

A Comparison and Evaluation of Qualitative Approaches to the Assessment of Risk from Invasive Species

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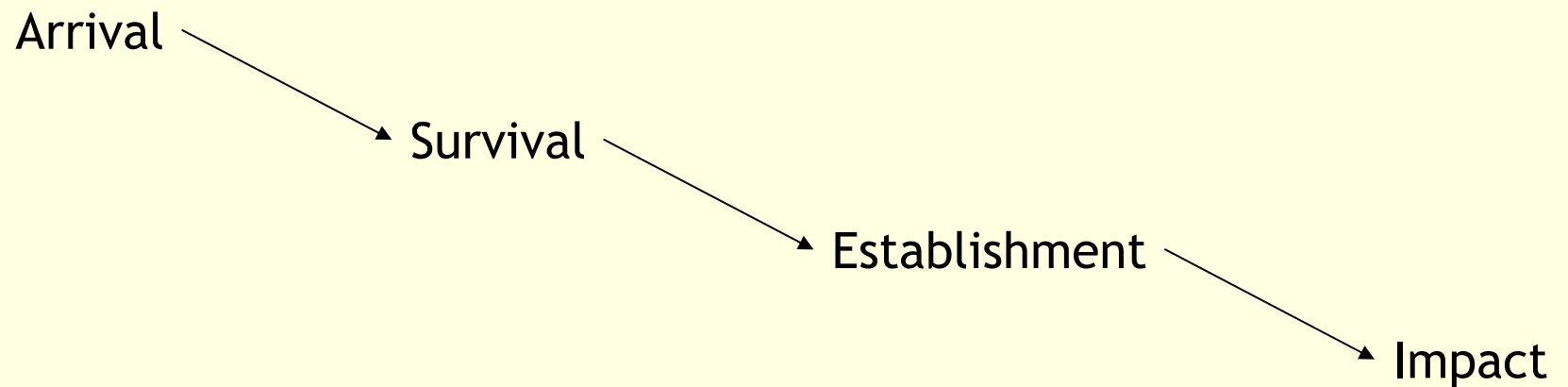
- There is a lack of information about many aquatic invasive species (AIS).
- This lack of info leads to a preference for qualitative risk assessment methods.
- There are multiple approaches to conducting qualitative risk assessments currently employed.
- No evaluation of these approaches exists.

Objectives

1. Review existing qualitative RA approaches.
2. Classify these approaches.
3. Evaluate these approaches in comparison to a quantitative approach.

- Scientific and grey lit search for qualitative RA methods.
- Methods organized into categories based on general approach.
- Three components to every method:
 1. Selection of Probability Rank
 2. Selection of Impact Rank
 3. Combination of Probability and Impact to get a Risk Rank

All qualitative approaches consider a partial event tree:



Max Probability

$$P(\text{Intro}) = \text{Max}[P(\text{Arrival}), P(\text{Survival}), P(\text{Establish})]$$

$$U(\text{Intro}) = \text{Max}[U(\text{Arrival}), U(\text{Survival}), U(\text{Establish})]$$

Example: Asian carp risk assessment (Mandrak and Cudmore 2004)

Min Probability

$$P(\text{Intro}) = \text{Min}[P(\text{Arrival}), P(\text{Survival}), P(\text{Establish})]$$

$$U(\text{Intro}) = \text{Max}[U(\text{Arrival}), U(\text{Survival}), U(\text{Establish})]$$

Examples:

CFIA Weed RA Guidelines

CEC RA Guidelines

National Code on Introductions and Transfers

RAM Committee

ANS Task Force

Only one approach to choosing impact:

1. Choose the maximum impact

Four approaches to combining probabilities and impacts to get risk:

1. Report probability and impact separately (eg, Mandrak and Cudmore 2004)
2. Choose the lowest rank (eg, CFIA Weed RA)
3. Average ranks and round up (eg, CEC RA Guidelines)
4. Choose the highest rank (eg, RAM Committee)

Lower Rank

Impact

		v. Low	Low	Mod	High	v. High
P(Introduction)	v. High					
	High					
	Mod					
	Low					
	v. Low					

Examples:

