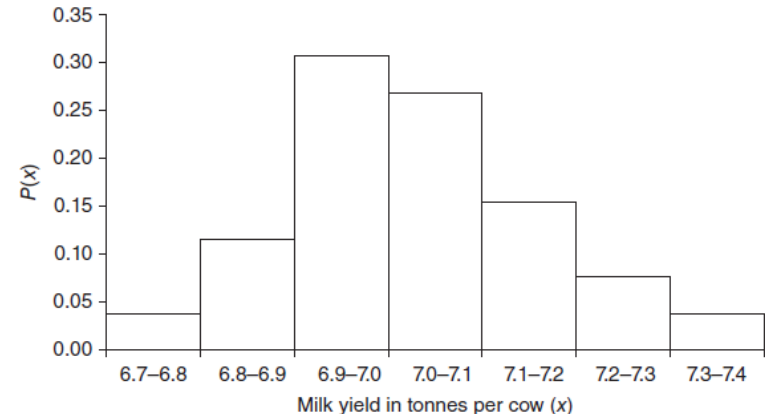
Turvey, C. G., Gao, X., Nie, R., Wang, L., & Kong, R. (2013). Subjective risks, objective risks and the crop insurance problem in rural China. *The Geneva Papers on Risk and Insurance-Issues and Practice*, 38(3), 612-633.

I. Direct Elicitation

Visual impact method (Hardaker et al. 2015)

Range in milk yield (kg per cow/year)	Probability weight (counters)	Count	Probability ^a
6700–6799	•	1	$1/26 = 0.038$
6800–6899	•••	3	$3/26 = 0.115$
6900–6999	••••• •••	8	$8/26 = 0.308$
7000–7099	••••• ••	7	$7/26 = 0.269$
7100–7199	••••	4	$4/26 = 0.154$
7200–7299	••	2	$2/26 = 0.077$
7300–7400	•	1	$1/26 = 0.038$
	Totals	26	1.000

^aProbabilities in this column do not sum exactly to 1.0 due to rounding.



I. Direct Elicitation

Using Likert scales

What are the chances of the following developments to happen on your farm, in the near future:

Low probability **High probability**

Loss of production due to (extreme) weather conditions	1	-	2	-	3	-	4	-	5
Loss of production due to disease (epidemic)	1	-	2	-	3	-	4	-	5

What is the impact on your farm in case the following developments did occur

Low impact **High impact**

Loss of production due to (extreme) weather conditions	1	-	2	-	3	-	4	-	5
Loss of production due to disease (epidemic)	1	-	2	-	3	-	4	-	5

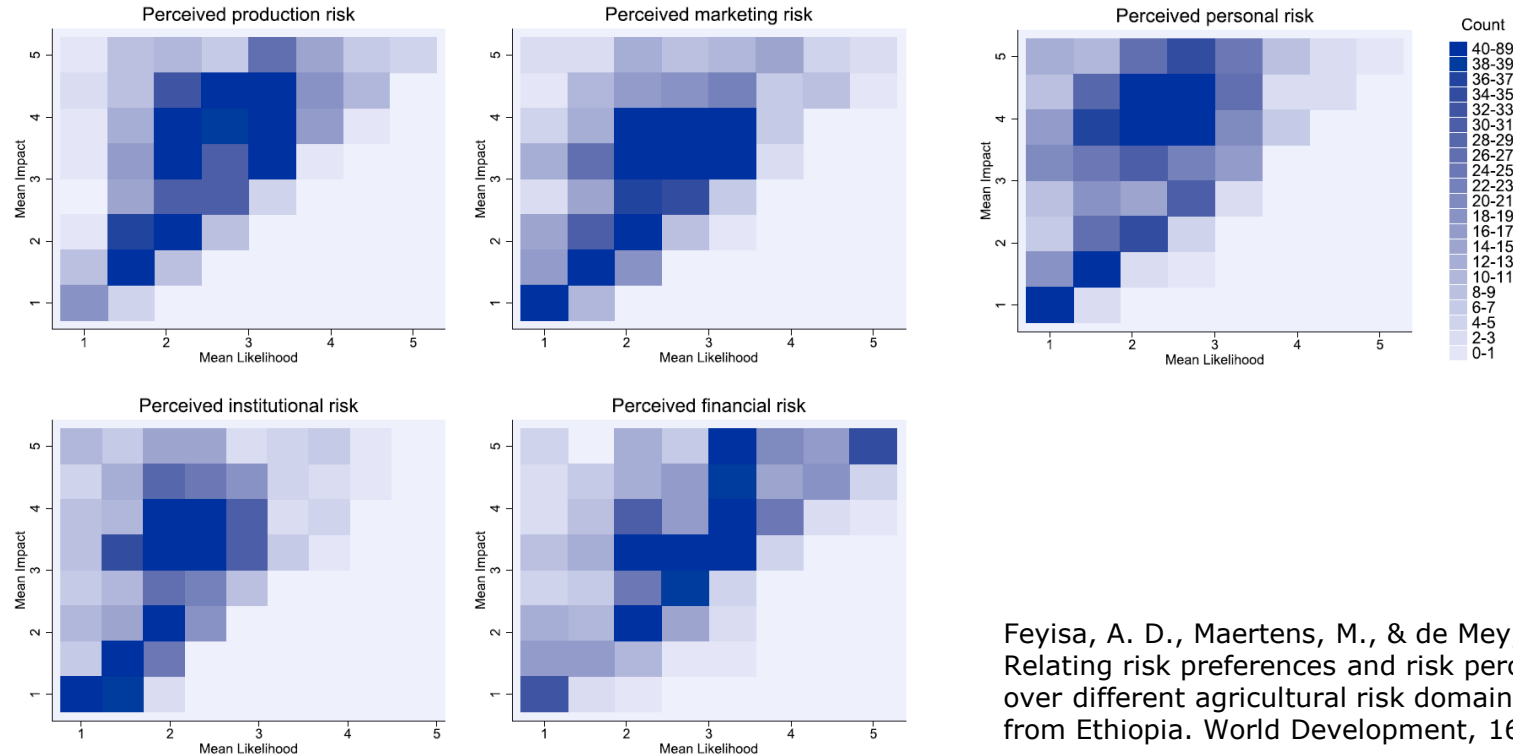
To what extend can you personally influence the occurrence or impact of the following developments:

