The University of Sydney

Confidence and risk

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Epistemology and Confidence

Objectivism

- truth and meaning resides in objects (objective)

Constructionism

- truth and meaning exist only in consciousness through interaction with objects

Subjectivism

- truth and meaning exist only in consciousness without interaction with objects

Science and Engineering

Ontology:

Realism (external reality)

Epistemology:

Objectivism

Theoretical perspective:

Positivism (objective truth can be discovered by observation of reality)

realist/objectivist/positivist stance

Science is objective and authoritative

constructionist perspective

All understandings are constructions

None is objective or absolute

No objective basis to discriminate (scientific/non-scientific)

Constructionist perspective on science

theories and models are constructed to represent reality

Scientific results

Authoritative if supported by testing in accordance with the scientific method (physical systems)

Scientistic results

Purportedly scientific but without the objectivity and authority derived from testing (no external reality – e.g., value judgements)

Scientistic approach erodes confidence

Confidence (trust) requires:

- **Honesty (ethics)**
- **Full disclosure**
- **Explicit statement of value judgements**

Confidence

Effect of uncertainty in probability estimates

Example: Design based on prototype testing

Influence of sampling variability

Uncertain failure probabilities for design strengths based on prototype testing

- Australian Standard procedure

$$R_{p,c} = R_{\min,n} / k(p,c,n)$$

$$k(p,c,n) = \{\ln(1-c) / [n \ln(1-p)]\}^{V_R}$$

$$R_d = R_{\min,n} / PSF$$

$$PSF = k(p,c,n) / \phi_p$$

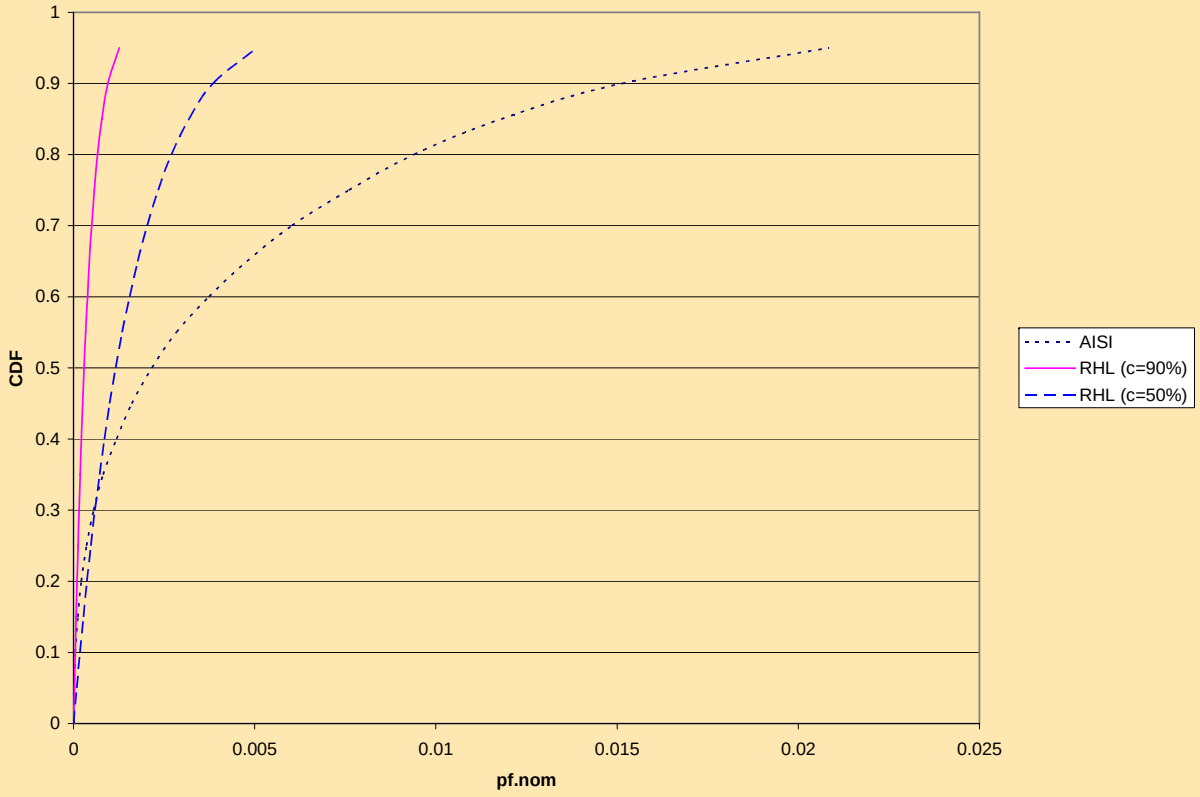
AISI procedure

$$R_D = \phi R_P$$

$$\phi = 1.5 M_m F_m \exp(-\beta_o V_o)$$

$$V_o = (V_M^2 + V_F^2 + C_P V_P^2 + V_Q^2)^{0.5}$$

$$C_P = (n-1)/(n-3)$$


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
CDF
0
0.005
0.01
0.015
0.02
0.025
pf.nom
AISI
RHL (c=90%)
RHL (c=50%)

Characteristic value of p_f ?

Statistical confidence

Probability that p_f exceeds characteristic value

Relates to concern that design is less safe than it should be

Fiducial confidence

Relates to concern that design is less safe than it should be **and** the unsafe design could subsequently fail

Probabilistic measure of fiducial confidence

Characteristic value $p_{f,nom,c}$:

$$\int_{p_{f,nom,c}}^{1} (f_{p_{f,nom}}(p) \cdot p) dp$$

For confidence equivalent to case with negligible uncertainty in distribution of p_f require:

$$\int_{p_{f,nom,c}}^{1} (f_{p_{f,nom}}(p) \cdot p) dp = p_{f,nom,c} / 2$$

$P_{f,nom,c} < p_{f,target}$

Table 1: Statistics of the uncertain distributions of p_f obtained from prototype testing

	$E[p_f]$	$F_{pf}(E[p_f])$	$p_{f,nom,c}$	$F_{pf}(p_{f,nom,c})$
AISI	**0.0054**	**0.67**	**0.0078**	**0.76**
RHL (c=90%)	**0.00042**	**0.63**	**0.00053**	**0.72**
RHL (c=50%)	**0.0017**	**0.63**	**0.00214**	**0.72**

Target $p_f=0.00135$

Confidence

Depends on epistemology

New probabilistic measure of fiducial confidence proposed for uncertain probability estimates