



*Epistemic and
stochastic uncertainty
in risk assessment*

Dirk Berkvens





Total uncertainty
=
epistemic uncertainty
+
stochastic uncertainty





Total uncertainty

Example: diagnostic test sensitivity

Sensitivity = probability that diseased animal tests positive

A decorative wireframe sphere is located in the top-left corner of the slide. It consists of a grid of lines forming a spherical shape, with a central point from which lines radiate outwards.

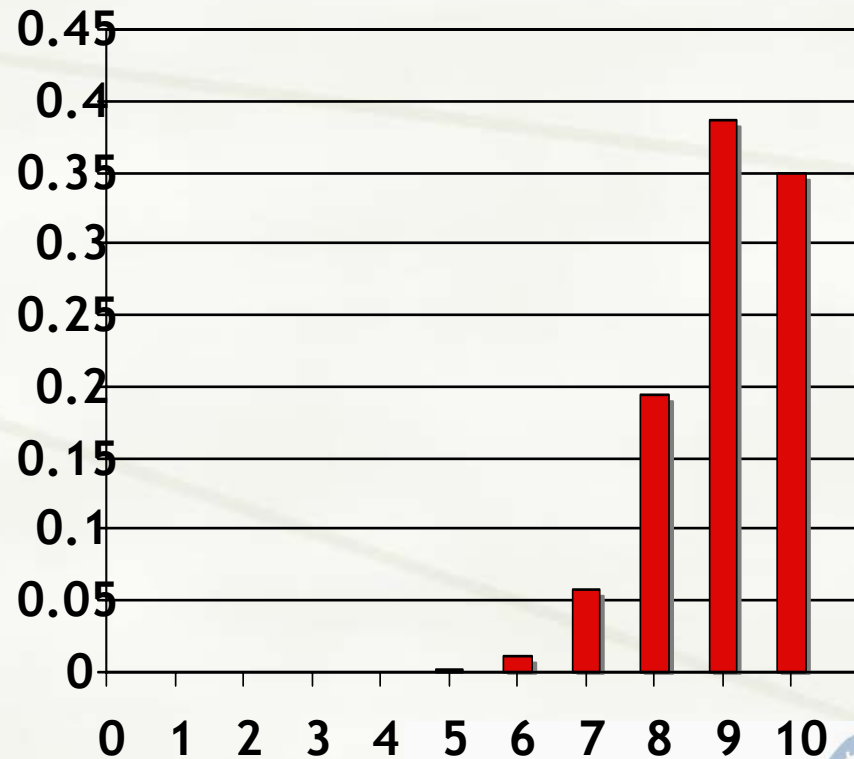
Case 1: sensitivity known

- ★ No epistemic uncertainty
- ★ Impossible to predict individual test result without performing test: stochastic uncertainty
- ★ Test 10 diseased animals with diagnostic test with $Se = 0.90$



Case 1: sensitivity known

+ve tests	probability
0	1E-10
1	9E-09
2	3.6E-07
3	8.7E-06
4	0.00013
5	0.00149
6	0.01116
7	0.05740
8	0.19371
9	0.38742
10	0.34868