Low influence **High influence**

Loss of production due to (extreme) weather conditions	1	-	2	-	3	-	4	-	5
Loss of production due to disease (epidemic)	1	-	2	-	3	-	4	-	5

I. Direct Elicitation

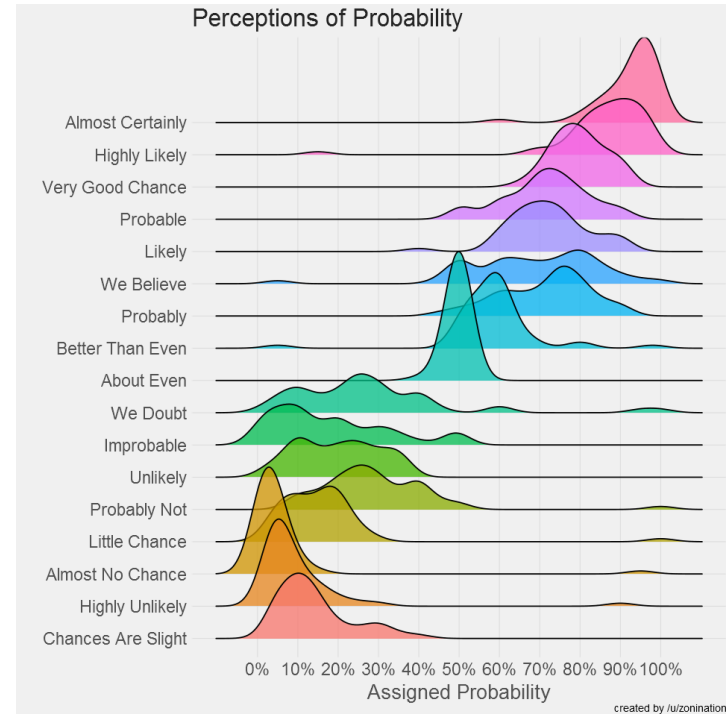
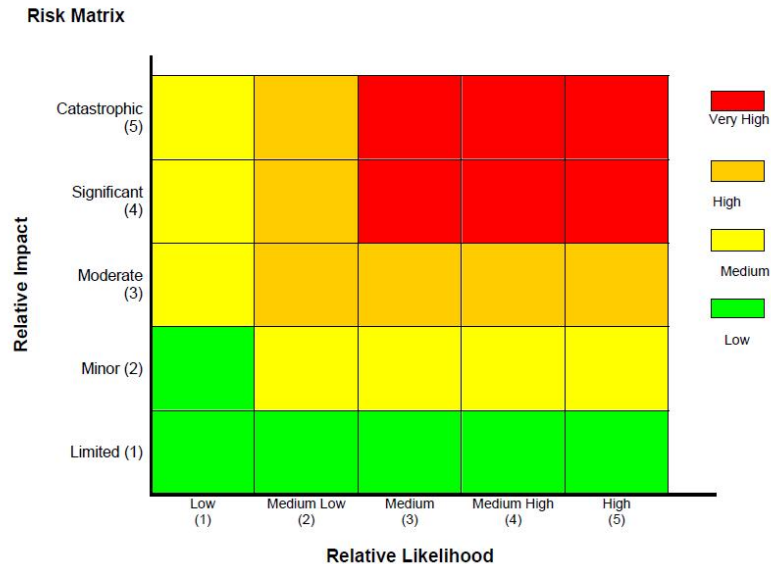
Creating Heatmaps



Feyisa, A. D., Maertens, M., & de Mey, Y. (2023). Relating risk preferences and risk perceptions over different agricultural risk domains: Insights from Ethiopia. *World Development*, 162, 106137.

I. Direct Elicitation

One word of caution... about muddy waters



II. Simulation

General approach

- Stylize your problem using equations
- Where you define outputs, and inputs affecting it
- Impose distributions on the stochastic inputs
- Parametrize model using data + expert elicitation
- Using Monte Carlo simulation, simulate input distributions across n iterations (e.g. using R or @Risk in Excel)
- Obtain empirical distribution of output > risk measures

II. Simulation

$$\text{Yield losses} = [\text{Yield}_{\text{potential}} - \text{Yield}_{\text{disease}}] \times \text{Price}.$$

$$\text{Yield}_{\text{potential}} = \frac{\text{Yield}_{\text{reference}}}{(1 - \text{Prevalence}_{\text{reference}}) \times (1 - \text{Mortality}_{\text{reference}})}.$$

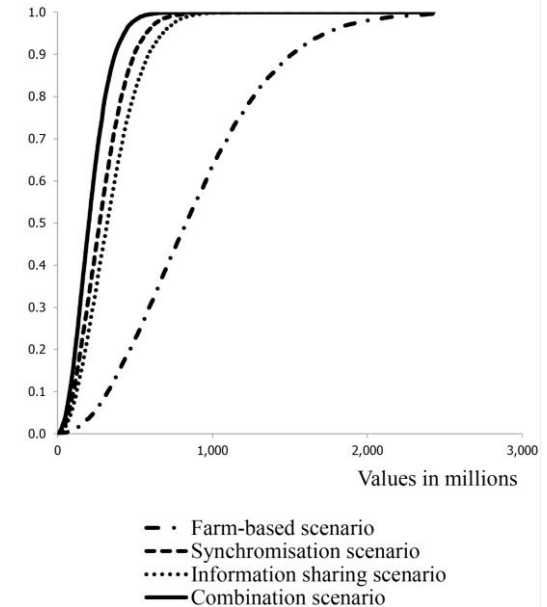
$$\text{Yield}_{\text{disease}} = \text{Yield}_{\text{potential}} \times (1 - \text{Prevalence}) \times (1 - \text{Mortality})$$

