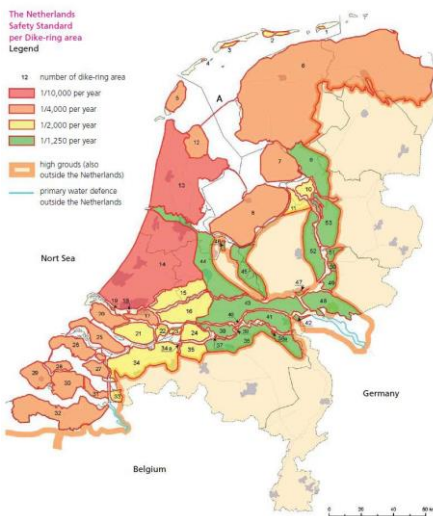




CPB Netherlands Bureau for Economic Policy Analysis

Safe Dike Heights at Minimal Costs

An Integer Programming Approach



IJsselmeer region:
system of mutually
dependent dike rings

Complex, but important.



Previous research

- Van Dantzig (1956)
- Eijgenraam (2006)
- Brekelmans et al. (2012): Optimalisering



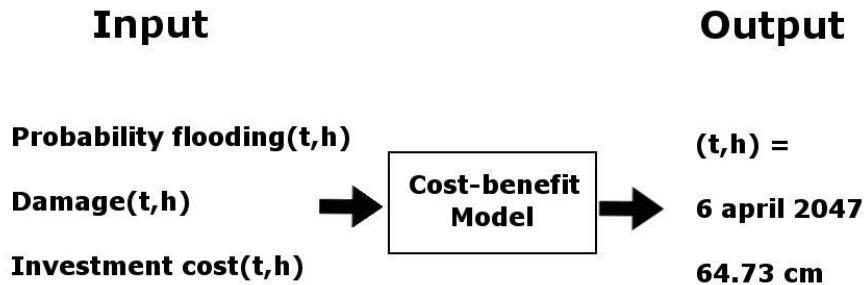
Cost-benefit analysis

optimal





Investing: When and How much?

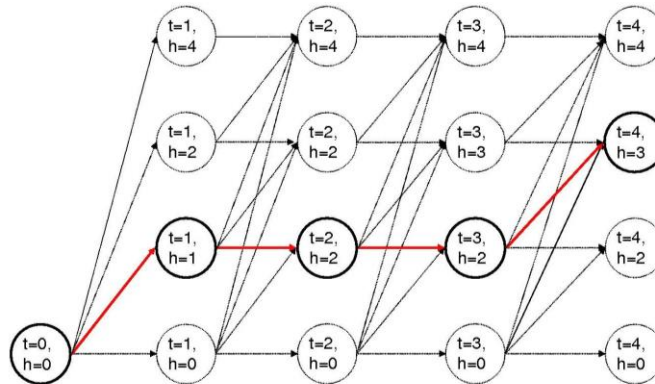


Heightening with 60 cm in 2050 is accurate enough

- Height: steps of 20 cm
- Time: periods of 5 years
- In general: many substantial uncertainties



Integer Programming Model



Sometimes you need some luck.....

- IP problems often hard to solve.
Is the Afsluitdijk problem too big?
- One, homogenous dikering: Shortest Path
- Heterogenous dikering or system of dependent dikerings: very close to Shortest Path



Optimality

All problem instances we investigated solved to proven optimality



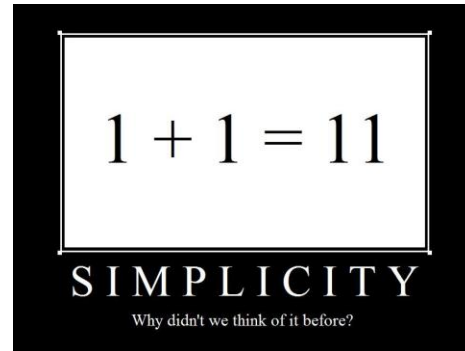
Compare Dique-Opt with Optimalising (12 non-homogenous dike rings)

- Dique-Opt: validate program on errors
Optimalising: validate heuristic method
- The difference in objective value (discounted costs of investment plus rest damage): always less than 2 %
- Mean solution time Optimalising: 12 minutes, Dique-opt: 12 seconds. (not fully comparable!)
- More important.....



Simplicity

- Copy the model needed (from CPB) in GAMS, AIMMS or C++
- Fill the data-arrays for investment, probability and damage
- Run CPLEX



Flexible

- locally specific flood prevention measures
- Different model-types
- What-if type policy evaluations





How save should the IJsselmeer dike rings optimally be?

Economical optimal water safety in a multi-level system: A new method applied to the IJsselmeer region.

Peter Zwaneveld

DD 2.3: Thursday 09.00-10.45



Dique-OPT

- Simple
- Flexible
- Optimal