CFIA Weed RA Guidelines

Average Ranks and Round Up

		Impact				
		v. Low	Low	Mod	High	v. High
P(Introduction)	v. High	Mod	High	High	v. High	v. High
	High	Mod	Mod	High	High	v. High
	Mod	Low	Mod	Mod	High	High
	Low	Low	Low	Mod	Mod	High
	v. Low	v. Low	Low	Low	Mod	Mod

Examples:

CEC Risk Assessment Guidelines
National Code on Introductions and Transfers

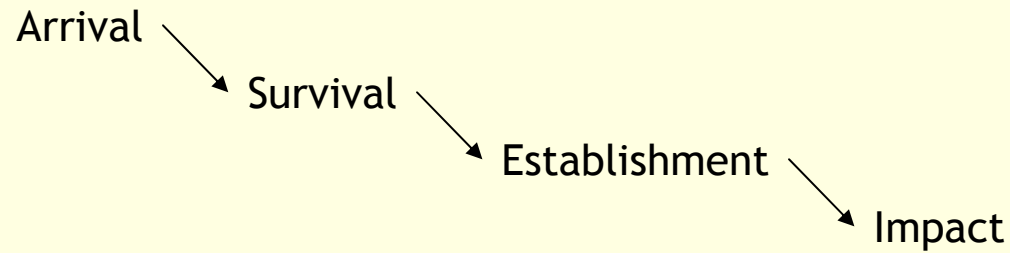
Higher Rank

Impact

		v. Low	Low	Mod	High	v. High
P(Introduction)	v. High					
	High					
	Mod					
	Low					
	v. Low					

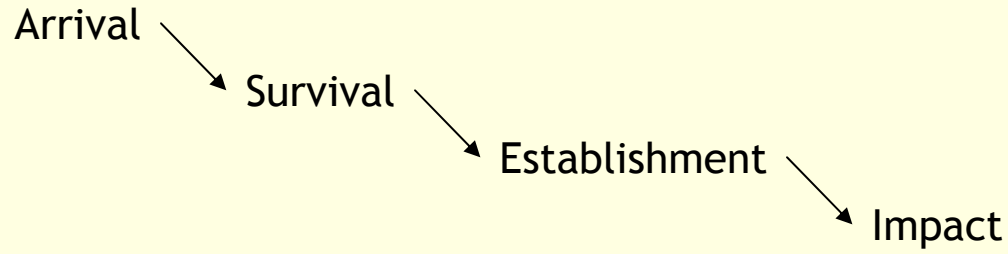
Examples:

RAM Committee
ANS Task Force



Methods

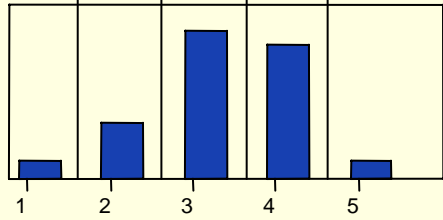
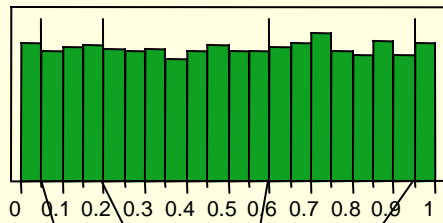
1. $P(\text{Intro}) = P(\text{Arrival}) \times P(\text{Survival}) \times P(\text{Establish})$
2. $\text{Risk} = P(\text{Intro}) \times \text{Impact}$
3. 10,000 random selections of each probability and impact
4. Calculate $P(\text{Intro})$ and Risk
5. Convert Probabilities, Impact, Risk into categories
6. Compare to $P(\text{Intro})$ and Risk from qualitative approaches



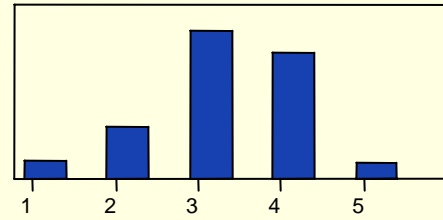
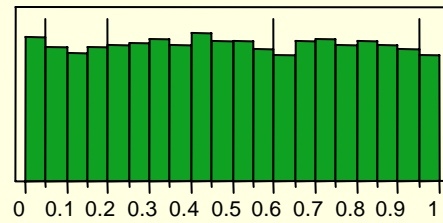
Methods