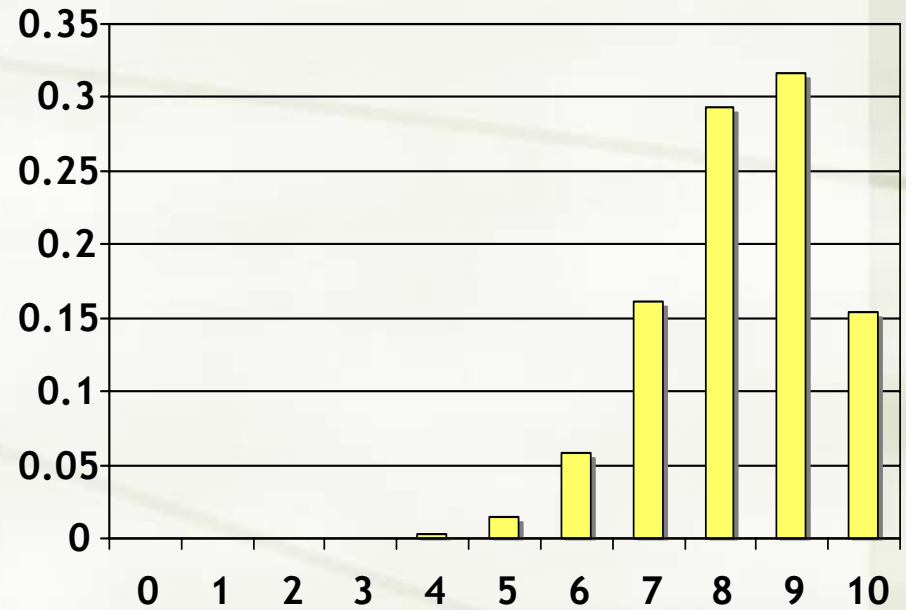
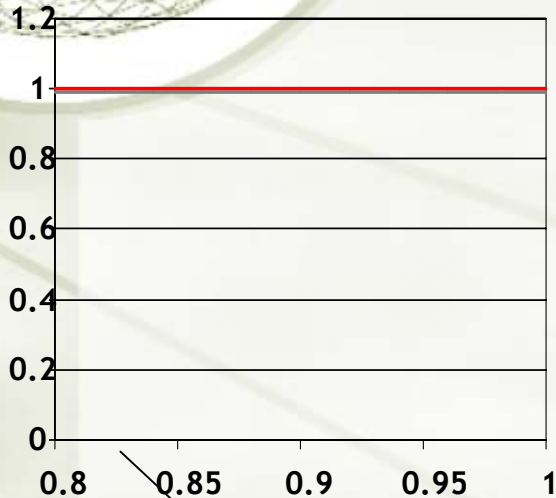
A decorative wireframe sphere is located in the top-left corner of the slide.

Case 2: sensitivity unknown

