

Risk Estimation: Experiment No. 8

28 March 2011



Dr. Andrea Herrmann

Motivation: Why risk estimation in Requirements Engineering?

Implementing requirement R

The History

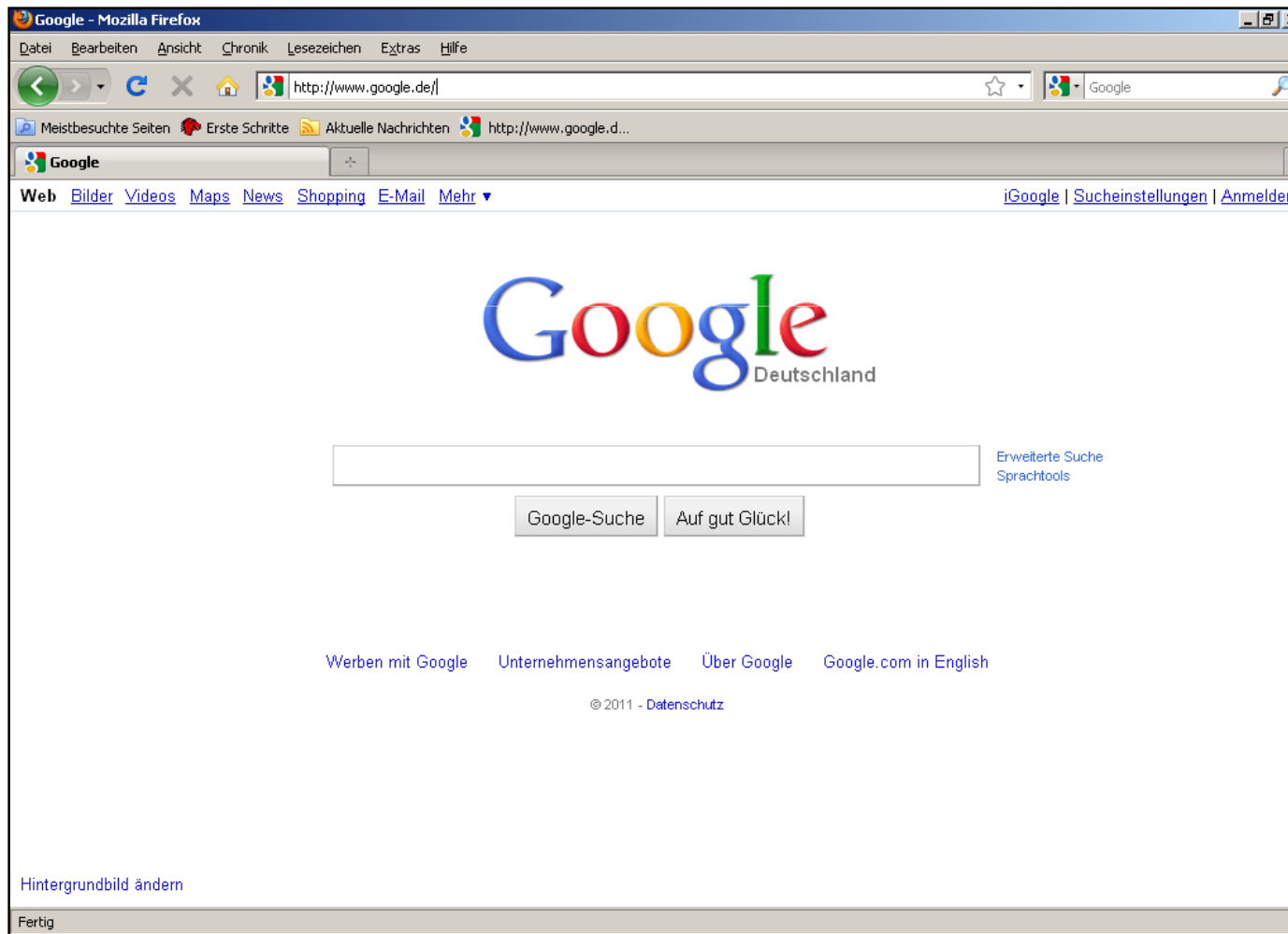
2007 two pilot experiments -> Journal of Empirical Software Engineering, 2009 & many research questions

2008-2011 six further experiments (including this one)

2011 onwards: replication?

