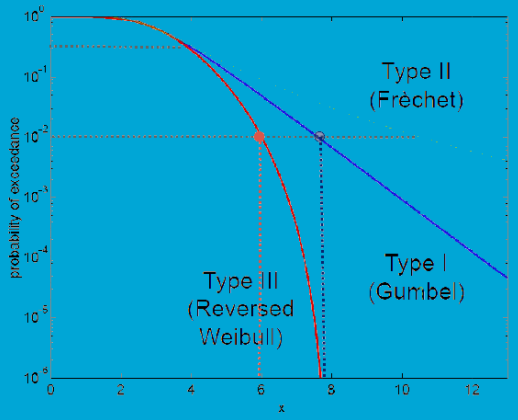
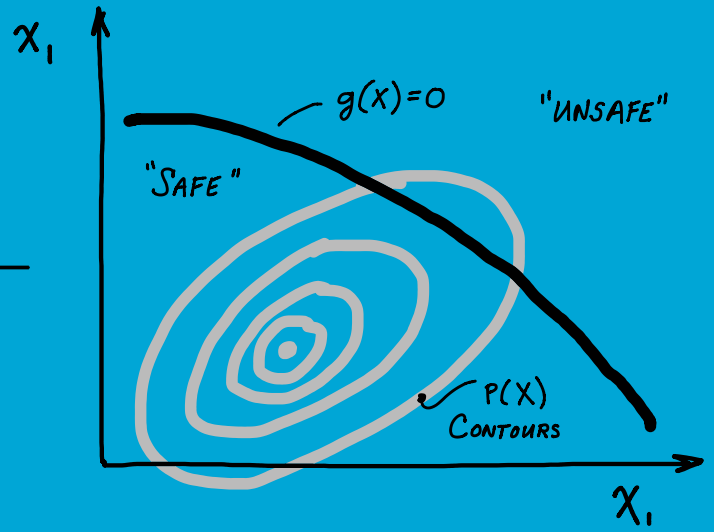
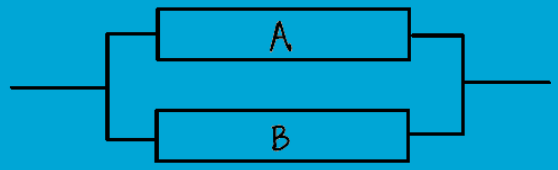
CIEM42X0 Probabilistic Design