Variable	Unit	Distribution	Description	Scenario			
				Farm-based	Synchronization ¹	Information sharing ¹	Combination ¹
Yield _{reference}	kg/ha/crop	Normal	Mean; SD	3.080; 1.403 ^a			
Prevalence rate _{reference}	% per crop	Uniform	Min; Max	10; 20 ^a			
Mortality rate _{reference}	% per crop	Uniform	Min; Max	10; 30 ^b			
Number of crops	#/year	Discrete	Value	1; 2; 3 ^a			
Shrimp price	1,000 VND/kg	Pert	Probability	0.35; 0.59; 0.06 ^a			
WSD			Min; ML; Max	30; 130; 190 ^b			
Prevalence rate-Lit	% per crop	Uniform	Min; Max	40; 71 ^c			
Prevalence rate-W*	% per crop	Pert	Min; ML; Max		29; 43; 64	40; 52; 66	41; 54; 71
Prevalence rate-W**	% per crop	Pert	Min; ML; Max		31; 48; 59	34; 51; 62	29; 39; 54
Mortality rate-Lit	% per crop	Uniform	Min; Max	80; 100 ^d			
Mortality rate-W*	% per crop	Pert	Min; ML; Max		76; 87; 97	80; 89; 99	70; 79; 88
Mortality rate-W**	% per crop	Pert	Min; ML; Max		56; 64; 78	64; 72; 86	47; 57; 70
AHPND							
Prevalence rate-Lit	% per crop	Uniform	Min; Max	52; 87 ^e			
Prevalence rate-W*	% per crop	Pert	Min; ML; Max		41; 54; 72	48; 70; 80	41; 51; 71
Prevalence rate-W**	% per crop	Pert	Min; ML; Max		29; 45; 58	42; 55; 70	29; 40; 55
Mortality rate-Lit	% per crop	Uniform	Min; Max	40; 100 ^f			
Mortality rate-W*	% per crop	Pert	Min; ML; Max		40; 56; 89	38; 64; 89	34; 54; 78
Mortality rate-W**	% per crop	Pert	Min; ML; Max		31; 47; 60	40; 55; 72	29; 43; 56

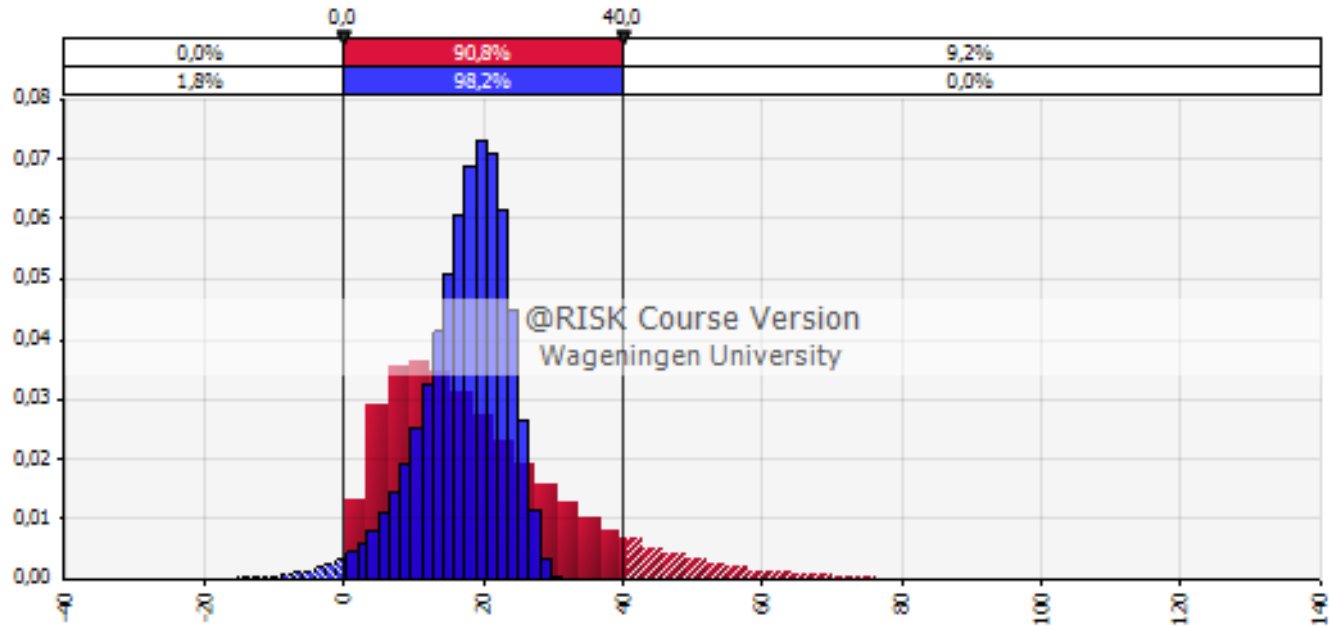
Notes: Lit: literature; W*: workshop in English; W**: workshop in Vietnamese; min: Minimum; ML: most likely; Max: maximum; SD: standard deviation.

Source: ^aPhong et al., 2021; ^bNgoc et al., 2021; ^cDesrina et al., 2022; ^dOIE 2021 and Thitamadee et al., 2016; ^eNguyen et al., 2021; ^fBoonyawiwat et al., 2018 and OIE 2021; ^gDuy et al., 2021; ^hLe et al., 2022; ⁱExpert elicitation in two workshops.

