

MONTE CARLO SIMULATION FOR SENSITIVITY ANALYSIS OF RISKS

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CONTENT

About us

What is Monte Carlo simulation?

What is sensitivity analysis?

Process overview

Discussion on R code

Demo

ABOUT US

We are Assethandling Ltd , based at Sci-Tech Daresbury.

Two main products – Asset Insight Manager and Programme Insight Manager

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ASSET handling

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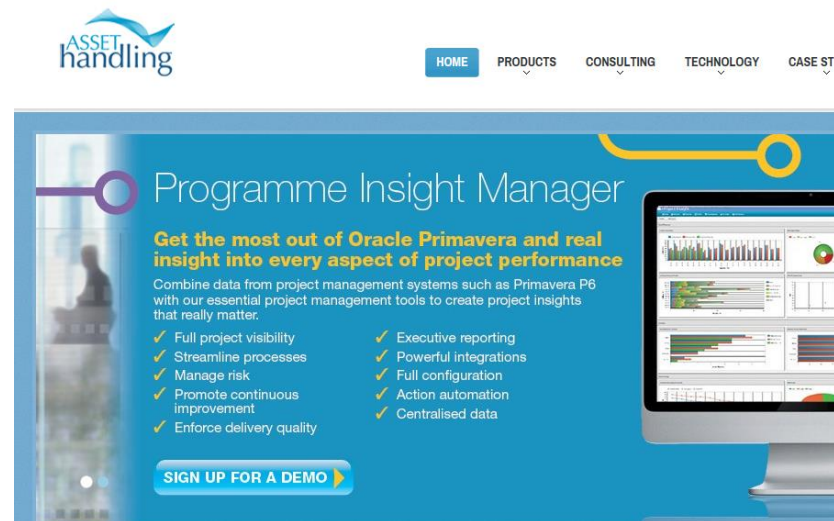
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ASSET handling

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WHAT IS MONTE CARLO SIMULATION

Monte Carlo simulation is mathematical technique that produces distributions of possible outcome values.

One main application is “to account for risks in quantitative analysis and decision making”.