Hydraulic and Offshore Structures (HOS) Track

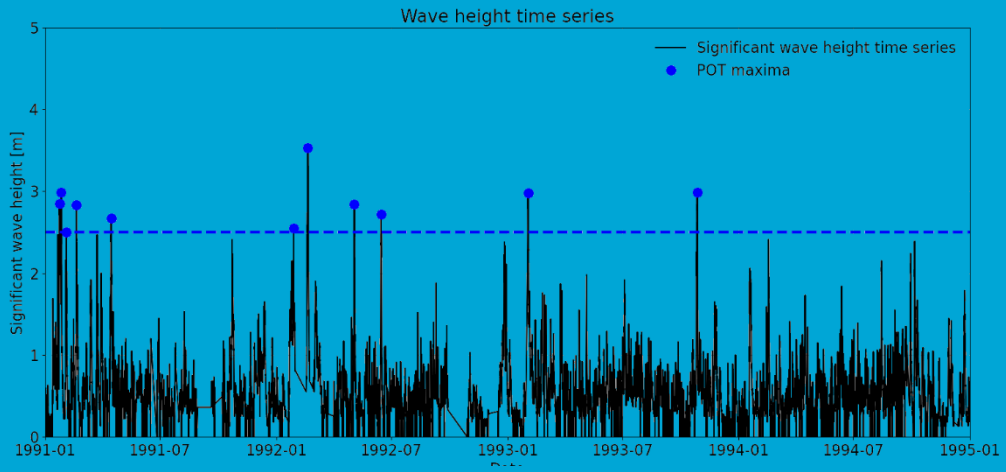
Civil Engineering MSc Program







Reliability-Based Design Philosophy



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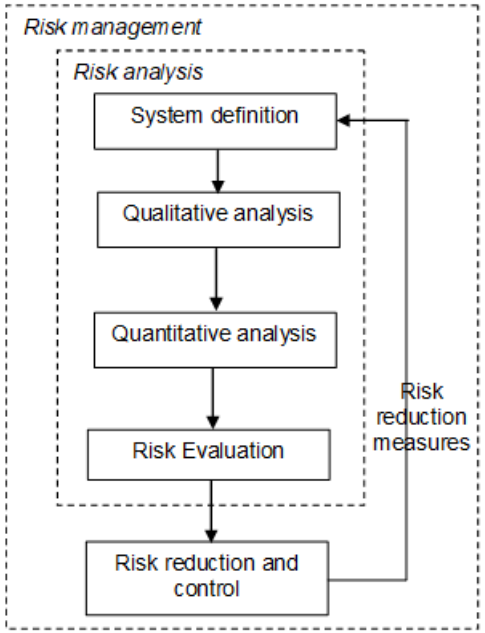
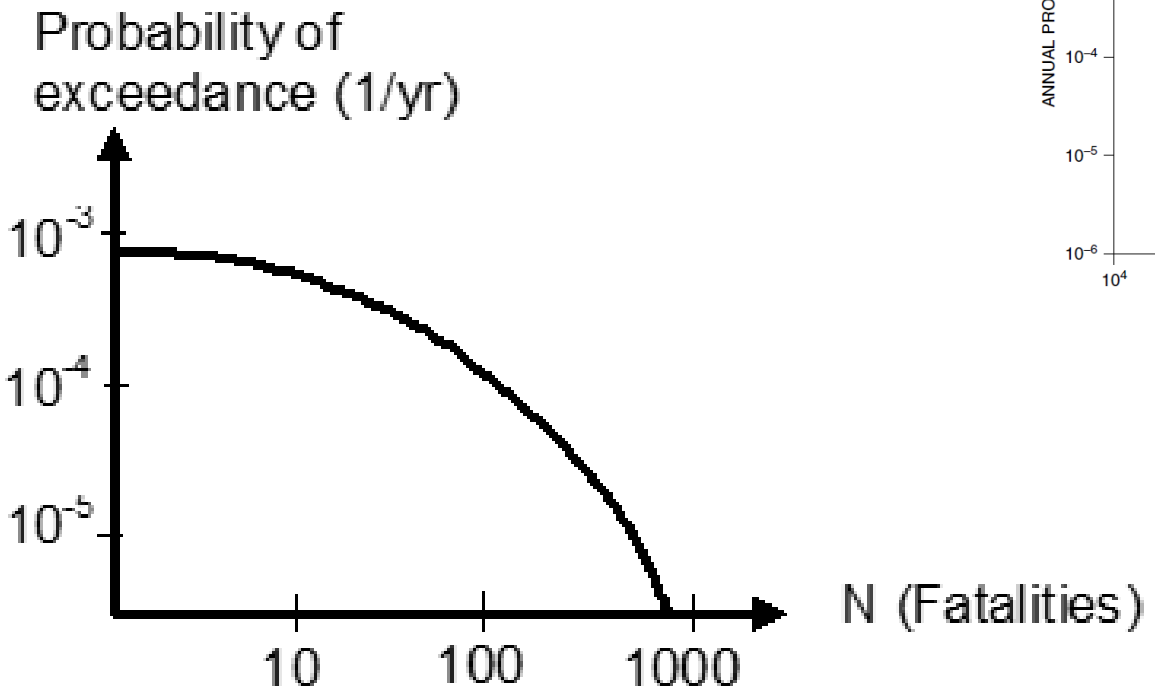
Note for reading the PDF