10.000 iterations
WSD based in Vietnamese workshop



II. Simulation



Blue = @RiskGamma(2;10)

Red = @RiskExtvalueMin(20;5)

III. Data-driven / Econometrics

In very general terms

- You want to estimate the distribution of a “risky” variable Y
- Assuming you have a series of observations for Y (across i and t)
- Conditional versus unconditional approaches
 - Unconditional: curve-fitting exercise (ML based)
 - Conditional: understanding and capturing the DGP
- Parametric, Non-parametric, and Semi-parametric approaches
- Very diverse approaches depending on field/risk (e.g. time series econometrics for price / financial risk)

III. Data-driven / Econometrics

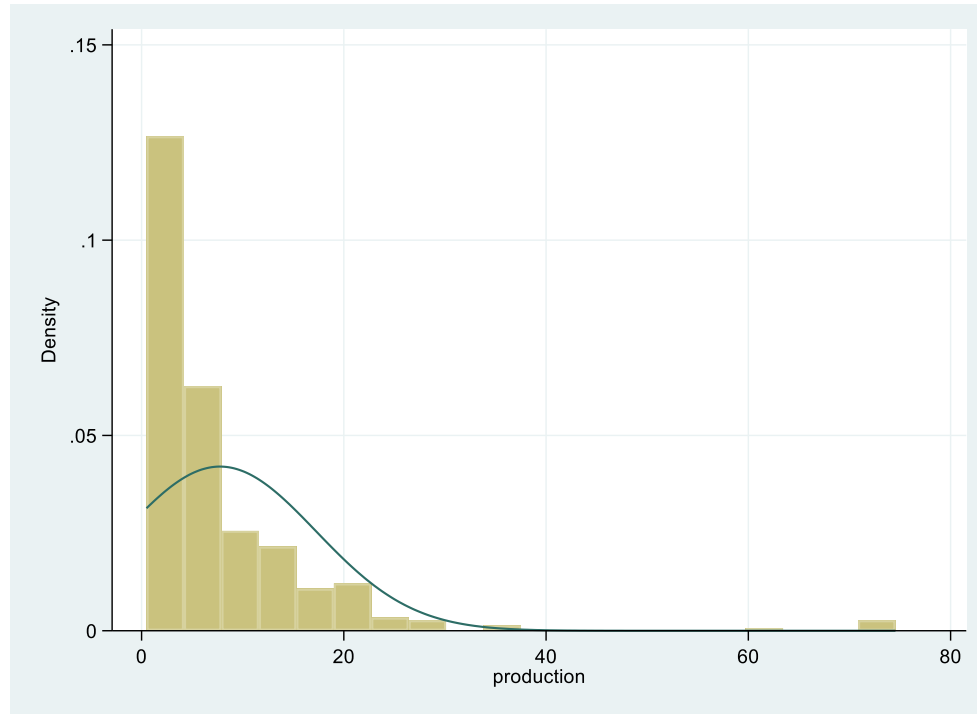
- Impossible to summarize all approaches, so as an example, let's focus on **production risk**
- We have 401 observations of rice producing farms in Senegal

Variable	Explanation	Mean	Std. Dev.
production	Rice production in tonnes	7.75	9.49
land	Land cultivated in ha	1.59	1.84
seed	Seed used in kg	204.51	245.48
labour	Labour used in man x days	87.73	55.49
fertilizer	Fertiliser applied in kg	540.23	661.49
irrgcost	Total costs spent on irrigation in 10 ³ FCFA	97529.10	112157.00
weed	Total costs spent on weeding in 10 ³ FCFA	49727.16	69124.87
bird	Total time spent on bird scaring in man x days	36.18	40.70

III. Data-driven / Econometrics

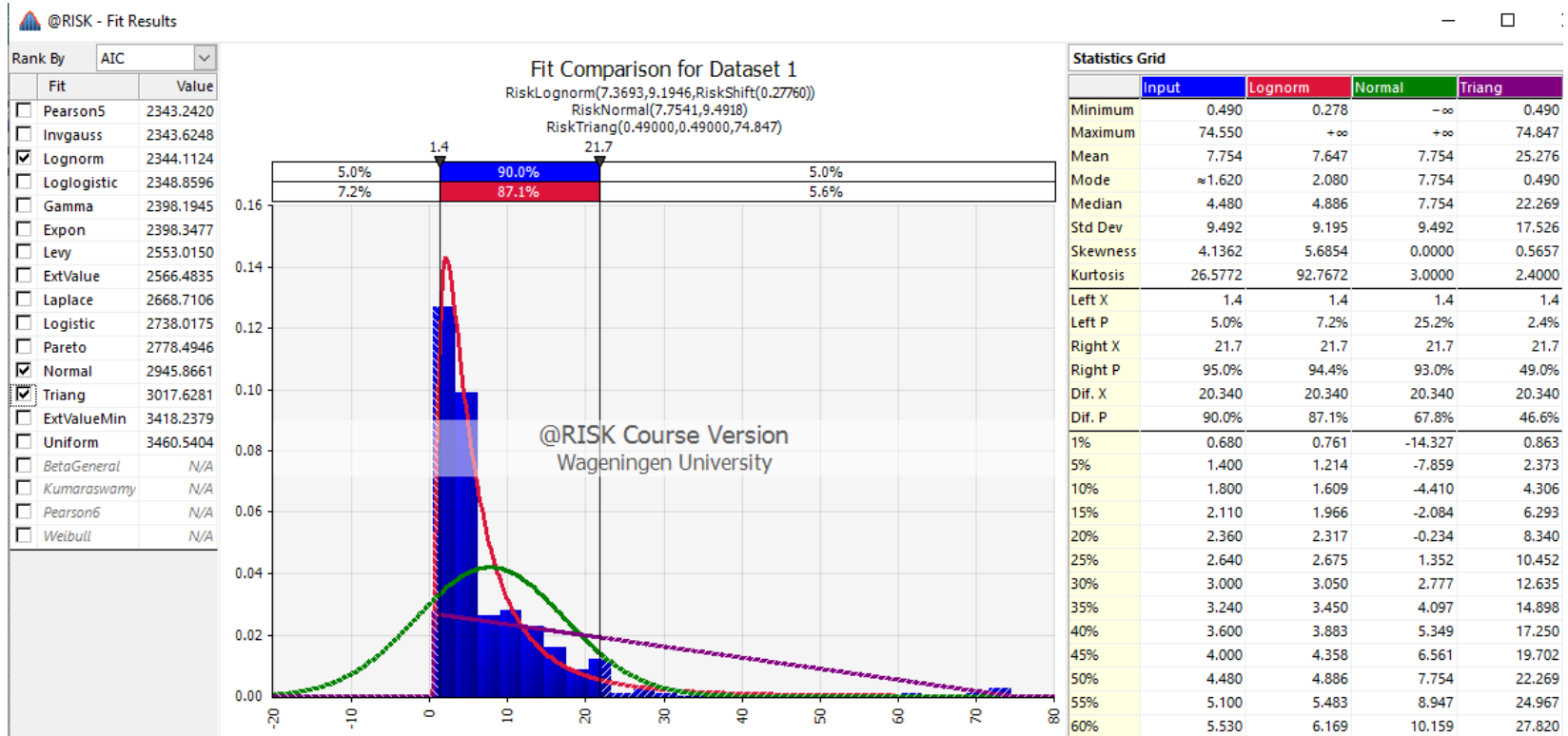
- Impossible to summarize all approaches, so as an example, let's focus on **production risk**
- We have 401 observations of rice producing farms in Senegal
- We will:
 - First explore production risk unconditionally
 - Next consider influential factors, measuring conditional risk
 - Finally consider an econometric framework that allows conditional risk estimation and its determinants: stochastic production functions / moment-based approach

