Åsmund's work in context

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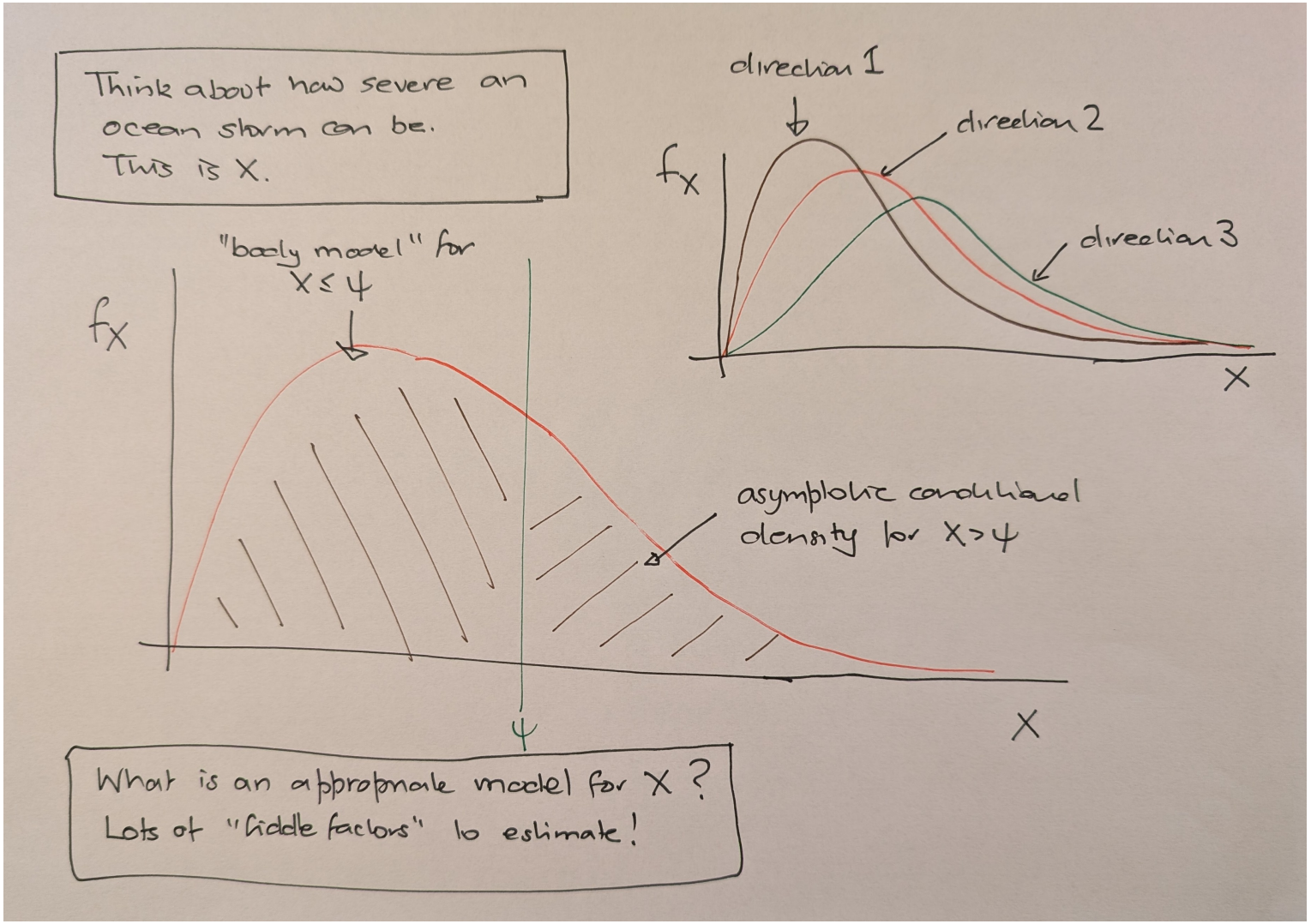