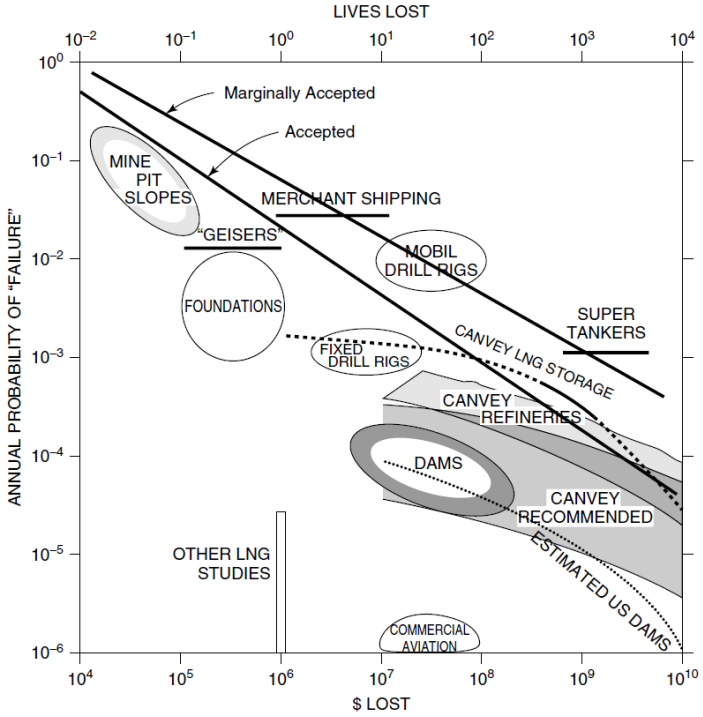
The following slides were used in class to illustrate these key points:

- In this unit is will be important to think about the problem you are analyzing and to ensure that it represents reality in an acceptable way mathematically
  - You know well now how to create univariate distributions; in this unit we will need to do this for several random variables and evaluate a multivariate distribution.
  - Refer to the textbook for understanding why the integration areas shows may be “incorrect”
  - Do the exercises in Chapter 1!!!
- Recognize where the the reliability analysis and risk analysis concepts in this unit fit into a typical design cycle.
  - In the “analyze” phase we are evaluating probabilities (especially failure probabilities), whereas in the “evaluate” phase we are checking whether or not our structure/system meets the specified “norm”
  - The “norm” varies widely by industry and application (each B module will be very different in this regard, in fact). Ideally the standards are at least risk-informed (e.g., economically advantageous offshore renewables, tunnel life safety), if not entirely risk-based (e.g., Dutch flood protection)
  - In this unit we don’t focus on deriving (or even using) the risk-based evaluation criteria, but it is important to keep in mind that this will play a big role in your engineering practice!

