
AIMMS Function Reference - GMPStochastic Procedures and Functions

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GMP::Stochastic Procedures and Functions

AIMMS supports the following procedures and functions for creating and managing generated stochastic mathematical program instances:

- `GMP::Stochastic::AddBendersFeasibilityCut`
- `GMP::Stochastic::AddBendersOptimalityCut`
- `GMP::Stochastic::BendersFindFeasibilityReference`
- `GMP::Stochastic::BendersFindReference`
- `GMP::Stochastic::CreateBendersRootproblem`
- `GMP::Stochastic::GetObjectiveBound`
- `GMP::Stochastic::GetRelativeWeight`
- `GMP::Stochastic::GetRepresentativeScenario`
- `GMP::Stochastic::MergeSolution`
- `GMP::Stochastic::UpdateBendersSubproblem`

GMP::Stochastic::AddBendersFeasibilityCut

The procedure `GMP::Stochastic::AddBendersFeasibilityCut` adds a Benders feasibility cut to the parent of a Benders feasibility problem. (The parent of a Benders feasibility problem is the parent of the corresponding Benders problem.) It uses the dual information from a solution of the Benders feasibility problem.

```
GMP::Stochastic::AddBendersFeasibilityCut(
    GMP,          ! (input) a generated mathematical program
    solution,     ! (input) a solution
    cutNo        ! (input) a scalar reference
)
```

Arguments:

GMP
An element in the set `AllGeneratedMathematicalPrograms`.

solution
An integer scalar reference to a solution.

cutNo
An integer scalar reference to a cut number.

Return value:

The procedure returns 1 on success, or 0 otherwise..

Remarks:

- The *GMP* should have been created by the function `GMP::Stochastic::CreateBendersFeasibilitySubproblem`.
- By using the suffix `.SubproblemFeasibilityCuts` of the associated symbolic mathematical program it is possible to refer to the row that is added by `GMP::Stochastic::AddBendersFeasibilityCut`. Let `gmpBen` be a Benders problem corresponding to the symbolic mathematical program `mp`. Then the row `mp.SubproblemFeasibilityCuts(gmpBen,1b1)` is added to the *GMP*, where `1b1` is an element in the set `AllGMPExtensions` created by this procedure using *cutNo*.

See also:

The routines `GMP::Instance::GenerateStochasticProgram`, `GMP::Stochastic::AddBendersOptimalityCut`, `GMP::Stochastic::CreateBendersFeasibilitySubproblem` and `GMP::Stochastic::BendersFindReference`.

GMP::Stochastic::AddBendersOptimalityCut

The procedure `GMP::Stochastic::AddBendersOptimalityCut` adds a Benders optimality cut to the parent of a Benders problem by using the dual information from a solution of the Benders problem.

```
GMP::Stochastic::AddBendersOptimalityCut(
  GMP,          ! (input) a generated mathematical program
  solution,     ! (input) a solution
  cutNo        ! (input) a scalar reference
)
```

Arguments:

GMP
An element in the set `AllGeneratedMathematicalPrograms`.

solution
An integer scalar reference to a solution.

cutNo
An integer scalar reference to a cut number.

Return value:

The procedure returns 1 on success, or 0 otherwise..

Remarks:

- The *GMP* should have been created by the function `GMP::Stochastic::BendersFindReference`.
- By using the suffix `.SubproblemOptimalityCuts` of the associated symbolic mathematical program it is possible to refer to the row that is added by `GMP::Stochastic::AddBendersOptimalityCut`. Let `gmpBen` be a Benders problem corresponding to the symbolic mathematical program `mp`. Then the row `mp.SubproblemOptimalityCuts(gmpBen, 1b1)` is added to the *GMP*, where `1b1` is an element in the set `AllGMPExtensions` created by this procedure using *cutNo*.
- The first time this procedure is called for a Benders problem a new column `mp.SubproblemObjectiveBound(gmpBen)` is added to the parent of the Benders problem. For this column a coefficient equal to the relative weight of the Benders problem will be added to the objective of the parent. For this column a coefficient of 1 is added to the optimality cut.

See also:

The routines `GMP::Instance::GenerateStochasticProgram`, `GMP::Stochastic::AddBendersFeasibilityCut`, `GMP::Stochastic::BendersFindReference`, `GMP::Stochastic::GetObjectiveBound` and `GMP::Stochastic::GetRelativeWeight`.

GMP::Stochastic::BendersFindFeasibilityReference

The function `GMP::Stochastic::BendersFindFeasibilityReference` returns the reference to the (feasibility) generated math program belonging to a node in the scenario tree. This generated math program represents the Benders feasibility problem for a stage and for some representative scenario in the scenario tree of a stochastic mathematical program.

```
GMP::Stochastic::BendersFindFeasibilityReference(
    GMP,           ! (input) a generated mathematical program
    stage,        ! (input) a scalar reference
    scenario      ! (input) a scenario
)
```

Arguments:

GMP

An element in the set `AllGeneratedMathematicalPrograms`.

stage

An integer scalar reference to a stage.

scenario

An element in the set `AllStochasticScenarios`.

Return value:

An element in the set `AllGeneratedMathematicalPrograms`.

Remarks:

- The function `GMP::Stochastic::CreateBendersRootproblem` creates all Benders feasibility problems for all nodes in the scenario tree, and must be called before calling `GMP::Stochastic::BendersFindReference`.
- The *GMP* should correspond to a root node, i.e., be created by using the function `GMP::Stochastic::CreateBendersRootproblem`.