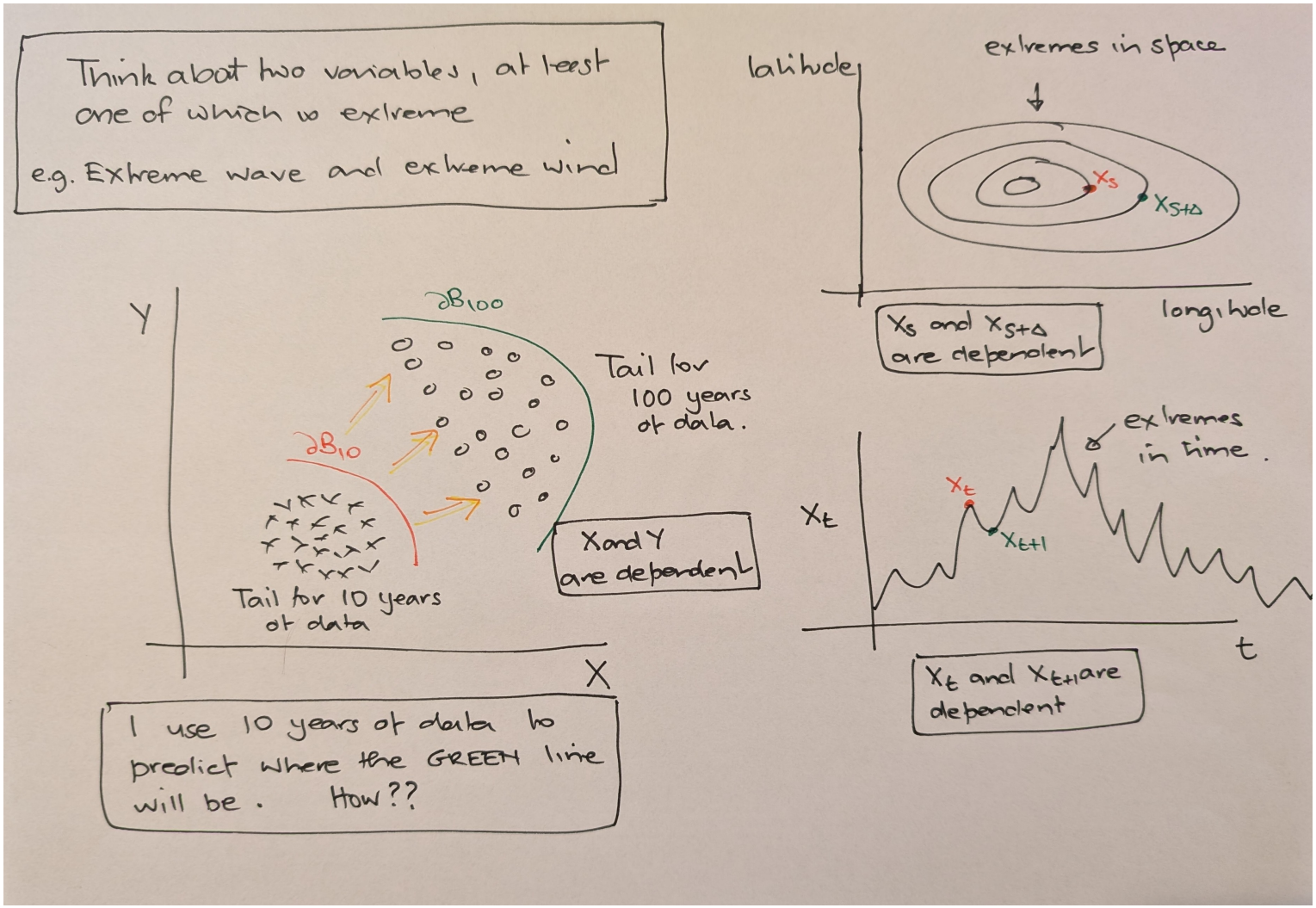
Characterising extremes of a random variable