Category	Risk Profile	P	P ³	Impact	Risk
v. Low	bottom 5%	≤ 0.05	≤ 0.0001	≤ 50	≤ 0.1
Low	lower 15%	0.05 - 0.2	0.0001 - 0.008	50 - 200	0.1 - 8
Moderate	mid 40%	0.2 - 0.6	0.008 - 0.22	200 - 600	8 - 216
High	high 35%	0.6 - 0.95	0.22 - 0.85	600 - 950	216 - 857
v. High	top 5%	≥ 0.95	≥ 0.85	≥ 950	≥ 857

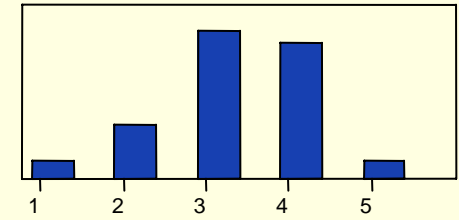
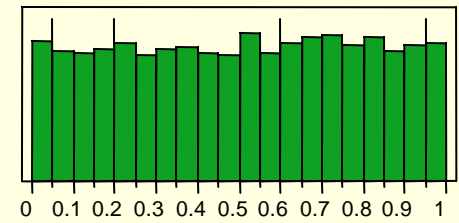
P(Arrival)



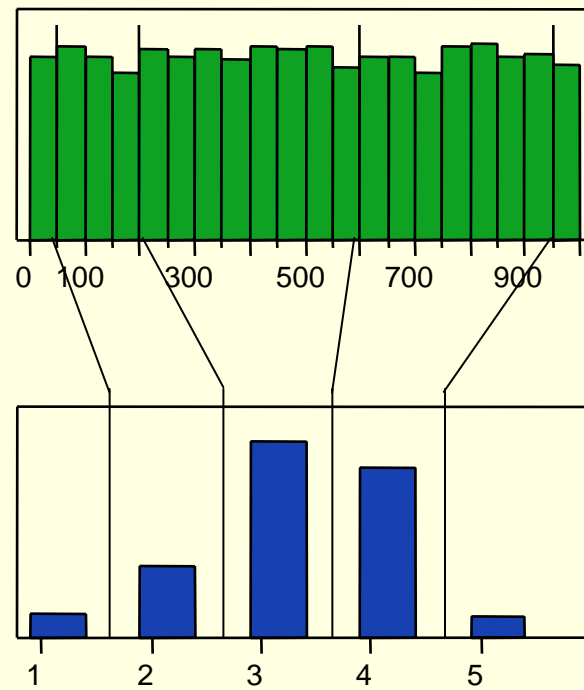
P(Survival)

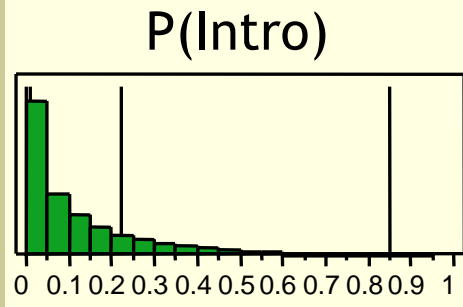


P(Establish)