Risk Analysis







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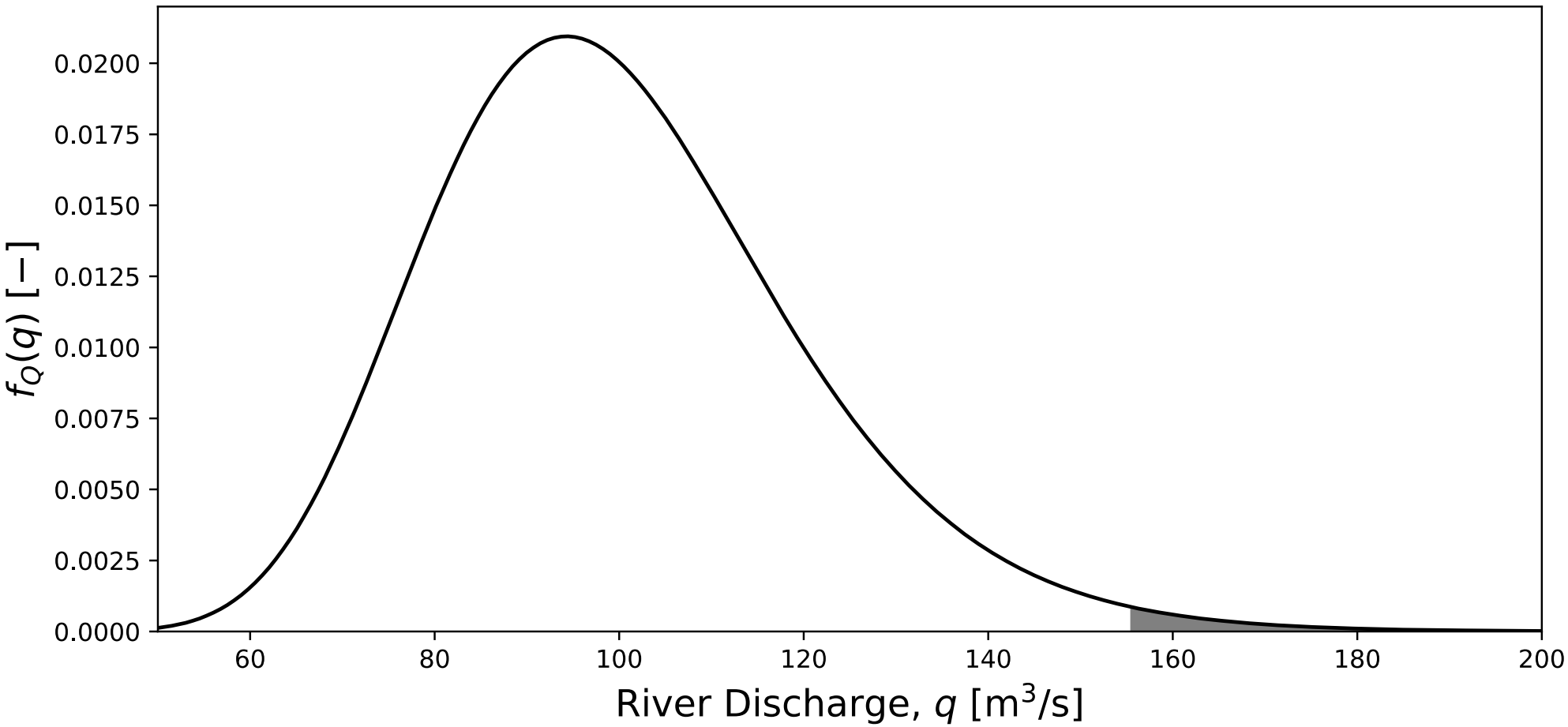
Reliability Analysis