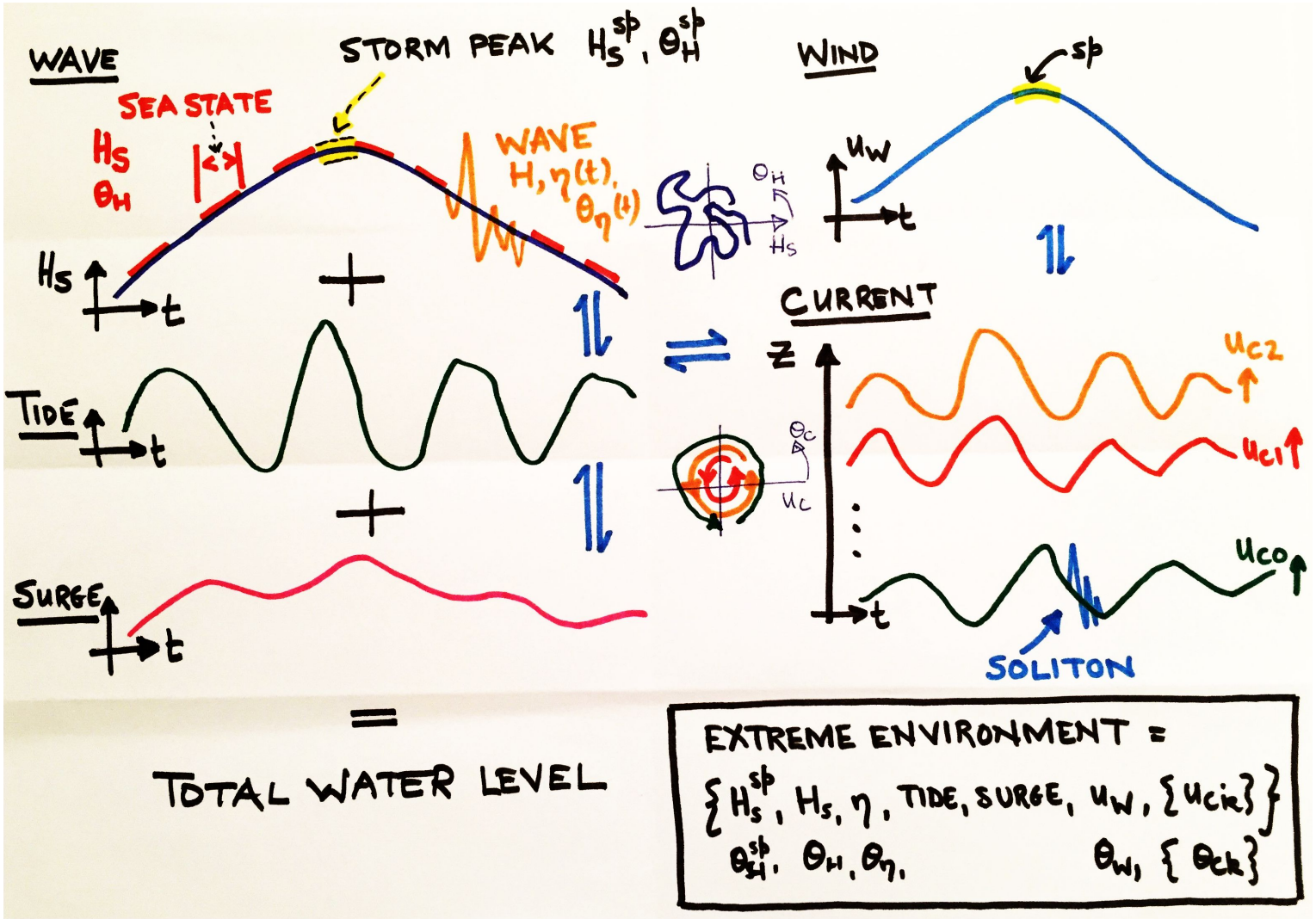
- This is not easy, even for just one variable