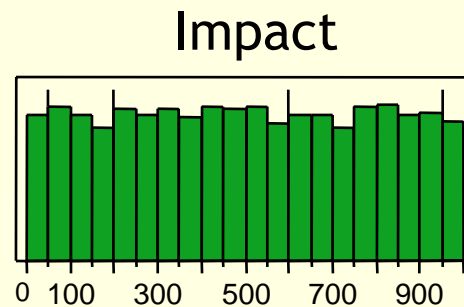


Impact

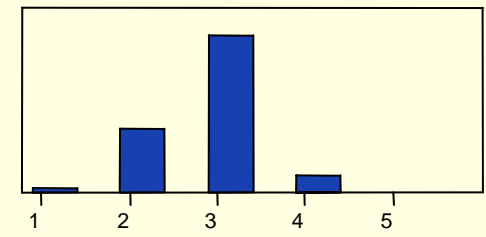
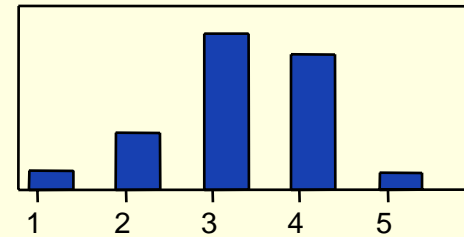
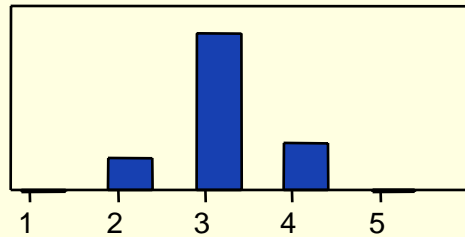
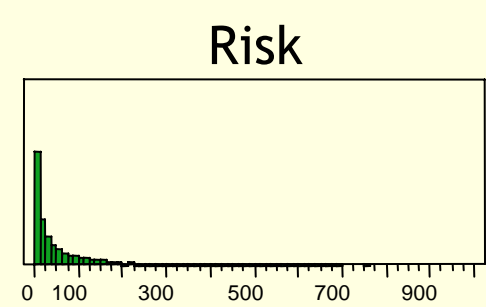




x



=



Compare to P(Intro) rank from qualitative RA methods

Compare to Risk rank from qualitative RA methods

Comparison of 6 qualitative + 1 quantitative approaches:

2 probability selections (min, max)

x

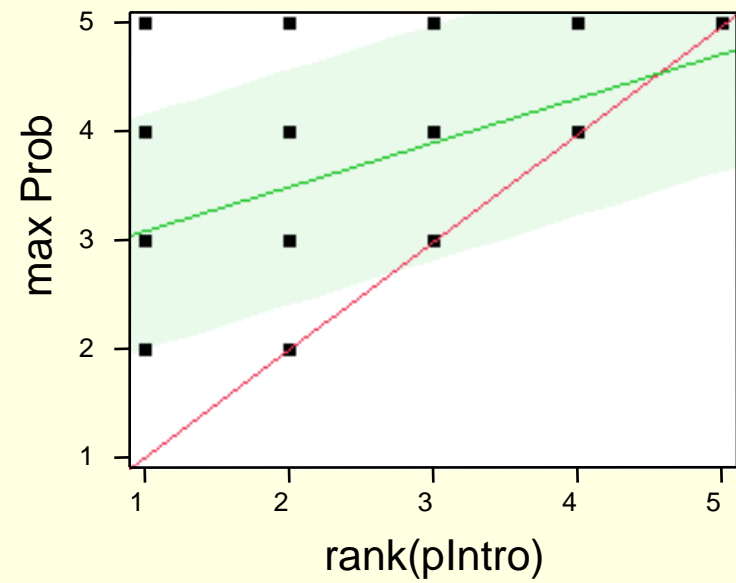
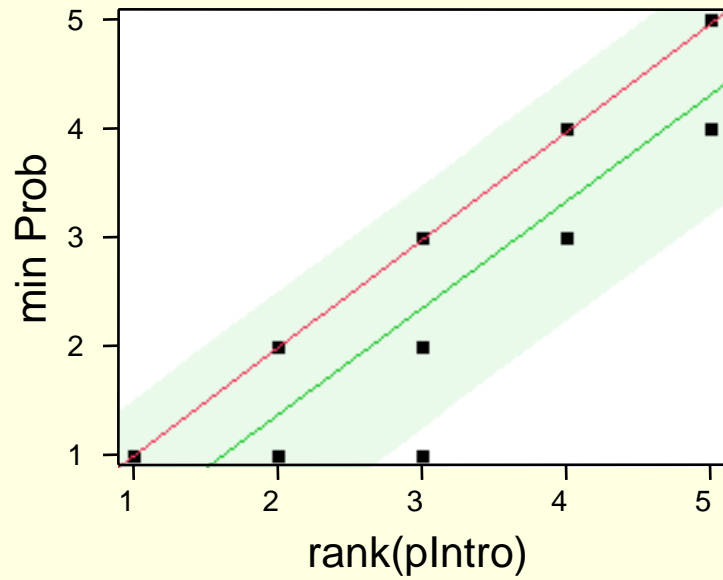
3 risk matrices (low, av, high)

6 possible qualitative approaches

	Min	Max
Low	eg, CFIA	?
Av	eg, CEC	?
High	eg, RAM	?