- ★ Epistemic uncertainty and stochastic uncertainty
- ★ E.g. test 10 diseased animals with diagnostic test with $0.80 \leq Se \leq 1.00$

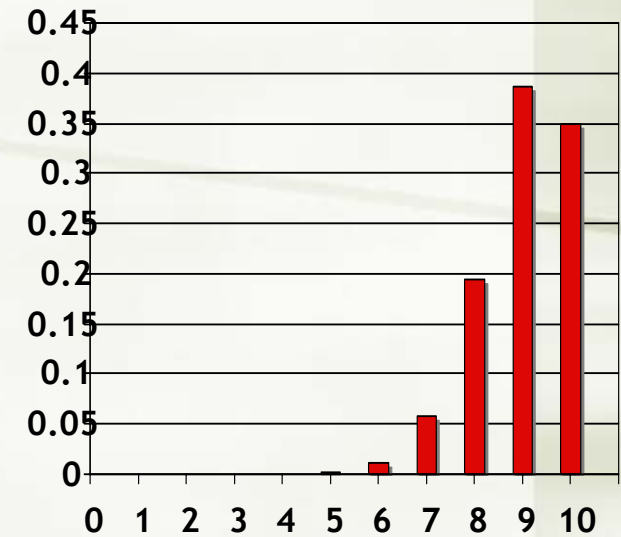
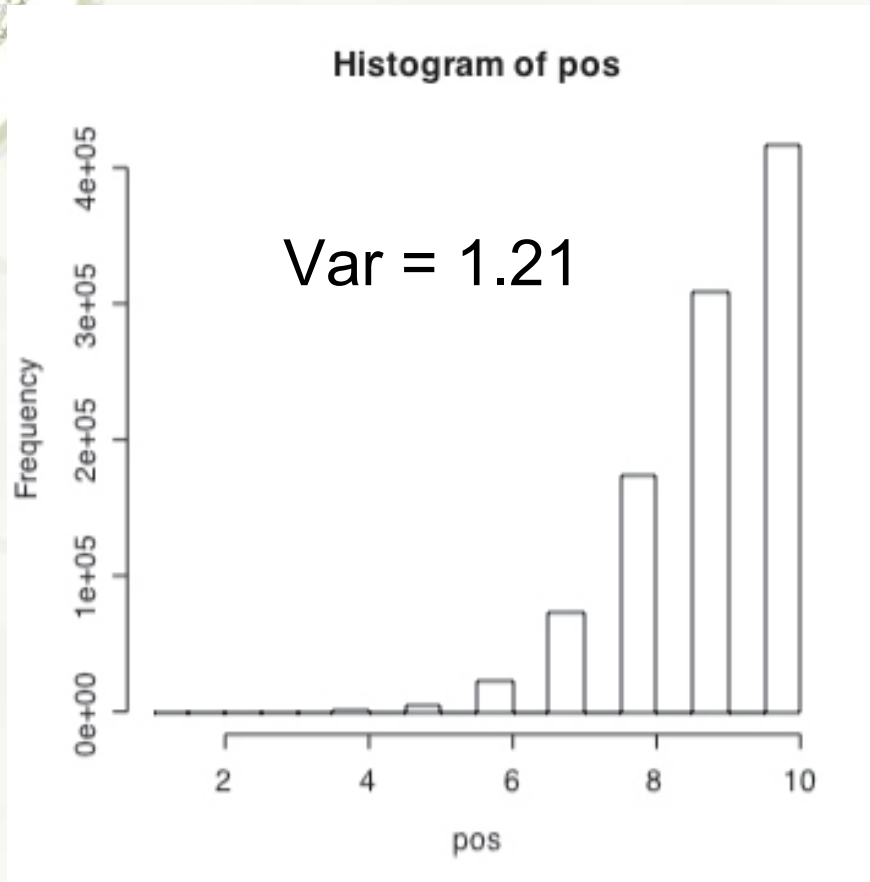