Unconditional Production Risk

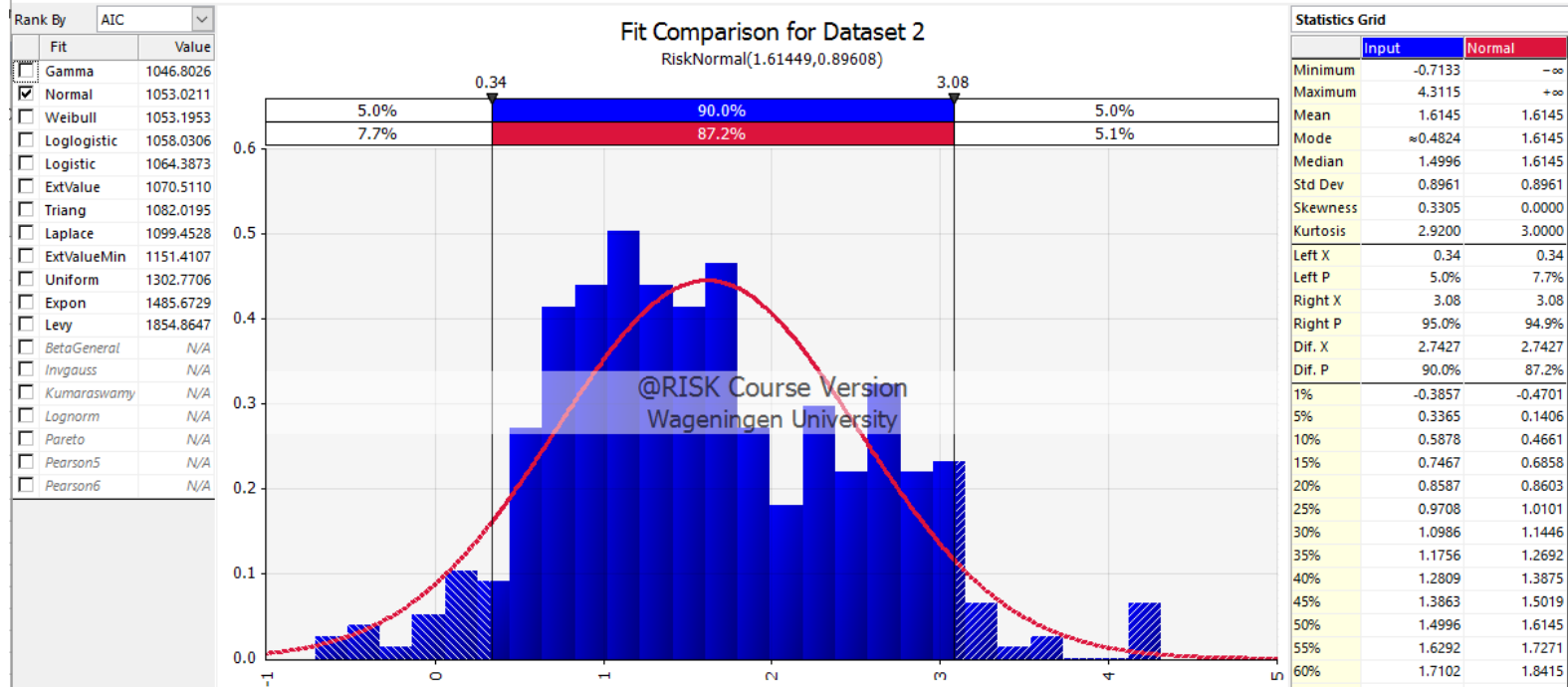


production				
Percentiles		Smallest		
1%	.68	.49		
5%	1.4	.49		
10%	1.8	.63	Obs	401
25%	2.64	.65	Sum of Wgt.	401
50%	4.48		Mean	7.754065
75%	9.84		Std. Dev.	9.491844
90%	16.81	Largest	Variance	90.09511
95%	21.74	71.4	Skewness	4.120663
99%	62.84	72.93	Kurtosis	26.26929
		73.25		
		74.55		