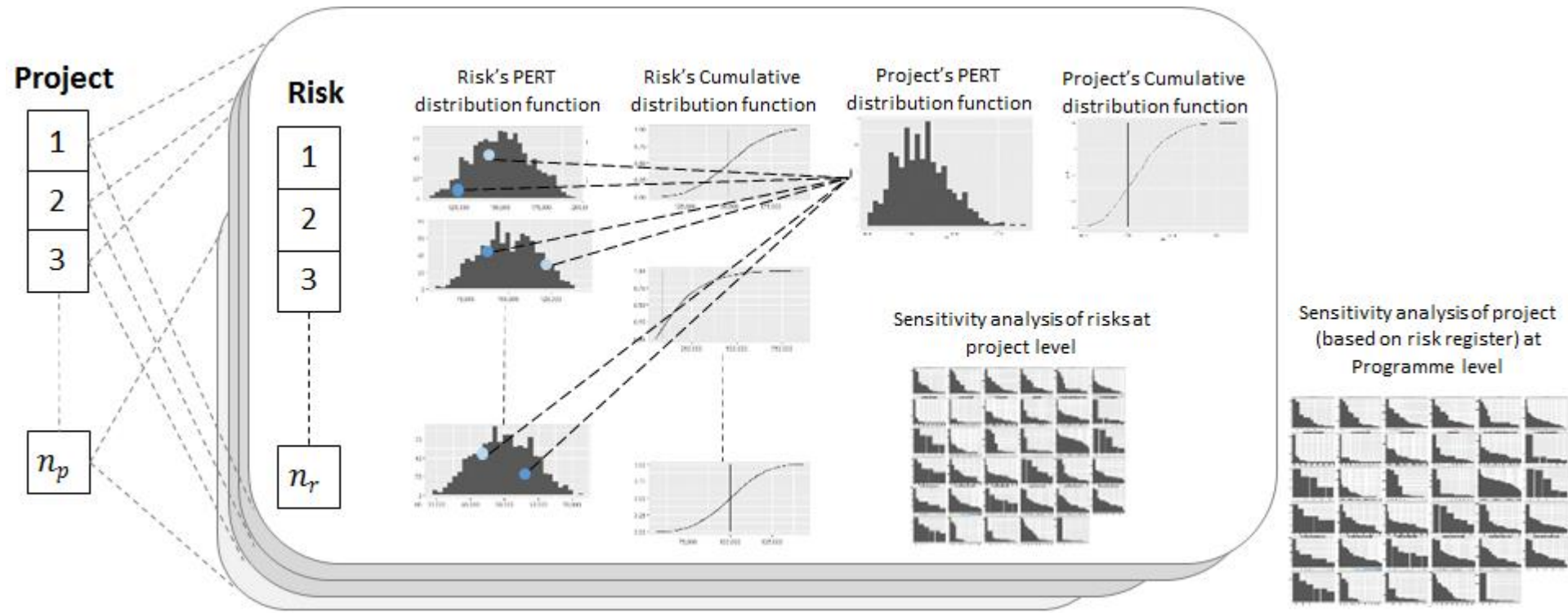
WHAT IS SENSITIVITY ANALYSIS

Sensitivity analysis (also known as what-if analysis) is used to determine the value of an individual risk change by varying an independent input.

Works using a combination of PERT analysis and Monte Carlo simulation

- Program (or project) evaluation and review technique, commonly abbreviated PERT is a statistical tool, used in project management. It is useful for modelling expert data.
- Other methods to model the distribution to generate sample values include uniform distribution, triangular distribution.

PROCESS OVERVIEW



DISCUSSION ON R CODE

Libraries used ``data.table`` and ``mc2d``

``data.table`` is an R package that provides an enhanced version of data.frames.

``mc2d`` means Two-Dimensional Monte- Carlo. Package provides additional probability distributions and other tools to construct and analysis One- Dimensional and Two- Dimensional simulations.

DISCUSSION ON R CODE

```
## generate PERT series from mc2d library for each risk
dt_sim <- dt_in[, list(mcr PERT_cost = list(round(rpert(
  1001, c_min_cost, c_ml_cost, c_max_cost, shape = 6
), 2))),
mcr PERT_time = list(round(rpert(
  1001, c_min_time, c_ml_time, c_max_time, shape = 6
), 2))),
by = c("node_id",
      "programme_id",
      "pestle_id")][, list(mcr PERT_cost = as.numeric(unlist(mcr PERT_cost)
      mcr PERT_time = as.nu
by = c("node_id", "programme
mcr_cum_cost = round(frank
mcr_cum_time = round(frank
mcr PERT_time
```


DISCUSSION ON R CODE

```
## Evaluate the series generated for calculate a score for each identified risk
dt_res1 <- dt_sim[, {
  res = lapply(cols, function(i) {
    vars = paste(c('mcr PERT', 'mcr_cum', 'c_min', 'c_ml', 'c_max'), i, sep =
      '_')
    min = get(vars[1])[which.min(abs(get(vars[1]) - get(vars[3])))]
    ml = get(vars[1])[which.min(abs(get(vars[1]) - get(vars[4])))]
    max = get(vars[1])[which.min(abs(get(vars[1]) - get(vars[5])))]
    round((min + (4 * ml) + max) / 6, 2)
  })
  names(res) = paste('mcr_score', cols, sep = "_")
  res
},
by = c("programme_id", "node_id", "pestle_id")]
```



DISCUSSION ON R CODE

```
## using the generated PERT series calculate the total possible "risk" from the identified risks
dt_dist1 <-
  rbindlist(replicate(1001, dt_sim1[, list(
    mcr PERT_cost = sample(mcr PERT_cost, size = 1),
    mcr PERT_time = sample(mcr PERT_time, size = 1)
  )],
  by = c("node_id", "pestle_id")[, list(
    mcr PERT_cost = sum(mcr PERT_cost, na.rm = TRUE),
    mcr PERT_time = sum(mcr PERT_time, na.rm = TRUE)
  )],
  by = c("node_id")],
  simplify = FALSE)[, `:=`(
  mcr_cum_cost = round(frak(mcr PERT_cost, ties.method = "max") / sum(!is.na(mcr PERT_cost)), 2),
  mcr_cum_time = round(frak(mcr PERT_time, ties.method = "max") /
    sum(!is.na(mcr PERT_time)), 2)
  ),
  by = c("node_id")]
```





DEMO

THANK YOU FOR LISTENING

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