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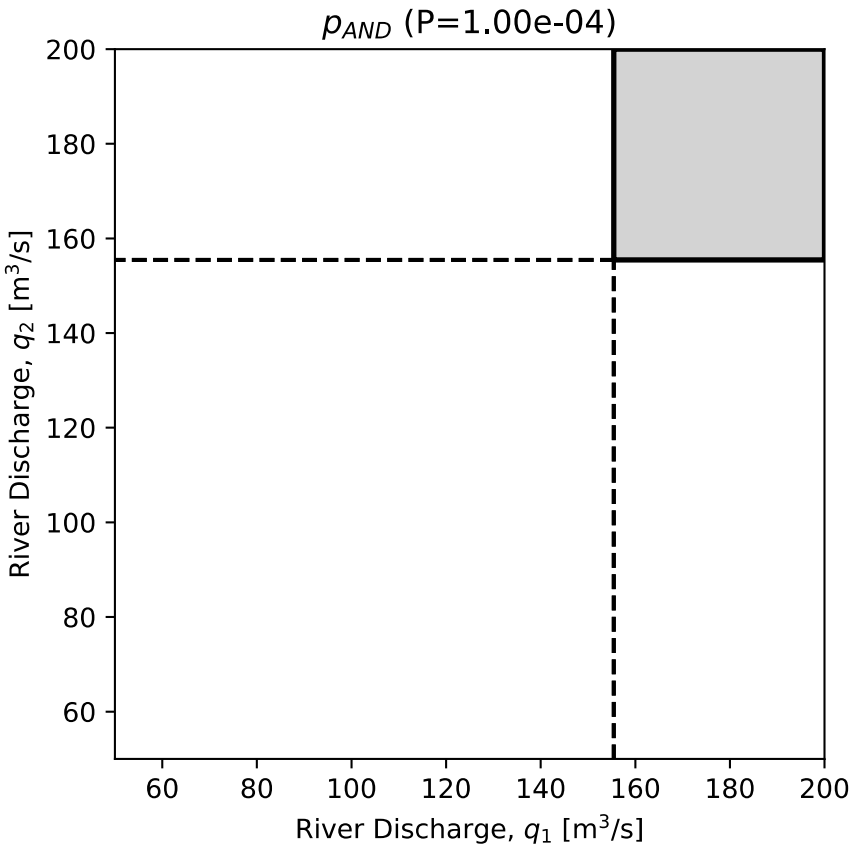
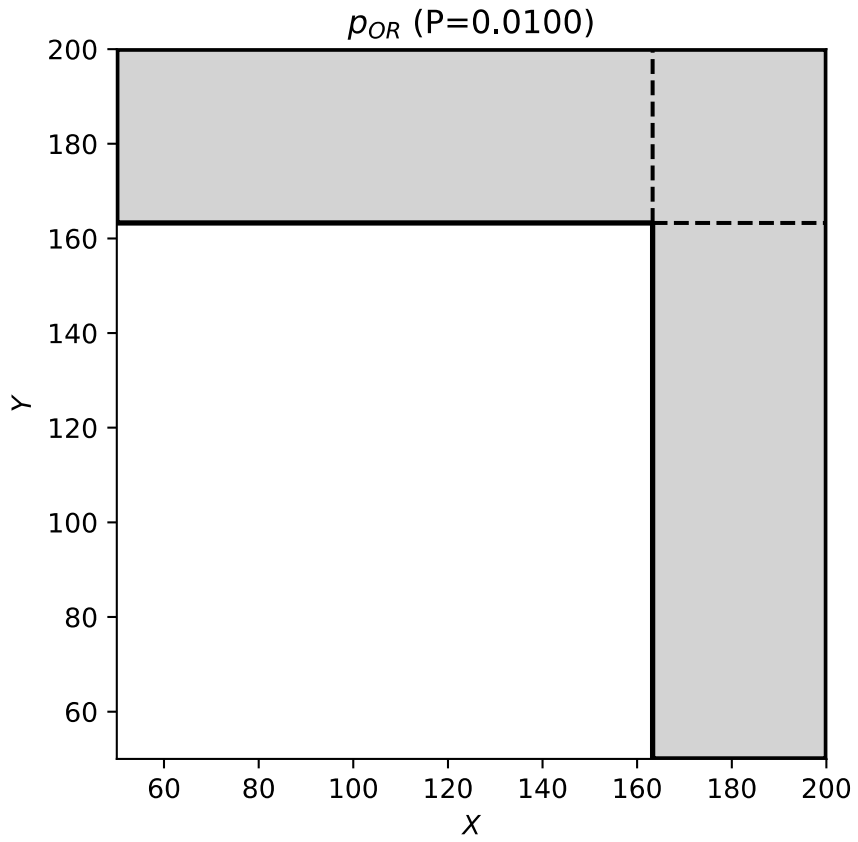
Reliability Analysis