Examples Used

- Hardware: Laptop crash
- Software: Google



Example: Context of Use

In this experiment, we adopt the **perspective of the user**.

Imagine that your laptop is the **only computer** which you use for your work. You have many important deadlines, at least one per week. For delivering your work results, you need to do an **online research**, e.g. using Google.

You are an experienced user – both of your laptop and of search machines. You are highly motivated to do your work successfully and in an efficient way.

The Method

Experiment7_Vorlage.xls [Kompatibilitätsmodus] - Microsoft Excel

Start Einfügen Seitenlayout Formeln Daten Überprüfen Ansicht Entwicklertools Add-Ins

Einfügen Zwischenablage

Schriftart Times New Rom 12

Ausrichtung

Zahl Standard % 000

Formatvorlagen Bedingte Formatierung Als Tabelle formatieren Zellenformatvorlagen

Zellen Einfügen Löschen Format

Bearbeiten Sortieren und Filtern Suchen und Auswählen

A5 MUC8: Google is not available and you can not execute your search there and now.

		without R(quirement) implemented							with R(quirement) im		
	Misuse Case	Requirement	Probability of MUC in % of the number of uses	Probability in times per year	Probability in 0-10 points	damage to customer in € (when MUC happens)	damage to customer in hours of time lost	Dissatisfaction of customer in 0-10 points	damage to customer in 0-10 points	Probability of MUC in % of the number of uses	Probability in times per year
1											
2	MUC8: Google is not available and you can not execute your search there and now.	R3: Use another search engine, like Altavista or Yahoo.									
3	MUC7: You have found a list of hits and opened 20 of these in a new window by right-click. Then, your browser crashes and all browser instances get lost. You must restart your search.	R4: Technical possibility to mark interesting hits and to save the list on your computer.									
4	MUC8: Google is not available and you can not execute your search there and now.	R5: Wait one day and then execute your search on Google.									
5	MUC6: A typing error in the search string leads to an (almost) empty list of hits.	R6: Automated detection and correction of typing errors.									
6	MUC9: Google is not available and you can not execute your search for the next three hours.	R3: Use another search engine, like Altavista or Yahoo.									
7	MUC9: Google is not available and you can not execute your search for the next three hours.	R7: Wait three hours and then retry.									
8	MUC9: Google is not available and	R8: Retry later.									

Laptop Google Methode 2 - Prio

Bereit 75%

The Method

ResultGroup12.xls [Kompatibilitätsmodus] - Microsoft Excel

Start Einfügen Seitenlayout Formeln Daten Überprüfen Ansicht Entwicklertools Add-Ins