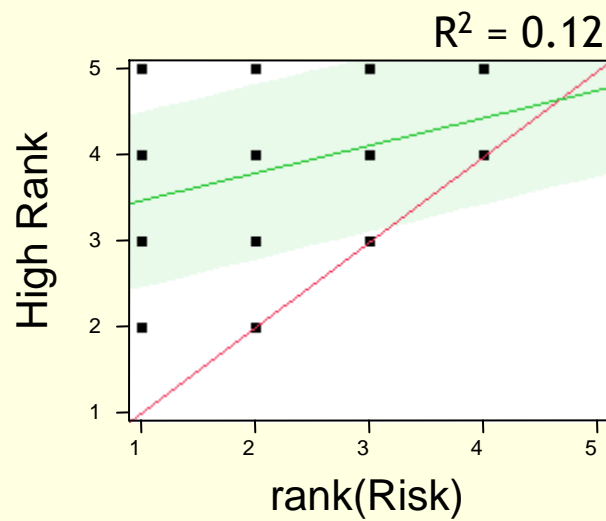
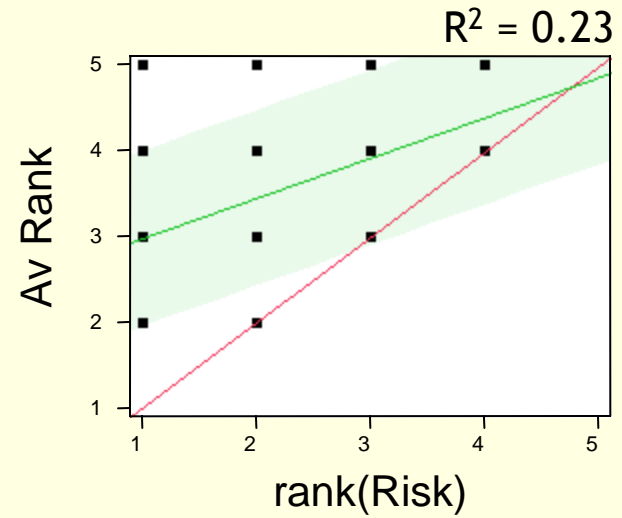
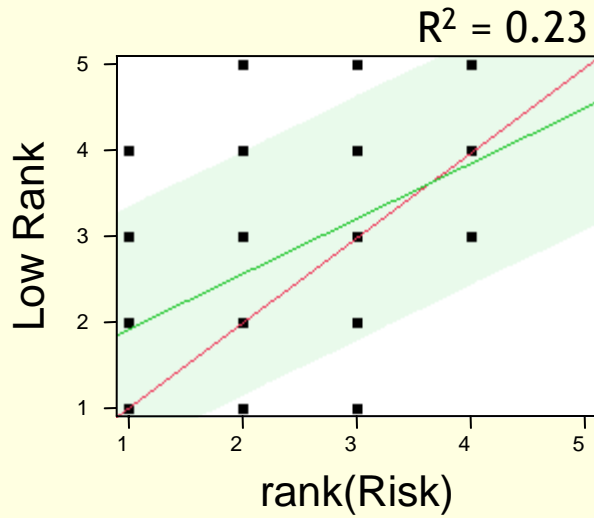
P(Introduction)

