7
CONCLUSIONS

While there has been a huge amount of work on stochastic programs with exogenous uncertainty, the same is not true for the case where the underlying stochastic processes depend on the decisions taken.

This works aims at contributing to fill this gap by studying a problem in the area of humanitarian logistics. The proposed re-formulation scheme overcomes the non-linearities that arise in the original formulation presented in the literature and the incorporation of the importance sampling concepts allows us to solve large instances of the problem – which would otherwise be untractable – by using sample scenarios even though the final probability distribution of the random variables is not known *a priori*.

The proposed approach was able to solve all the instances available in the literature in very short time. Additionally, larger instances of the problem were created – and will be made publicly available – in order to assess the performance of the developed algorithms. Medium-size instances were solved within reasonable times (each one of them was solved in under 17 minutes) and solutions provably within 1% of the global optimal have been found. Large-size instances were solved using samples of scenarios of network configuration and solutions were also within 1% of the global optimal. Considering that the only article that deals with the exact same problem studied in this thesis used instances with only 5 edges, an eight-fold improvement has been obtained.

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Future work and extensions

Regarding improvements on the specific problem discussed in this work, there are some issues that can probably be dealt with more efficiently:

a) The problem solved at each iteration is very similar to that of the previous one – the only difference being the |S| cuts added to improve the approximation of the exponential function. Instead of solving each problem from scratch, the previously obtained solution may provide useful information which may then be used to reduce computational times.

b) Valid cuts and/or tailor-made heuristics may be identified/developed to decrease the computational effort related to the number of binary variables.

A decrease in the computational time required to solve the problem of each iteration may allow for an increase in the number of scenario samples used to solve large-scale problems, thus providing better-quality solutions.

Additionally, it would also be of interest to carry out both in-sample and out-of-sample (following the algorithm suggested in Appendix B) analyses of the problem in order to empirically determine the adequate number of sample scenarios in each case. In this sense, the incorporation of the importance sampling concepts could be further explored by using scenario samples drawn from probability distributions other than the original ones and adapting the problem accordingly.

Five main future(/current) work alternatives lie ahead:

a) Extend the methodology to consider the coupling between first and second stage variables to be given not only by the probability of occurrence of scenarios but also by the feasible region of second stage problems.
b) Adapt the methodology to consider the existence of a correlation structure between the random variables.
c) Adapt the solution procedure into a branch-and-cut framework.
d) Incorporation of risk measures and probabilistic constraints (as in the context of chance-constrained programming).
e) Explore the proposed linearization technique in the context of the unconstrained quadratic 0–1 minimization problem.
f) Study the applicability and performance of the proposed methodology to other problems of the same nature, such as those described in Chapter 1: stochastic queuing networks, stochastic PERT and revenue management.