Einfügen Zwischenablage

Times New Rom 12

Schriftart Ausrichtung Zahl

Standard % 000

Bedingte Formatierung Als Tabelle formatieren Zellenformatvorlagen

Einfügen Löschen Format Zellen

Sortieren Suchen und Filtern Auswählen Bearbeiten

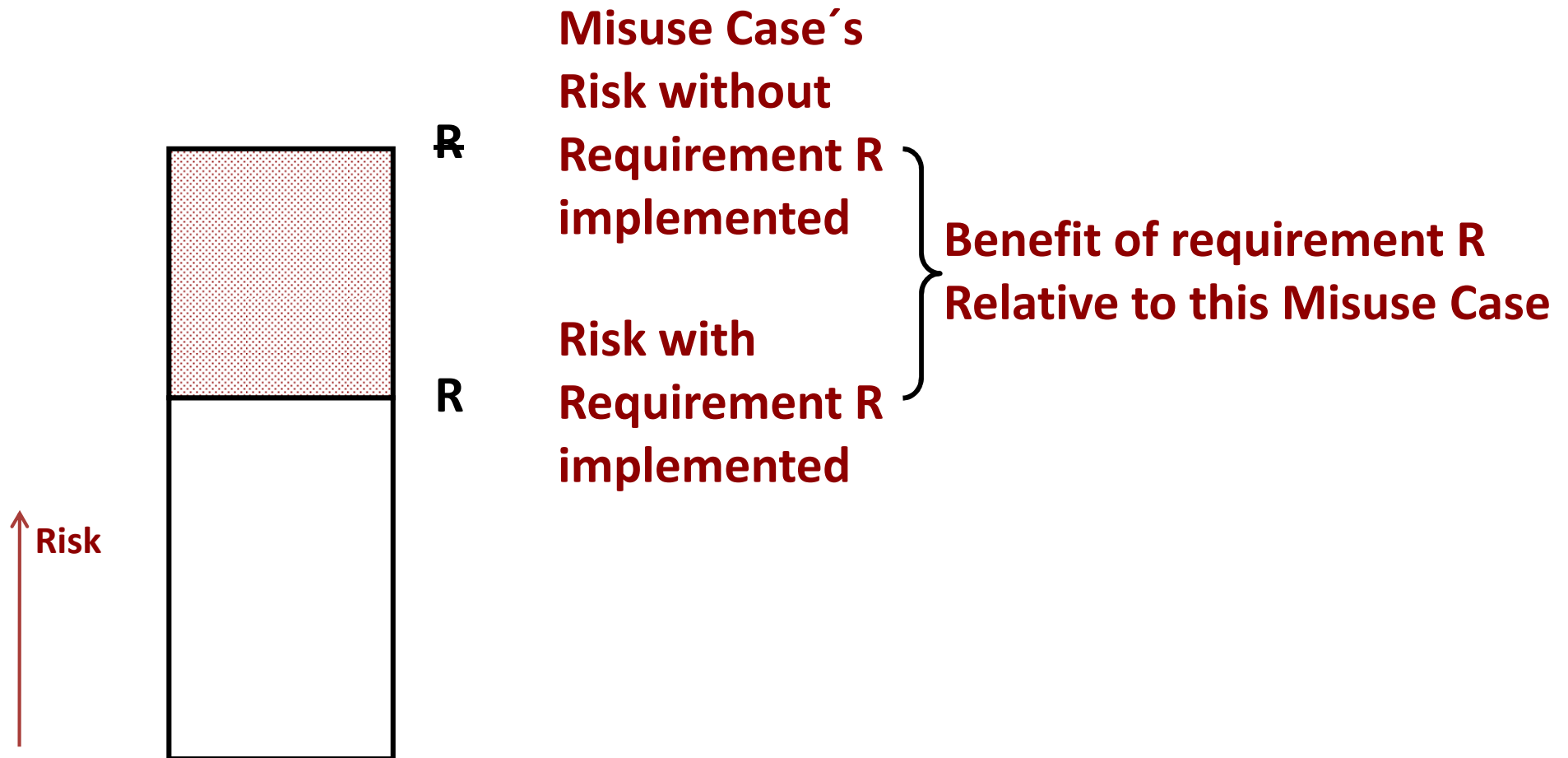
O1

	A	B	D	E	G	I	J	L	N	P	Q	R
1												
	Misuse Case	Countermeasure/ requirement	average probability p of Misuse Case in % of tried purchases (reference risk)	damage d in % of possible turnover per purchase (reference risk)	$p \times d =$ reference risk in percental loss of turnover (in %)	modified risk with/out countermeasure: average probability p of Misuse Case	damage d	$p \times d =$ risk	countermeasure benefit = risk difference in terms of % of turnover			
2	MUC1: too much information on user interface leads to user frustration, errors and finally to	R1: step-by-step guidance of the user	10	5	0,5	50	50	25	24,5			
3		R2: No explanations on user interface	10	5	0,5	20	7	1,4	0,9			
4		R3: menu exists and allows to return to former steps of the	10	5	0,5	70	65	45,5	45			
5		R4: context-sensitive help text for unexperienced users	10	5	0,5	8	3	0,24	0,26			
6		R5: express sales feature for experienced users, which as default values sets start station = machine's position, date = today, time = as soon as possible, means of transport = all, class = 2nd	30	17	5,1	15	8	1,2	3,9			
7	MUC2: Experienced users are slowed down by the step-by-step-guidance											
8	MUC3: The hidden features "bike" and "handicapped person" are not seen in the menu and therefore cyclists and handicapped persons do not use the machine	R6: menu item "bike and handicap"	50	65	32,5	20	20	4	28,5			

risk estimation evaluation of requirements

Bereit Mittelwert: 1,993333333 Anzahl: 7 Summe: 11,96 75 %

Risk of a Misuse Case



Metrics and Scales

Probability of Misuse Case (MUC):

- **Probability of MUC in % of the number of uses**
 - In 100 work sessions, how many times does the MUC happen? E.g. 10% = 10 out of 100 times
- **Average times per year**
 - Within the period of one year, how often does the MUC happen? E.g. once per year (=1) or once out of 10 years (=0.1)
- **Probability in 1-7 points**
 - 1 = extremely unlikely, (almost) never
 - 3 = rather rarely
 - 5 = rather frequently
 - 7 = extremely frequently, (almost) always