Results



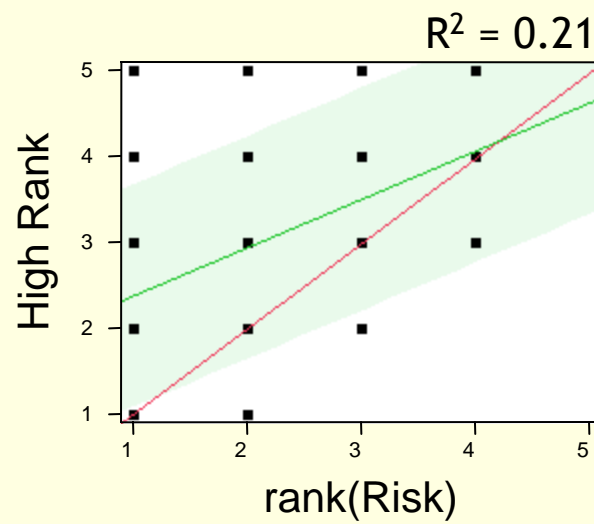
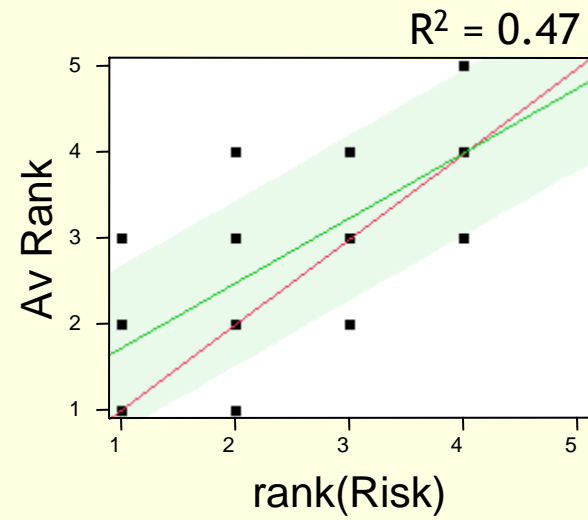
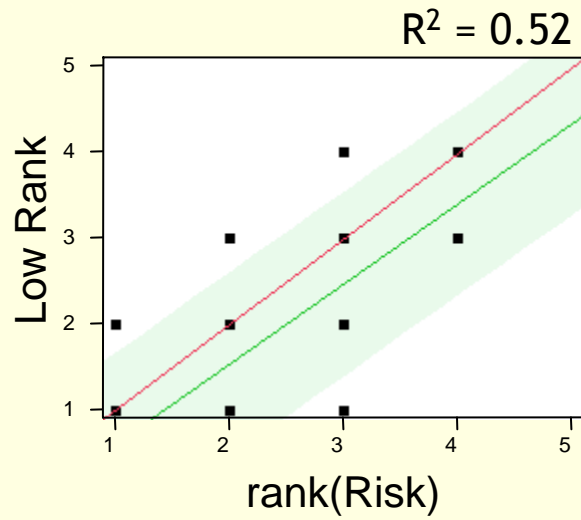
Risk with max Prob

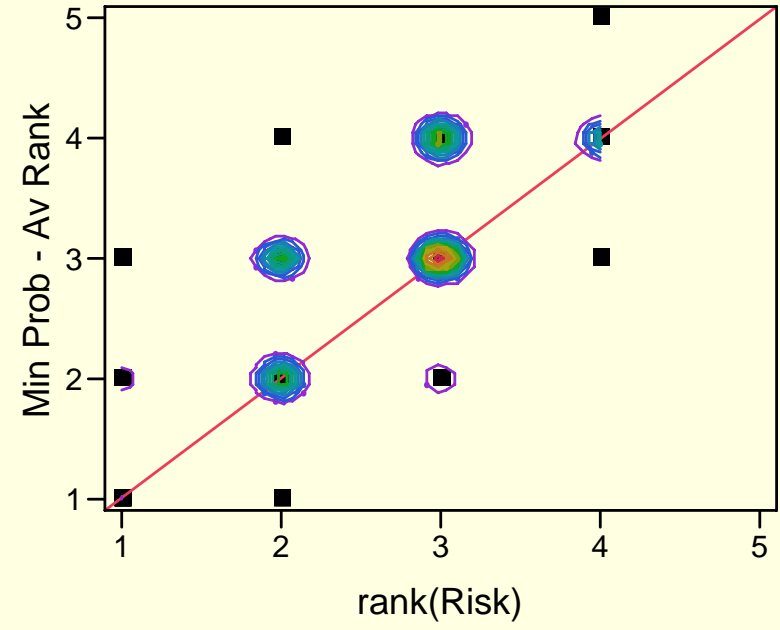
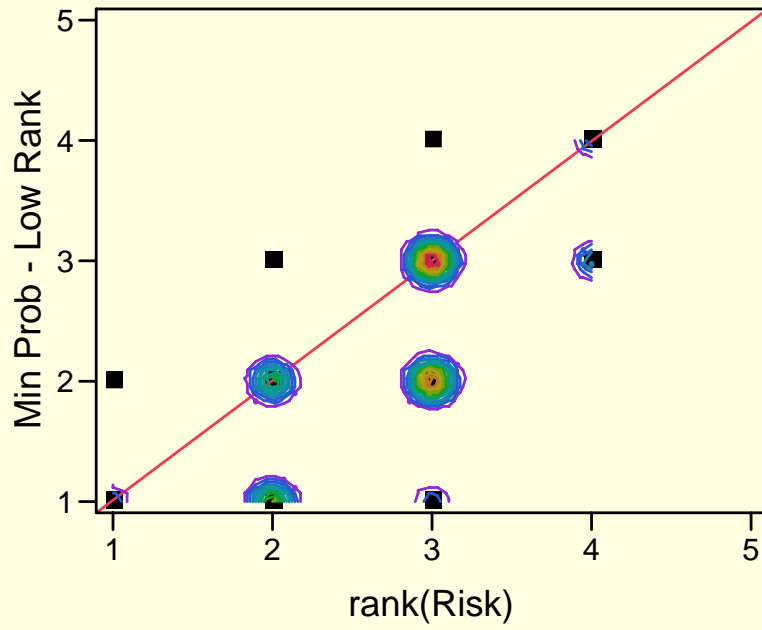
Results