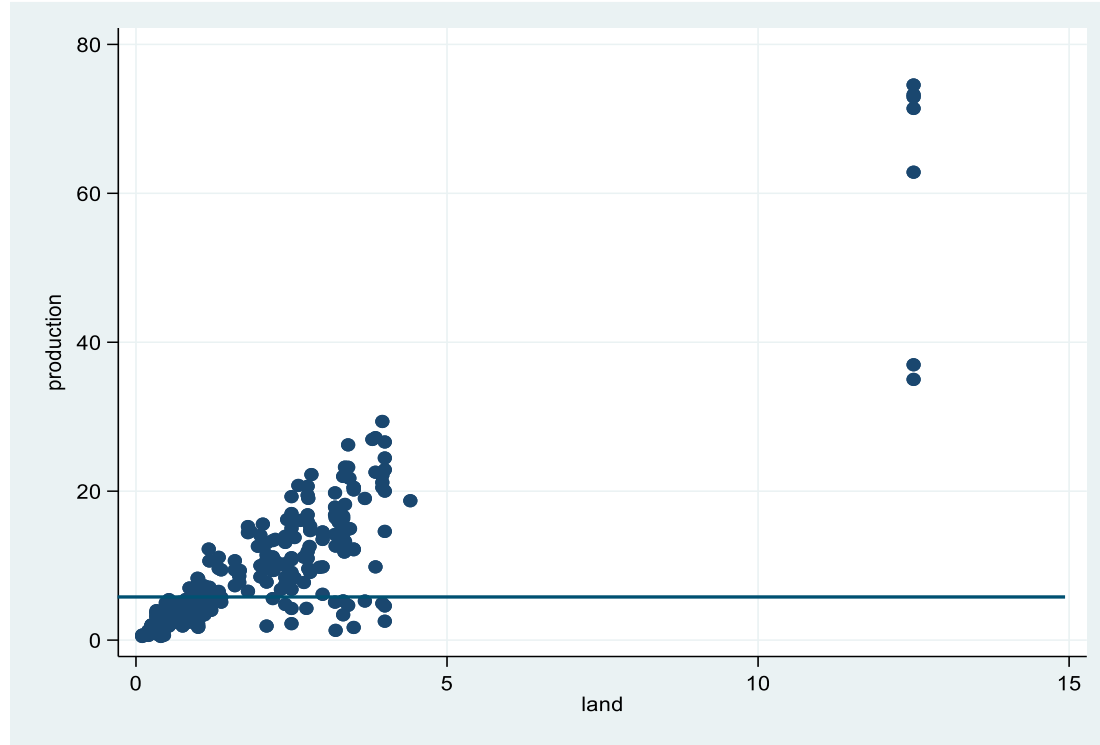
Unconditional Production Risk



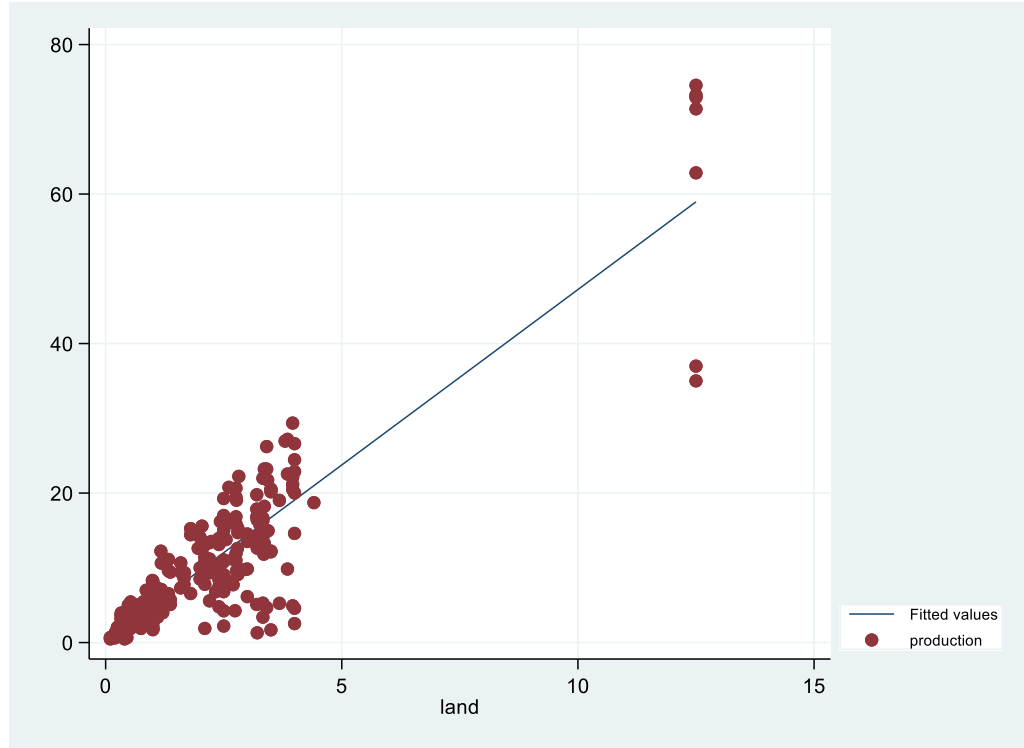
Unconditional Production Risk



Unconditional Production Risk



UnConditional Production Risk



Conditional Production Risk

Stochastic production function approach (Just and Pope, 1978/79)

- $Y_{i,t} = g(t) + m(X_{i,t}) + \varepsilon_{i,t}h(i,t)$
 - $g(t)$ is a time trend (technological advance)
 - $m(X_t)$ captures the effects of influencing factors (inputs, weather, soil conditions, etc.)
 - ε_t is an error term with zero mean and potential heteroskedasticity through variance $h(i,t)$

Conditional Production Risk

Stochastic production function approach (Just and Pope, 1978/79)

- $Y_{i,t} = g(t) + m(X_{i,t}) + \varepsilon_{i,t}h(i,t)$
 - $h(i,t) = h(Z_{i,t})$
 - Where $Z_{i,t}$ is a vector of factors influencing variance. Typically contains the inputs: can be characterised as risk increasing, risk neutral or risk decreasing
- Extended to the higher moments by Antle (1983): impact on skewness, kurtosis, ...
- Many more extensions such as focussing on downside risk by looking at semi-variance (e.g. Finger et al., 2018)