Metrics and Scales

Damage caused:

- **damage to you in €**
 - How much money in € (or \$, then please indicate) do you as a user of the laptop/ Google lose when the MUC happens?
- **damage to you in hours of time lost**
 - When the MUC happens, how much time do you lose? (calendar time, not work time) e.g. when you must wait 24 hours and repeat an activity of half an hour, then you have lost 24 hours of calendar time, but only half an hour work time
- **Your dissatisfaction in 1-7 points**
 - 1 = extremely satisfied
 - 3 = rather satisfied
 - 5 = rather dissatisfied
 - 7 = extremely dissatisfied
- **damage to you in 1-7 points**
 - 1 = (almost) no damage
 - 3 = rather low damage
 - 5 = rather high damage
 - 7 = extreme damage

Agenda

- 14:00-14:05 welcome
- 14:05-14:20 introductory presentation
- 14:20-15:00 risk estimation on questionnaires
- 15:00-15:15 discussion
- 15:15-15:25 presentation of results of former experiments
- 15:25-15:30 closing

Expected Result

- Fuzzy Misuse Cases/ requirements (group 1) versus measurable Misuse Cases/ requirements (group 2)
 - Standard deviation of probabilities/ damages
 - Participants feel certain about their estimates
 - Think risk estimation is easy to do
- Standard deviation prediction by participants

Discussion

- What metric/ scale do you prefer?
- How does uncertainty enter into the results?
- What information was missing?
- What assumptions did you make when estimating?

Results of Former Experiments

Objectives of the Experiment Series

- to learn about the *practical needs* of risk-based requirements prioritization, such as preparation, training, material/ tool, knowledge, time consumption, effect of statistics
- To understand the *factors which influence the quality of the outcome*
- To develop method and tool which can be *used in practice*

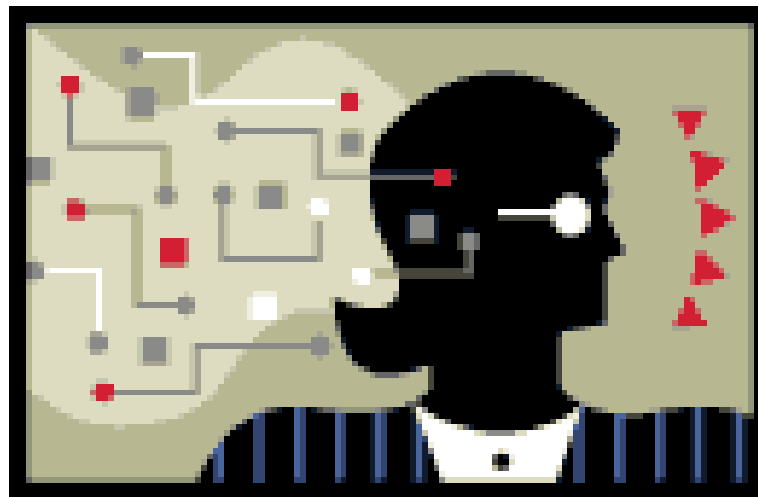
8 Experiments

- Comparison of risk-based prioritization to another prioritization method (4 experiments)
- repeatability (2)
- How near are estimations to statistics? (1)
- Compare estimation of measurable risk with fuzzy risk (1)

Research Question of Today's Experiment

influence on the **quality of risk estimation** of two factors:






- **Fuzziness:** Are the estimates achieved for measurable risks better than those for fuzzy or abstract risks?
- **Scales:** Are damage and probability of risks easier to estimate on a scale of points than in percent or Euro?



