concept

Frode Drevland, Kjell Austeng and Olav Torp

Uncertainty analysis
Modeling, estimation
and calculation

Concept report   No 11

NTNU
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Olav Torp

Uncertainty analysis - Modeling, estimation and calculation

Theoretical fundament

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Theoretical fundament

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Summary:
The report starts with a short description of necessary statistiscal theory and some important probability distributions. This theoretical part is followed by a description of chosen methods for estimation and calculation used in uncertainty analyses. Both analytical models and simulation is discussed. We perform a set of calculations of the formulas for mathematical/statistical calculation of the estimated basis figures for the analysis. One conclusion from these calculations is that Successive calculation and similar analythical methods are very robust in relation to deviations from the true probability distribution for the individual cost elements.

An important chapter is looking at how sensitive the results of analysis are for errors in the estimated input data. The conclusion is that the possibility for, and consequences of serious error is much larger when it comes to estimation of input-data than than for assumptions of skewness in the probability function, and also a lot larger than than the errors that are made in the calculation model itself. This is regardless of whether one uses an analythical model or simulation. Errors that occur due to inaccuracies in the formulas also are significantly smaller than errors caused by faulty estimates. The report finishes off by describing the basis for some tools that can be used as support in uncertainty analysis.

Summary

Frode Drevland, Kjell Austeng and Olav Torp
Uncertainty analysis - Modelling, estimation and calculation
Theoretical foundation

Concept Report No. 11

The report starts with a short description of necessary statistical theory and some important probability distributions.

This theoretical part is followed up by a description of some central methods for estimation and calculation used in uncertainty analysis. Both analytical models and simulation is discussed. Related to this we have performed a set of calculations of the formulas for mathematical/statistical calculation of the estimated basis figures for the analysises.

One conclusion from the calculations is that Successive Calculation and other similar analytical methods are very robust in relation to deviations from the true probability distribution for the individual cost elements.

We have also looked at how sensitive the analysis results are for errors in the estimated input data. In the majority of analysis models that are being employed in Norway the probability distribution is set by determining three points on the probability density curve. (Se Concept Report No. 12 about methods for uncertainty analysis). These points are often the 10th percentile (or the 1th percentile), the mode and the 90th percentile (or the 99th percentile). An analysis has been made of the consequences of incorrect estimates for these values under different assumptions. These consequences are universal and apply whether ones uses analytical calculations or simulations.

The most important conclusion of the report is that the possibility for and the consequences of serious error are much larger when it comes to estimation of input data than for assumptions of skewness in the probability function, and also a lot larger than the errors that are made in the calculation model itself. This is regaardless whether one uses an analytical model or simulation. Errors that occur due to inaccuracies in the formulas also are significantly smaller than errors caused by faulty estimates.

Further on the analyses show that the effects of errors in the input data are large if the relative uncertainty in the real probability distribution is high. The same applies if the skewness in the real distribution is large. When using the 10th and 90th percentile as outer boundaries in the estimates, errors in the estimation of these will yield larger errors than errors in the estimation of the mode or expected value.

The report finishes off by describing the basis for some tools that can be used as support in uncertainty analysis.
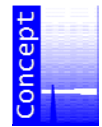
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