Conditional Production Risk and Determinants

```
* Mean
xtreg LNproduction LNland LNseed LNlabour LNFertilizer LNirrgcost LNweed LNbld i.year, fe
est store mean
predict e, e
predict ue, ue
gen e2=e*e
gen e3=e*e*e
gen e4=e*e*e*e
* Variance
xtreg e2 LNland LNseed LNlabour LNFertilizer LNirrgcost LNweed LNbld i.year, fe
est store variance
* Skewness
xtreg e3 LNland LNseed LNlabour LNFertilizer LNirrgcost LNweed LNbld i.year, fe
est store skewness
* Kurtosis
xtreg e4 LNland LNseed LNlabour LNFertilizer LNirrgcost LNweed LNbld i.year, fe
est store kurtosis
* Semi-variance
xtreg e2 LNland LNseed LNlabour LNFertilizer LNirrgcost LNweed LNbld i.year if ue<=0, fe
est store semi_variance
* Overview Table
esttab mean variance skewness kurtosis semi_variance, star(* 0.1 ** 0.05 *** 0.01) drop(*.year) mtitles(Mean Variance Skewness Kurtosis Semi-var)
```

Conditional Production Risk and Determinants

	(1) Mean	(2) Variance	(3) Skewness	(4) Kurtosis	(5) Semi-var
LNland	0.862*** (4.18)	-0.0513 (-0.53)	0.0116 (0.09)	-0.00190 (-0.01)	-0.193 (-1.01)
LNseed	-0.299* (-1.95)	0.120 (1.64)	-0.106 (-1.05)	0.109 (0.91)	0.296* (1.86)
LNlabour	0.129*** (2.64)	-0.0395* (-1.71)	0.0706** (2.20)	-0.0882** (-2.33)	-0.110** (-2.26)
LNfertilizer	0.150** (1.99)	-0.0236 (-0.66)	0.0285 (0.57)	-0.0412 (-0.71)	-0.101 (-1.22)
LNirrgcost	0.110 (0.83)	-0.00144 (-0.02)	0.0174 (0.20)	-0.00726 (-0.07)	0.113 (0.95)
LNweed	0.0502* (1.81)	-0.00877 (-0.67)	-0.00599 (-0.33)	0.00656 (0.30)	0.00484 (0.08)
LNbird	-0.0213 (-1.23)	0.00168 (0.21)	-0.00260 (-0.23)	0.000992 (0.07)	-0.0107 (-0.54)
_cons	0.0486 (0.03)	-0.123 (-0.15)	-0.0699 (-0.06)	0.0976 (0.07)	-1.630 (-1.08)
N	401	401	401	401	180

t statistics in parentheses

* p<0.1, ** p<0.05, *** p<0.01

Key/Take Home Messages I



- There are various (often confounded) risk-related concepts that all rely on probability and impact.
- Our knowledge on these dimensions matters and leads to risk, uncertainty, ambiguity, and ignorance.
- Risk usually has a distinct set of features, explore and explain these in your context.
- Various definitions of risk exist, be explicit in your paper.
- Risk is inherently subjective, and that is fine.
- An objective versus subjective view/approach depends on the application.

Key/Take Home Messages II



- Among the diverse set of risk measures (and related concepts), all are incomplete. So choose wisely or combine measures.
- Align your risk measure with your view on / definition of risk having your decision maker or research subject in mind.
- Different risk measure = different level of risk.
- Consider looking at multiple risks jointly, rather than single sources
- Various approaches exist to characterizing farm-level risk exposure, typically your research question and data availability/reliability will guide your choice.
- We discussed direct elicitation vs. simulation vs. econometrics

Exit Through the Gift Shop (1)

Financing sustainable and resilient transitions in agri & food systems

Wageningen, 13-14 Nov 2024



Exit Through the Gift Shop (2)

Summer school

Risk Analysis and Risk Management in Agriculture: Updates on Modelling and Applications - 3 ECTS

The farm sector is affected by a large and changing set of risk sources including more volatile producer prices, unusual weather patterns, upstream and downstream market power along the value chain, increasing dependence on financial institutions, and political risks. This induces the need for (new) risk management tools. Also the Common Agricultural Policy is considering risk management as an important component of agricultural policy.

Lecturers



**prof.dr.ir. MPM (Miranda)
Meuwissen**
Personal Professor

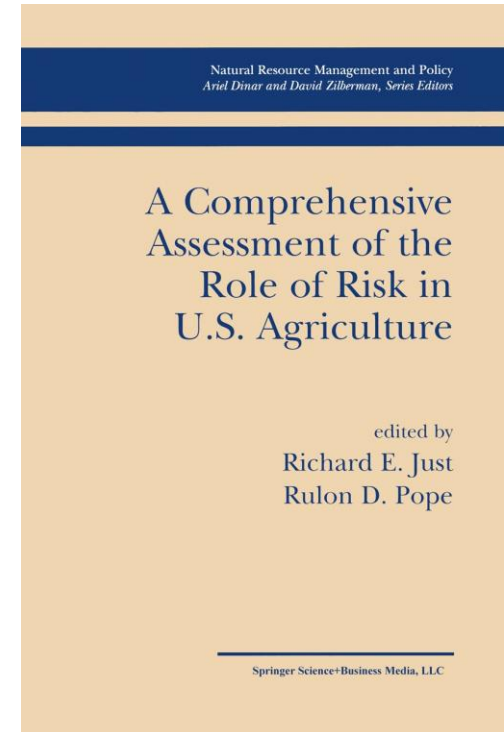
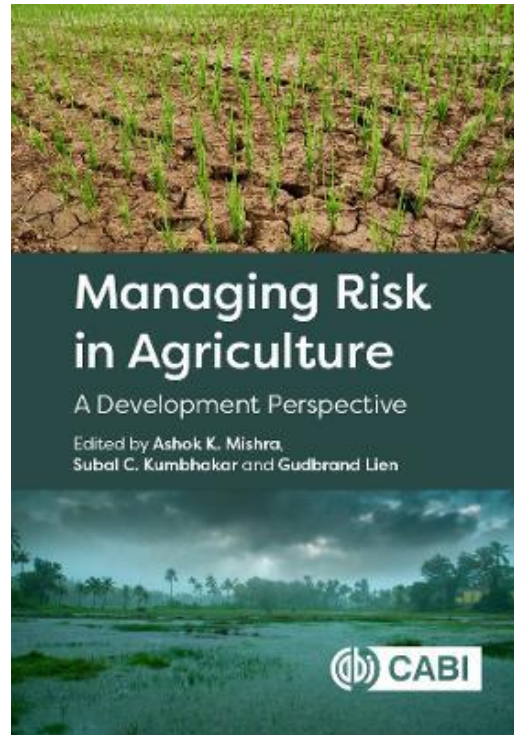
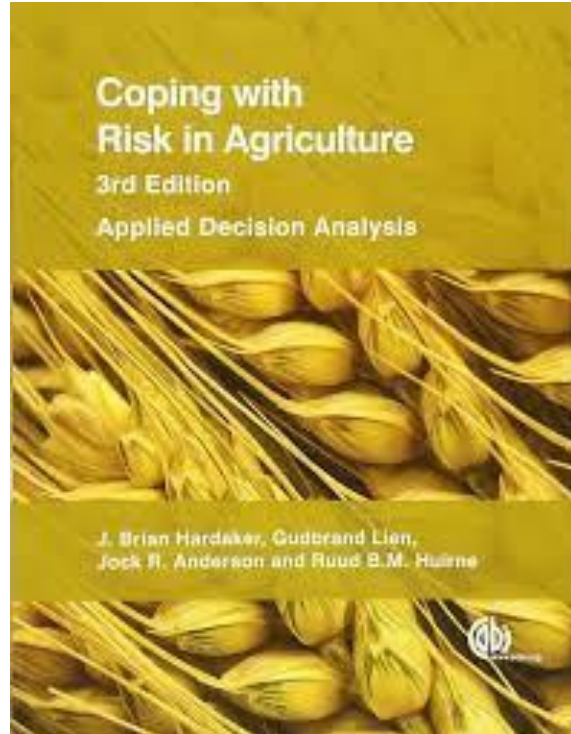