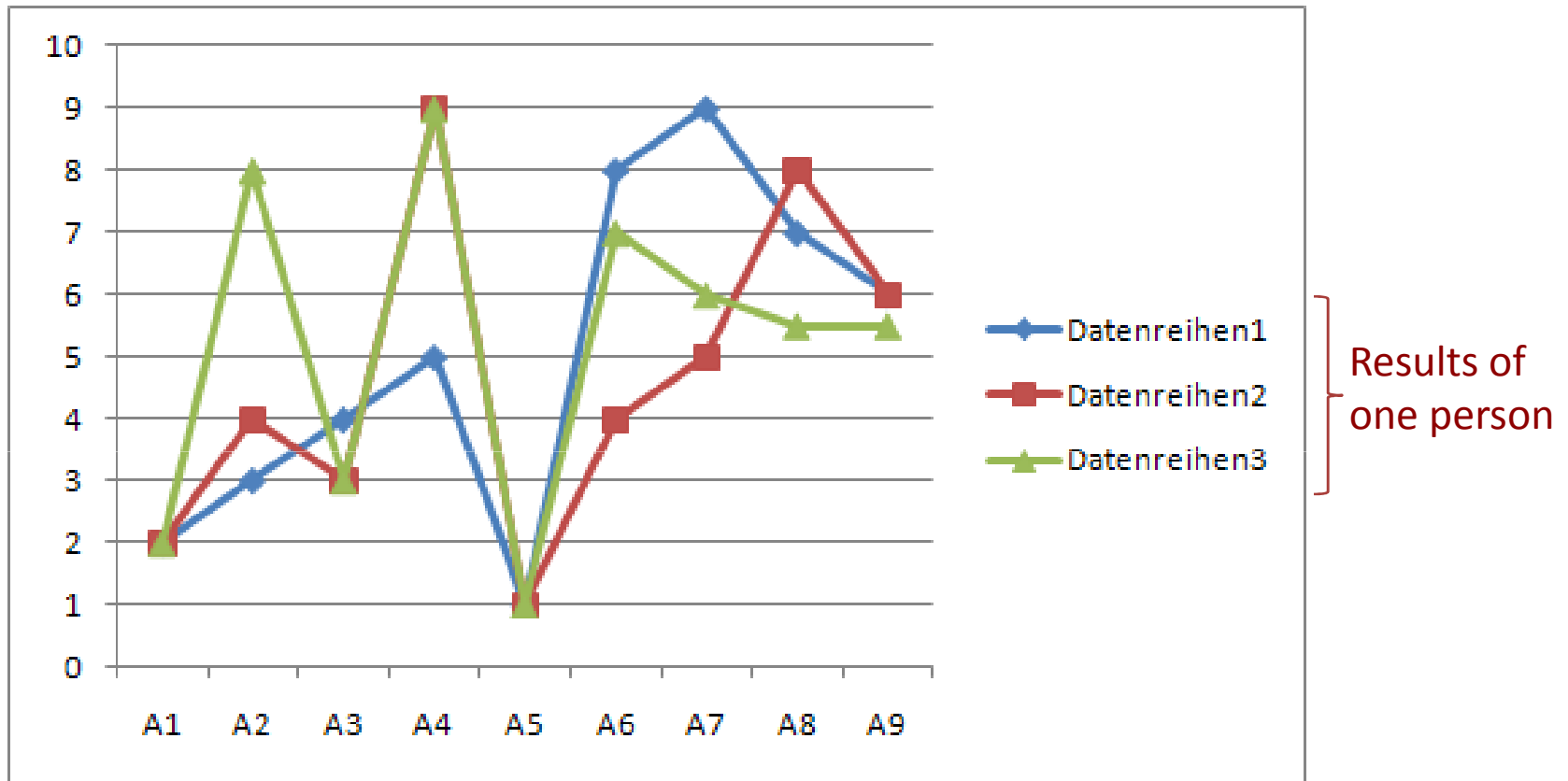
Results Exp. 1-3

- Risk-based requirements prioritization compared to simpler methods:
 - takes more time
 - Experienced as less easy to use; participants feel less certain about results; reflect view of participants less
 - Results not better: higher standard deviation
- Factors that improve risk estimation: see next slide

Results: Exp. 1-3

	Group discussion	Transparency	Prioritization criterion and metrics
Time need			
Coefficient of variation			
Ease of use		 (50%)	
Result expected to be realistic		 (50%)	
Frequency of naming a certain requirement as difficult			

Exp. 4: Reliability



Average distance $M(A) = (|P1-P2| + |P1-P3| + |P2-P3|) / 3$, averaged over all A
Euklidic distance/ average $= (\sqrt{\sum M(A)^2}) / 5$

Results: Exp. 4

	Average distance	Euklid./ average
Sorting	1.82	1.30
Exp 1, risk estim.	1.81	1.52
Exp 3, risk estim.	1.44	1.12
probability	2.35	1.45
damage	2.00	1.31