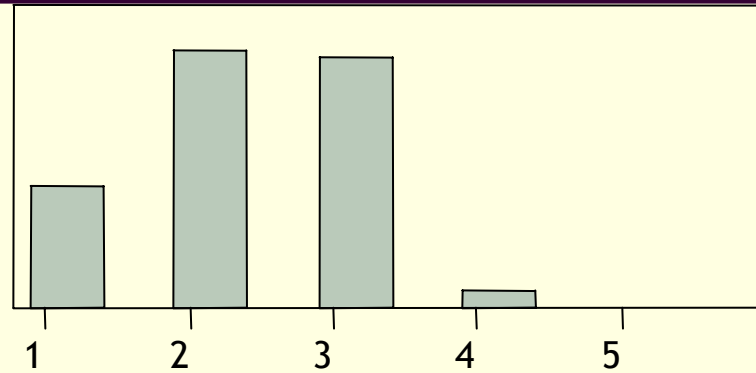
Risk with min Prob

Results

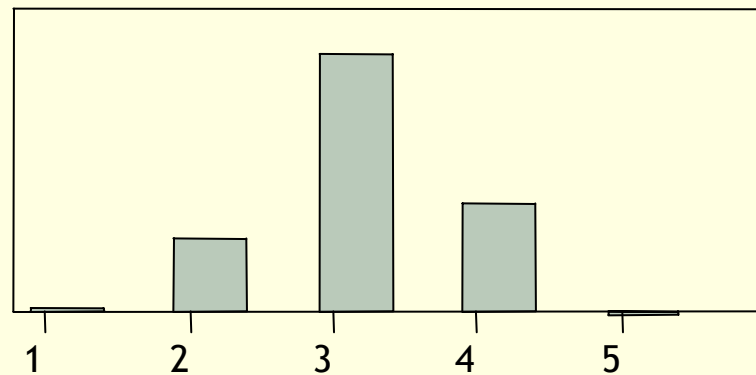




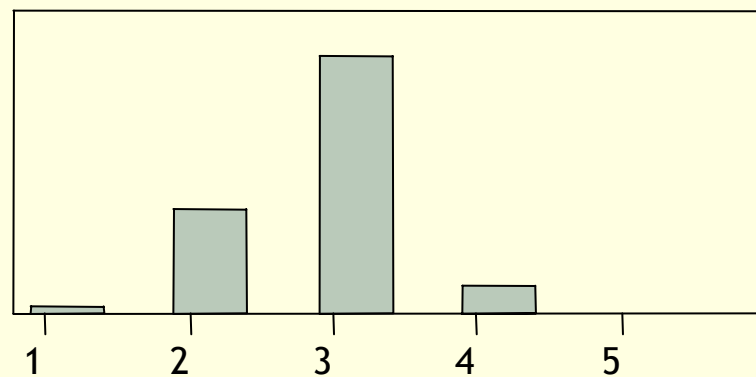
Lower Rank



Average Rank



Quantitative



1. The minimum probability approach produces ranks most consistent with the quantitative approach.
2. All approaches choose the maximum impact and report maximum uncertainty ranks.
3. To combine probability and impact ranks to get a risk rank, the lowest rank or average rank approaches combined with the minimum probability rank produces risk ranks most consistent with the quantitative approach.
4. Lower rank approach biases results toward underestimating risks.
5. Average rank approach biases results toward overestimating risk, but is more consistent with the quantitative approach.