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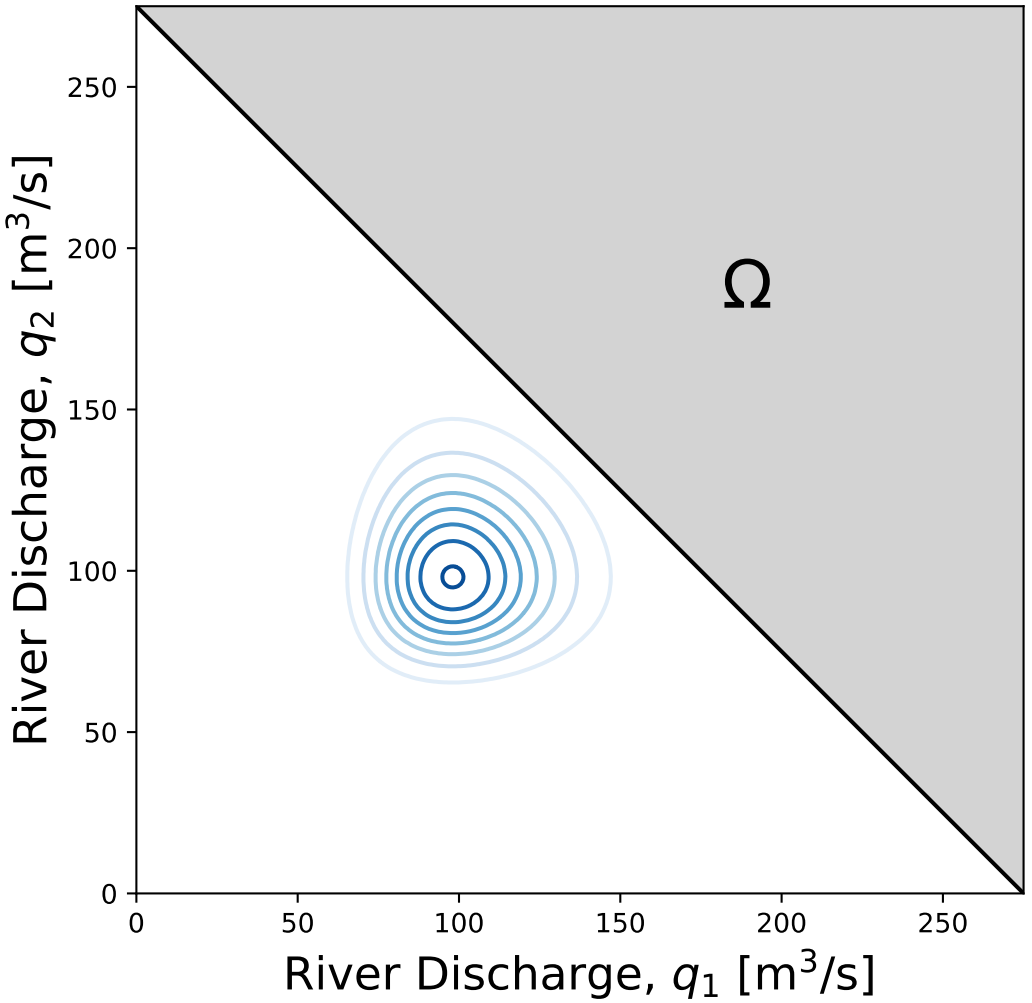
Reliability Analysis