Results: Exp. 5

- **Deviation from statistics:**
 1. 3-560%
 2. 3-436%
- **age?** (<30 vs. older)
 1. First no influence
 2. older participants used new knowledge better
- **Job experience:** participants with job experience in computer science (>1 year) estimated worse (!), but improved – unlike unexperienced estimators
- **Former experience with a risk event** lead to overestimation of probability

Lessons Learned about Risk Estimation

- Risk-based requirements prioritization
 - is time-consuming: takes more time per estimation and demands more estimations
 - not easy to use
- High *information need*
 - about system, environment and technologies – current and future
 - Perspectives: user, developer, maintainer, management
 - Statistics are useful, but not always available
- Needs *unambiguous, tangible, quantified* misuse cases, requirements, metrics, reference system
- *Tool support* -> transparency
- Repeatability is low
- Learning improves estimates, but not age or experience



Questions?

Thank you for your participation!

Andrea Herrmann

Back-up

8 Experiments

1. Compares risk-based prioritization to sorting in two steps; need of risk estimation
2. Like experiment 1
3. Compares risk-based prioritization to Kano; Compare to previous experiments
4. repeatability of risk estimation (3 estimations by the same person); Pilot study
5. Risk estimation in two phases (Delphi method); How near are estimations to statistics? Influence of age, job experience, risk awareness, former experience with the risk event?
6. Compare risk estimation with AHP and conjoint analysis
7. Repeatability of risk estimation
8. Compare estimation of measurable risk with fuzzy risk






Experiments 1-8: Design

	Exp. 1	Exp. 2	Exp. 3	Exp. 4	Exp. 5	Exp. 6	Exp. 7	Exp. 8
Methods	Risk estimation versus Sorting	Risk estimation versus Sorting	Risk estimation versus Kano	Risk estimation, sorting, Kano	Risk estimation	Risk estimation and Conjoint Analysis	Risk estimation	Risk estimation
Software system	Fictitious internet flea market	Real CASE tool	Fictitious ticket mach., Mockups	Like exp. 1 & 3	Laptop crash, sw development	Real elearning tool	Real elearning tool	Laptop, Google
Group discussion	No	Yes	Yes	No	Between estimation phases	No	Half of the groups	No
Metrics	Relative damage in %, Probability in %	Damage in lost Calendar hours, Frequency in Number of months	Damage in lost Turnover or Customer dissatisfaction, Probability in %	Like exp. 1 and 3	Probability in %	relative	Probability in %, damage in points	3 probability metrics, 4 damage metrics