Characterising extremes in potentially many random variables



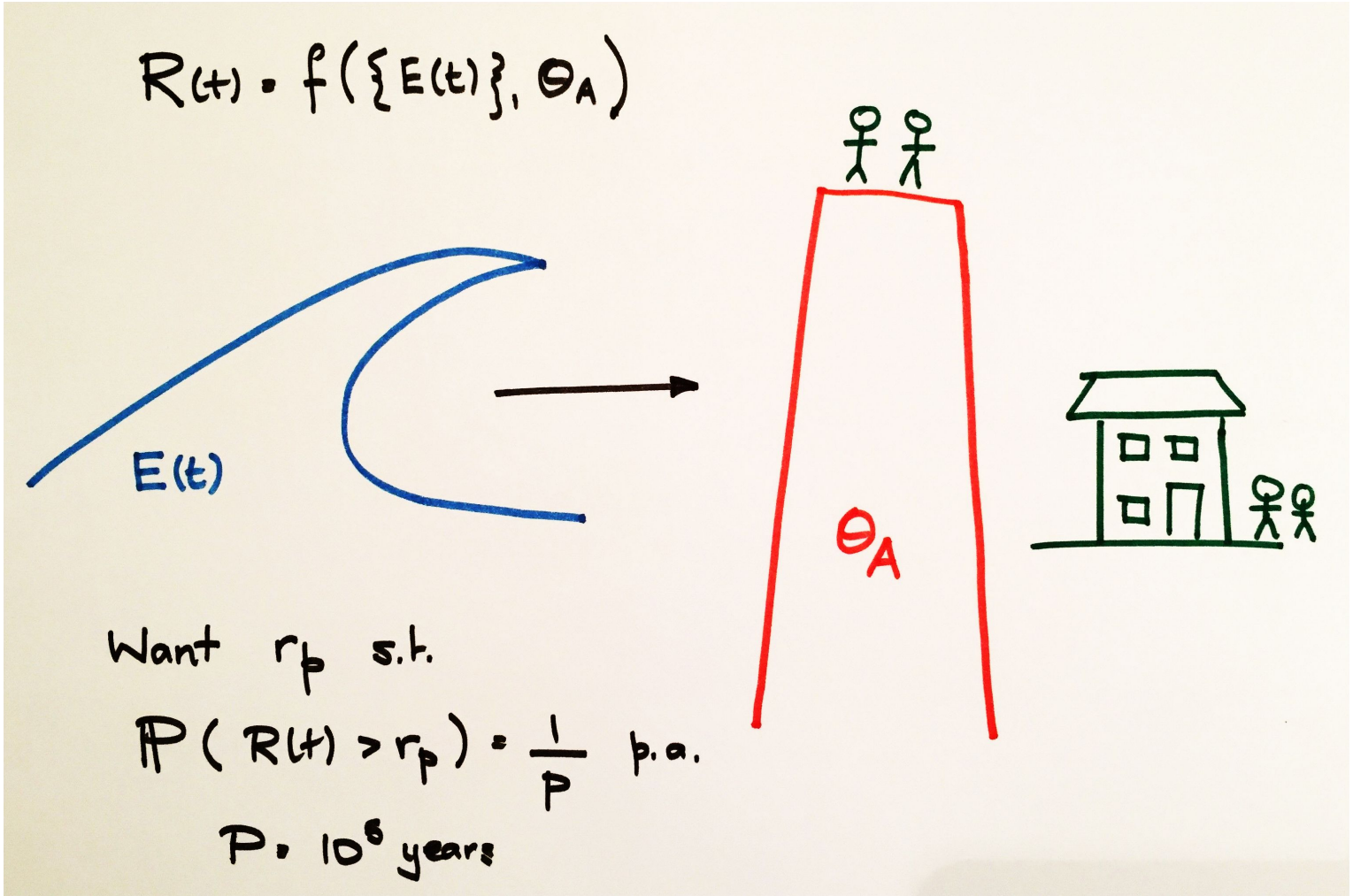
- Much harder for many variables; often don't have enough data or processing power

Characterising the extreme ocean environment



- Multiple coupled physical processes; rare, extreme events

Characterising ocean structure interaction and structural risk



- Ocean environment is harsh; marine structures at risk of failure; reliability standards must be met

Optimal design of marine structure

Set-up

- A marine system with "strength" specifications $\boldsymbol{\mathcal{S}}$
- An ocean environment $\boldsymbol{X}$ dependent on covariates $\boldsymbol{\Theta}$
- A structural "loading" $\boldsymbol{Y}$ as a result of environment X and covariates $\boldsymbol{\Theta}$
- System utility (or risk) $U(\boldsymbol{Y}|\boldsymbol{\mathcal{S}})$ for loading $\boldsymbol{Y}$ and specification $\boldsymbol{\mathcal{S}}$
- Desired U typically specified in terms of annual probability of failure
- $\boldsymbol{Y}|X, \boldsymbol{\Theta}$ and $X|\boldsymbol{\Theta}$ (and U?) subject to uncertainty $\boldsymbol{Z}$
- $\boldsymbol{Z}$, $\boldsymbol{\Theta}$, X, $\boldsymbol{Y}$ are multidimensional random variables