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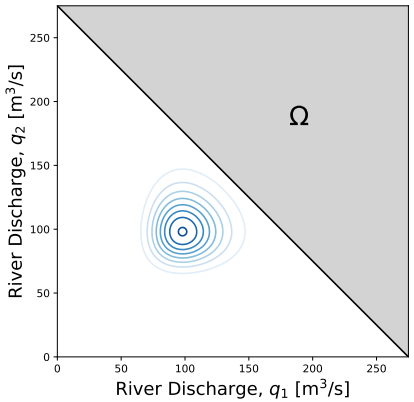
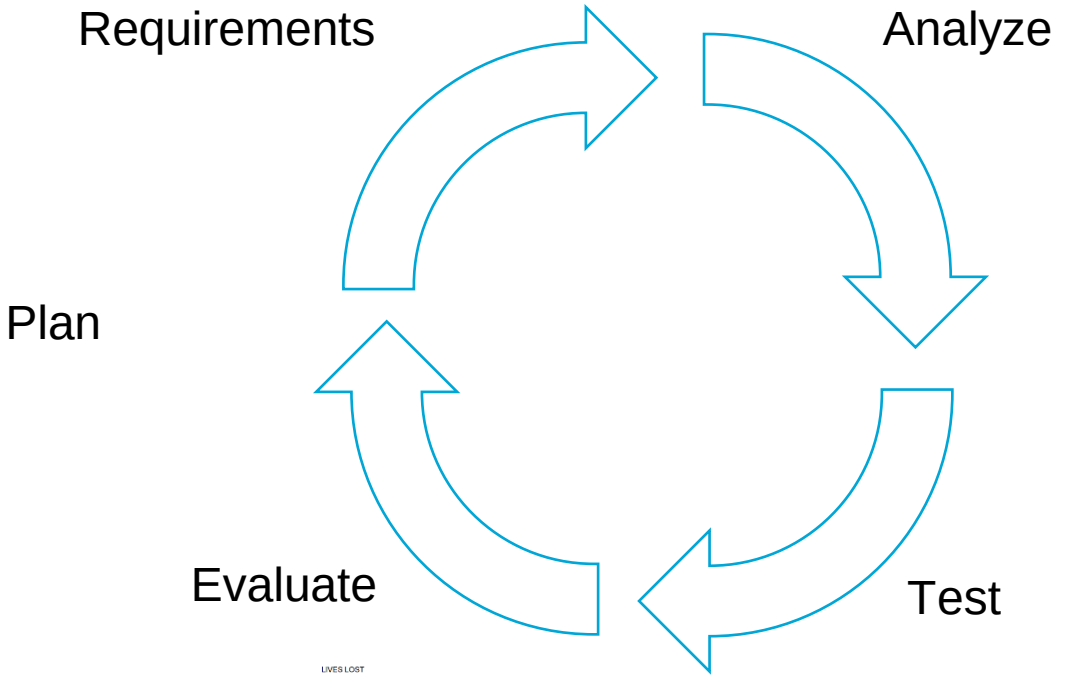
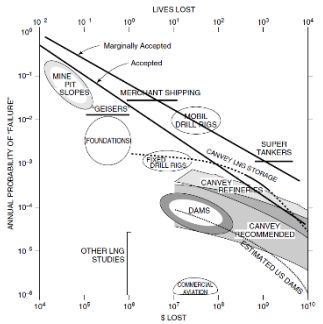
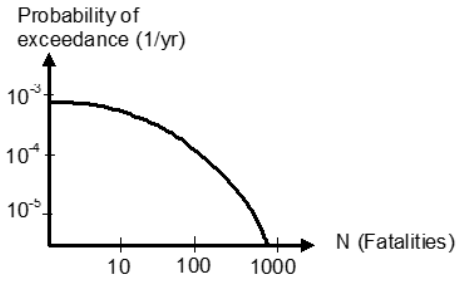
Reliability-Based Design Philosophy









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How we will approach reliability-based design

- Risk Analysis: evaluation, assessment, context (MUDE)
- Continuous Distributions, Extreme Value Analysis (MUDE, Week 2)
- → Dependence touched lightly
  (covered in cross-over!!! CEGM2005 tudelft-citg.github.io/MORE
- Component Reliability:
  a function of random variables $p_{\mathrm{f}} = \int_{\Omega} f_X(x)\,\mathrm{d}x$
- System Reliability:
  build on MUDE:, solving complex systems

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Summary of Reliability-Based Design Philosophy

- Reliability methods for analysing and evaluating structures/system
- Risk analysis provides a framework for evaluation
- We will apply this to your design case in our unit!

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