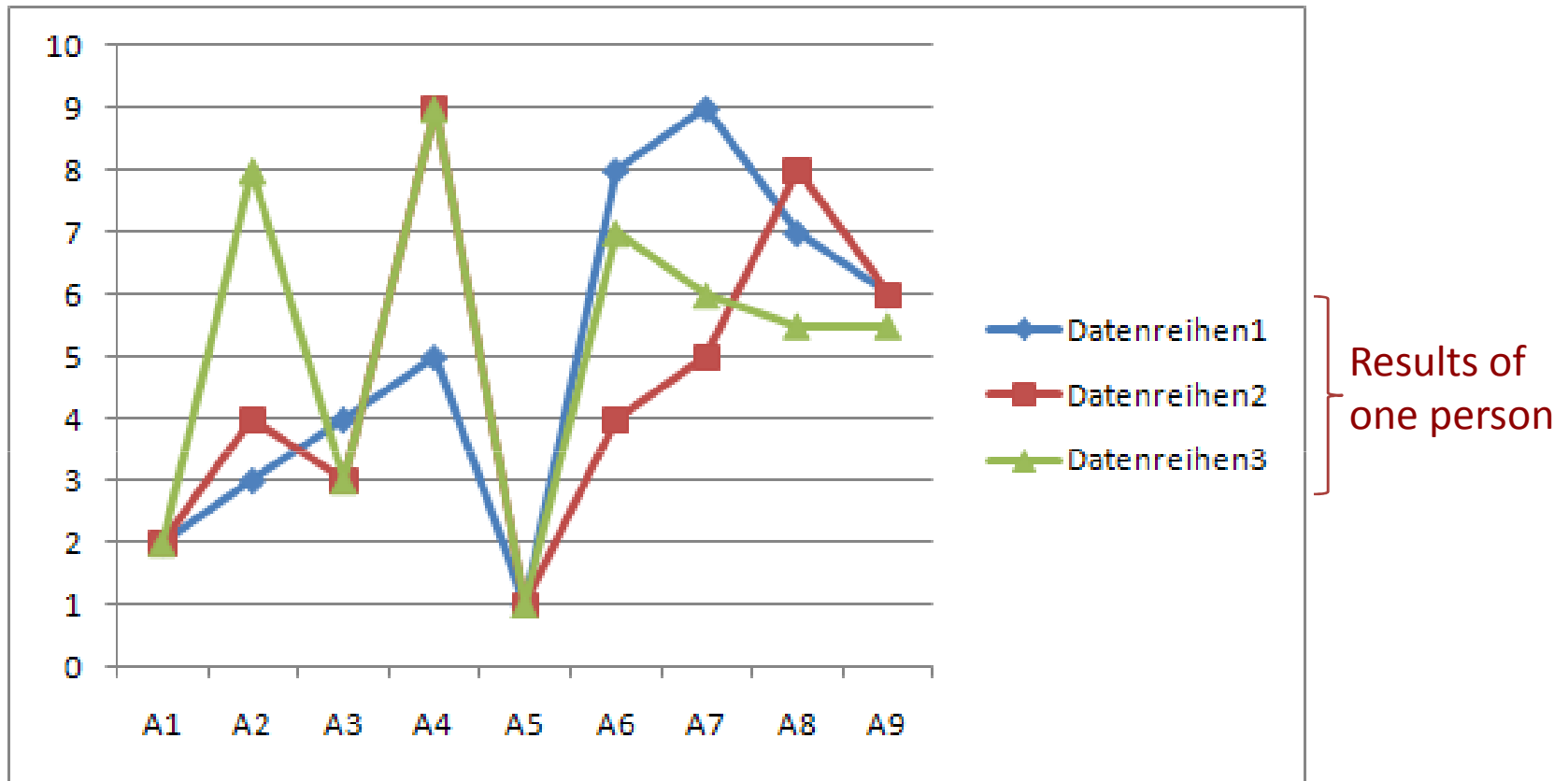
Experiments 1-8: Practical Constraints

	Exp.1	Exp. 2	Exp. 3	Exp. 4	Exp. 5	Exp. 6	Exp. 7	Exp. 8
Number of particip	10	24	46	4	36	25	11	50?
Number of resulting data sets	10	7	11	4	36	25	33	50?
Number of risks	12 (9 requ)	6 (7 requ)	3 (6requ)	12+3	11	3	8	11
Time	3 hours	1.5 hours	20 min	3x30 min	2 hours	20 min	4x20 min	90 min
Transparen cy by tool	No	Yes	No	Yes	No	No	No	No

Results: Exp. 1-3

	Group discussion	Transparency	Prioritization criterion and metrics
Time need			
Coefficient of variation			
Ease of use		 (50%)	
Result expected to be realistic		 (50%)	
Frequency of naming a certain requirement as difficult			

Exp. 4: Reliability



Average distance $M(A) = (|P1-P2| + |P1-P3| + |P2-P3|) / 3$, averaged over all A
Euklidic distance/ average $= (\sqrt{\sum M(A)^2}) / 5$

Results: Exp. 4

	Average distance	Euklid./ average
Sorting	1.82	1.30
Exp 1, risk estim.	1.81	1.52
Exp 3, risk estim.	1.44	1.12
probability	2.35	1.45
damage	2.00	1.31

Results: Exp. 5

- **Deviation from statistics:**
 1. 3-560%
 2. 3-436%
- **age?** (<30 vs. older)
 1. First no influence
 2. older participants used new knowledge better
- **Job experience:** participants with job experience in computer science (>1 year) estimated worse (!), but improved – unlike unexperienced estimators
- **Former experience with a risk event** lead to overestimation of probability

Lessons Learned about Risk Estimation

- Risk-based requirements prioritization
 - is time-consuming: takes more time per estimation and demands more estimations
 - not easy to use
- High *information need*
 - about system, environment and technologies – current and future
 - Perspectives: user, developer, maintainer, management
 - Statistics are useful, but not always available
- Needs *unambiguous, tangible, quantified* misuse cases, requirements, metrics, reference system
- *Tool support* -> transparency
- Repeatability is low
- Learning improves estimates, but not age or experience