Case 2: sensitivity unknown



Se = 0.8293

Case 2: sensitivity unknown



Var = 0.90





Epistemic uncertainty

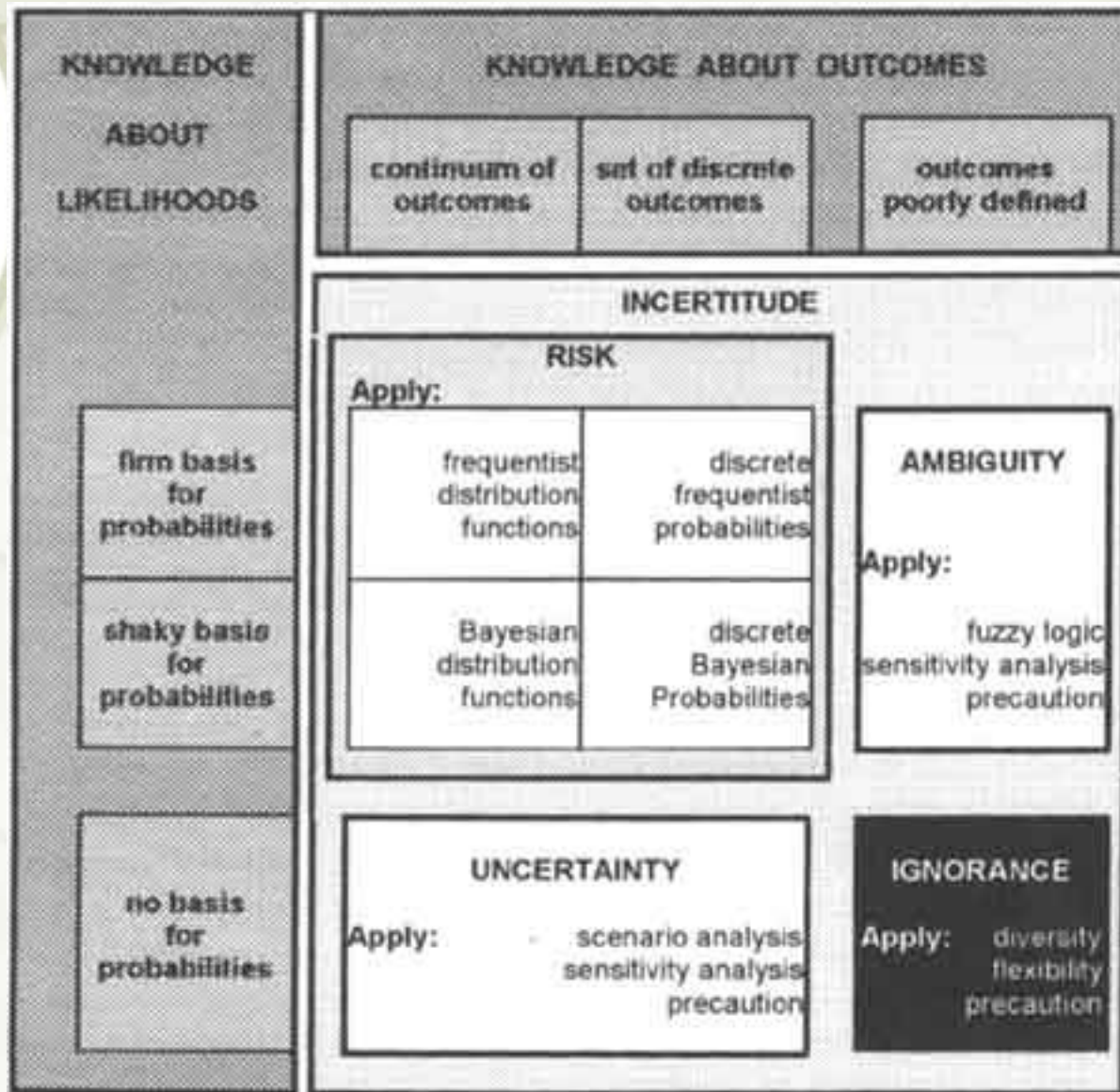
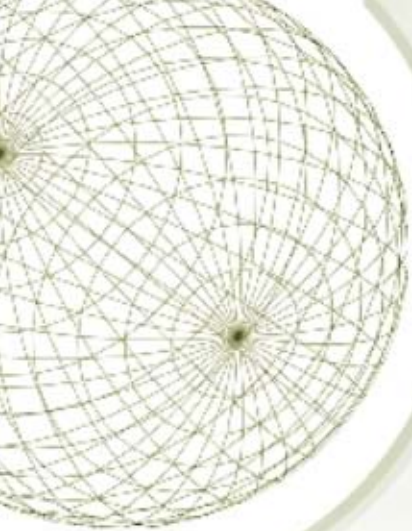
- ★ Lack of knowledge about parameters of system to be studied
- ★ Can be decreased:
 - ★ Available data
 - ★ Expert opinion
 - ★ Further measurements



Stochastic uncertainty

- ★ Inherent to system, consequence of chance
- ★ Cannot be decreased through further study
 - ★ de Laplace \Leftrightarrow Heisenberg
 - ★ Free will





Andrew Stirling

<http://www.sussex.ac.uk/sussexenergygroup/profile7513.html>



		knowledge about outcomes		
		perfect knowledge	outcomes defined	outcomes poorly defined or unknown
knowledge about likelihoods	perfect knowledge	certitude	<p style="text-align: center;">incertitude</p> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 10px; width: 45%;"> <p style="text-align: center;">risk</p> <div style="border: 1px solid black; padding: 5px; margin: 5px; text-align: center;">frequentist risk evaluation</div> <div style="border: 1px solid black; padding: 5px; margin: 5px; text-align: center;">Bayesian risk evaluation</div> </div> <div style="border: 1px solid black; padding: 10px; width: 45%;"> <p style="text-align: center;">ambiguity</p> <p style="text-align: center;">fuzzy logic sensitivity analysis</p> <p style="text-align: center;"><i>precautionary principle</i></p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="border: 1px solid black; padding: 10px; width: 45%;"> <p style="text-align: center;">uncertainty</p> <p style="text-align: center;">scenario analysis sensitivity analysis <i>precautionary principle</i></p> </div> <div style="border: 1px solid black; padding: 10px; width: 45%;"> <p style="text-align: center;">ignorance</p> <p style="text-align: center;"><i>precautionary principle</i></p> </div> </div>	
	firm basis for probabilities			
	shaky basis for probabilities			
no basis for probabilities				

100 years



MEDICINE ANTWERP
1906 2006



firm basis
for probabilities

shaky basis
for probabilities