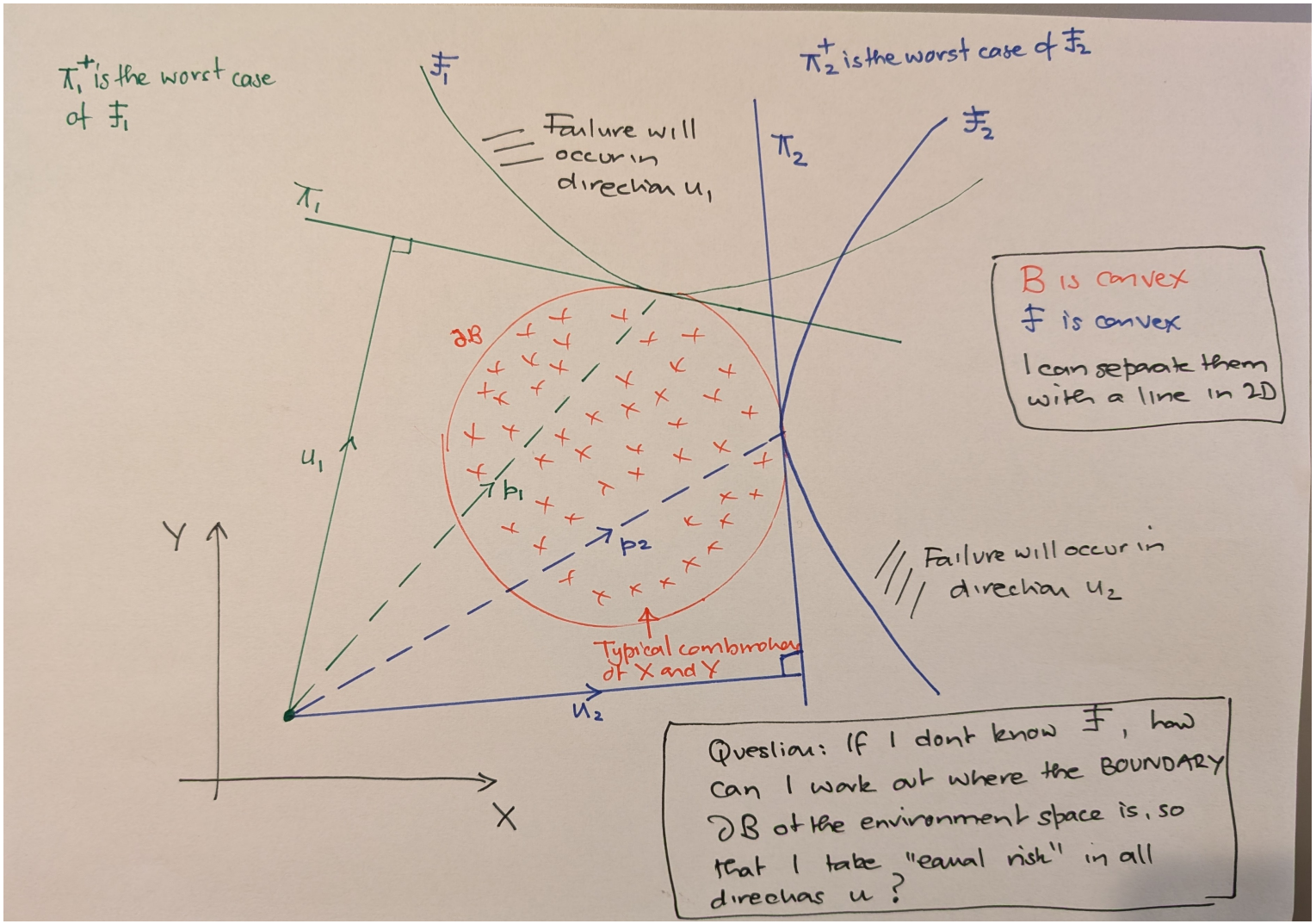
Optimal design

- A model $f_{X|\Theta,Z}$ for the environment
- A model $f_{Y|X,\Theta,Z}$ for environment-structure interaction
- A model $f_{\Theta|Z}$ for the covariates

$$\mathbb{E}[U|\boldsymbol{\mathcal{S}}] = \int_\zeta \int_y \int_x \int_\theta U(y|\boldsymbol{\mathcal{S}},\zeta) f_{Y|X,\Theta,Z}(y|x,\theta,\zeta) f_{X|\Theta,Z}(x|\theta,\zeta) f_{\Theta|Z}(\theta|\zeta) f_Z(\zeta)\, d\theta\, dx\, dy\, d\zeta$$

$$\Rightarrow \text{solve for } \boldsymbol{\mathcal{S}} \text{ to achieve required (safety) utility}$$

Åsmund's contribution: design contours and survival times



- If we make certain assumptions about the environment and the failure processes, Åsmund has given us methods to estimate the boundary ∂B of the environment set (and related quantities) which **we're sure** will be well-behaved.