**The value of the stochastic solution in multistage problems**

**Summary**

In this paper, parameters EVPI, the (expected value of perfect information) and VSS (value of the stochastic solution) are generalized for multistage stochastic programs. EVPI is a measure of how much it is reasonable to pay to gain access to perfect information and VSS is measure of the goodness of the expected solution value when the expected values are replaced by the random values for the input variables. The lower and upper bounds of these parameters are generalized for various deterministic equivalent models in multistage stochastic programs.

Deterministic Equivalent Model of a general multistage optimization model is presented along with the solution to the average scenario and its expected value in each time period. A scenario-tree based approach is used to deal with uncertainty in the stochastic parameters. Although, in two stage problems, the first stage variables are fixed to determine VSS, the same procedure cannot be applied to multi-stage problems. So, a chain of expected values is introduced, where for EEV\_t, the decision variables until stage (t-1) are fixed at the optimal values obtained in the related average scenario model, EV. In each stage, VSS can be calculated to check how good the approximation of the stochastic program to the deterministic one is up to that stage, when the expected values are used instead of the random variables. The final value of the chain happens to be the expected value of using the expected value solution, EEV, in two-stage models. Certain inequalities for the lower and upper bounds of the parameters are proved for different structures of the problem. The extension of these bounds is primarily useful in avoiding to obtain the optimal stochastic value (RP value) when the average based solution is good enough, as it also happens for the two-stage problem.

Further, a procedure to determine the dynamic solution of the average scenario model is presented. For a symmetric and balanced scenario tree, expected value of the dynamic solution coincides with the expected value solution. For other cases, use of the dynamic solution of the average scenario is more realistic, as it provides a chain of non-anticipative decisions. Moreover, the deterministic dynamic model of the average scenario results is a better approximation to the stochastic model than the classical deterministic model of the average scenario. The same result is proven for an investor problem which includes multi-period stochastic optimization. Determination of VSS and EVPI for two stage and multi-stage stochastic optimization problems is in accordance with the approach of the paper. In the paper, bounds for the VSS and EVPI are generalized and an approach for determining dynamic solution of the average scenario model is presented.

[Laureano F. Escudero · Araceli Garín · María Merino · Gloria Pérez , “The value of the stochastic solution in multistage problems”]

**Chance-Constrained Programming with Joint Constraints**

**Summary**

The objective of the paper is to determine deterministic equivalents for joint constraints in chance constrained programming (CCP) models. Methods to determine deterministic equivalents are provided for models with random coefficient matrix and models for which assumption of independence is relaxed for random right-hand side (RHS) elements. For the CCP model,

Maximize

Subject to P() ,

Where, ,

In the first case, the elements of the coefficient matrix () are assumed to be independent random variables having a multi-variate normal distribution with a known mean and covariance matrix. The corresponding deterministic equivalent includes two constraints which are concave. The solution to the resulting deterministic equivalent problem is obtained by solving a separable convex program with multiple parameters. Piece-wise linear approximation techniques are discussed for solving the program. If the elements of the random coefficient matrix have identical covariance matrix, the problem simplifies to a separable convex program for which the right-hand side elements are linear functions of single elements. The results are generalized for the CCP models with multiple joint constraints.

In the second case, the CCP models whose RHS elements are dependent random variables, specifically a mixture of random vectors is considered. By taking logarithm on both sides, the problem can be recast as a separable program with convex feasible set. The resulting problem can be solved by piece-wise linear approximations or using a non-linear programming algorithm. The deterministic equivalent for this constraint includes certain parameters and an estimation procedure for determining these parameters is provided for a given joint distribution function of b. For a joint CCP model in which can be expressed as a sum of two independent continuous random variables ξi and nt, methods to determine the deterministic equivalent is presented. It requires that the logarithm of the cumulative distribution function of these random variables ξi and nt, are concave. In another case, with distribution free assumptions, deterministic equivalents for joint CCP models in which RHS elements or are independent continuous random variables with finite first and second moments are obtained. These methods of determination of deterministic equivalents for random RHS elements and random coefficient matrix are discussed in the class. The paper presents additional cases with RHS elements as a mixture of random variables.

[R. Jagannathan, 1972, ‘Chance-Constrained Programming with Joint Constraints’]