dr.ir. Y (Yann) de Mey
Associate Professor

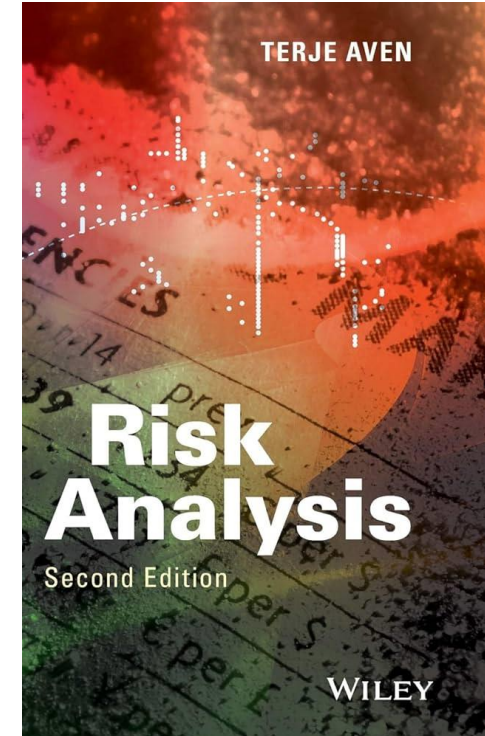
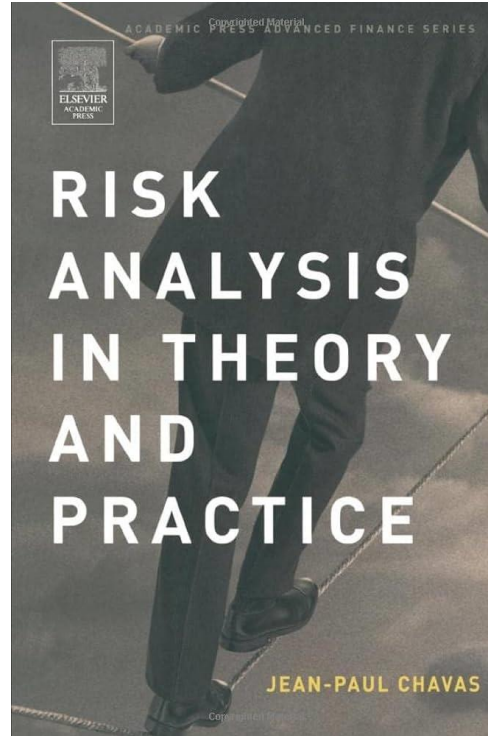
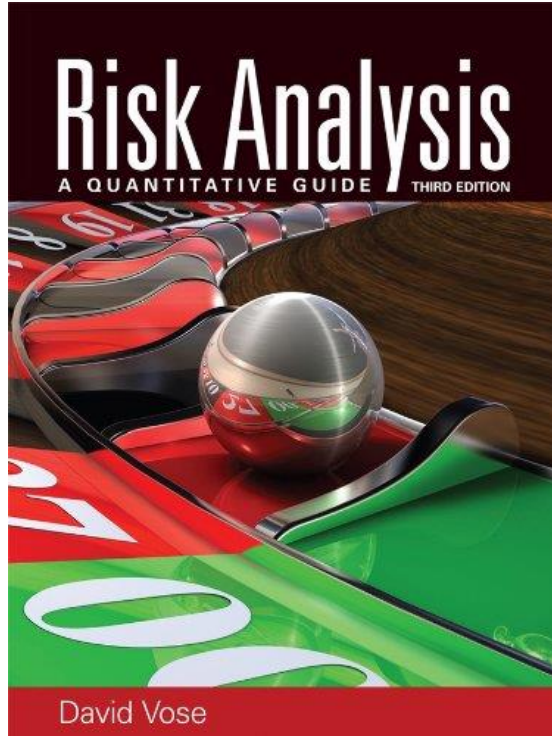


dr. TPF (Tobias) Dalhaus
Associate Professor

Some References – Risk in Agriculture



Some References – Risk Analysis in General



References mentioned during Q/A

Risk versus (in)efficiency

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Incorporating Prospect Theory

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Eliciting risk preferences

- Iyer, P., Bozzola, M., Hirsch, S., Meraner, M., & Finger, R. (2020). Measuring farmer risk preferences in Europe: a systematic review. *Journal of Agricultural Economics*, 71(1), 3-26.

Thanks! Questions?

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