See also:

The routines `GMP::Instance::GenerateStochasticProgram`, `GMP::Stochastic::BendersFindReference` and `GMP::Stochastic::CreateBendersRootproblem`.

GMP::Stochastic::BendersFindReference

The function `GMP::Stochastic::BendersFindReference` returns the reference to the generated math program belonging to a node in the scenario tree. This generated math program represents the Benders problem for a stage and for some representative scenario in the scenario tree of a stochastic mathematical program.

```
GMP::Stochastic::BendersFindReference(
    GMP,                ! (input) a generated mathematical program
    stage,              ! (input) a scalar reference
    scenario            ! (input) a scenario
)
```

Arguments:

GMP

An element in the set `AllGeneratedMathematicalPrograms`.

stage

An integer scalar reference to a stage.

scenario

An element in the set `AllStochasticScenarios`.

Return value:

An element in the set `AllGeneratedMathematicalPrograms`.

Remarks:

- The function `GMP::Stochastic::CreateBendersRootproblem` creates all Benders problems for all nodes in the scenario tree, and must be called before calling `GMP::Stochastic::BendersFindReference`.
- The *GMP* should correspond to a root node, i.e., be created by using the function `GMP::Stochastic::CreateBendersRootproblem`.

See also:

The routines `GMP::Instance::GenerateStochasticProgram`, `GMP::Stochastic::BendersFindFeasibilityReference` and `GMP::Stochastic::CreateBendersRootproblem`.

GMP::Stochastic::CreateBendersRootproblem

The function `GMP::Stochastic::CreateBendersRootproblem` generates a mathematical program that represents the Benders problem at the unique node at stage 1 in the scenario tree of a stochastic mathematical program, and it also creates all Benders problems for all other nodes.

This function collects all columns and rows that correspond to the unique (representive) scenario at stage 1 in the scenario tree.

```
GMP::Stochastic::CreateBendersRootproblem(
    GMP,                ! (input) a generated mathematical program
    [name]              ! (optional) a string expression
)
```

Arguments:

GMP

An element in the set `AllGeneratedMathematicalPrograms`.

name

A string that holds the name for the Benders problem created for *GMP* at stage 1.

Return value:

A new element in the set `AllGeneratedMathematicalPrograms` with the name as specified by the *name* argument.

Remarks:

- The *GMP* should have been created by the function `GMP::Instance::GenerateStochasticProgram`.
- The generated math program belonging to the node of a Benders subproblem can be obtained by using the function `GMP::Stochastic::BendersFindReference`.
- If the *name* argument is not specified, or if it is the empty string, then the name of the *GMP*, stage 1 and the unique representative scenario at stage 1 are used to create a new element in the set `AllGeneratedMathematicalPrograms`.

See also:

The routines `GMP::Instance::GenerateStochasticProgram`, `GMP::Stochastic::BendersFindReference` and `GMP::Stochastic::UpdateBendersSubproblem`. See Section 19.1 of the Language Reference for more details on scenario tree, scenarios and stages.

GMP::Stochastic::GetObjectiveBound

The function `GMP::Stochastic::GetObjectiveBound` returns the level value of the column `mp.SubproblemObjectiveBound` in a solution of a Benders problem, where `mp` denotes the corresponding symbolic mathematical program.

```
GMP::Stochastic::GetObjectiveBound(  
    GMP,          ! (input) a generated mathematical program  
    solution      ! (input) a solution  
)
```

Arguments:

GMP

An element in the set `AllGeneratedMathematicalPrograms`.

solution

An integer scalar reference to a solution.

Return value:

In case of success, the level value. Otherwise it returns UNDF.

Remarks:

- The *GMP* should have been created by the function `GMP::Stochastic::BendersFindReference`.
- Initially, the column `mp.SubproblemObjectiveBound` is not part of the Benders problem but it will be added if the procedure `GMP::Stochastic::AddBendersOptimalityCut` is called.

See also:

The routines `GMP::Instance::GenerateStochasticProgram`, `GMP::Stochastic::AddBendersOptimalityCut` and `GMP::Stochastic::BendersFindReference`.

GMP::Stochastic::GetRelativeWeight

The function `GMP::Stochastic::GetRelativeWeight` returns the relative weight of a scenario at some stage in the scenario tree belonging to a stochastic mathematical program. The weight is relative to the sum of the weights of all scenarios that have the same parent at that stage.

```
GMP::Stochastic::GetRelativeWeight(
    GMP,          ! (input) a generated mathematical program
    stage,       ! (input) a scalar reference
    scenario     ! (input) a scenario
)
```

Arguments:

GMP
An element in the set `AllGeneratedMathematicalPrograms`.

stage
An integer scalar reference to a stage.

scenario
An element in the set `AllStochasticScenarios`.

Return value:

In case of success, the relative weight. Otherwise it returns UNDF.

Remarks:

The *GMP* should have been created by the function `GMP::Instance::GenerateStochasticProgram`.

See also:

The routines `GMP::Instance::GenerateStochasticProgram` and `GMP::Stochastic::GetRepresentativeScenario`. See Section 19.1 of the Language Reference for more details on scenario tree, scenarios and stages.

GMP::Stochastic::GetRepresentativeScenario

The function `GMP::Stochastic::GetRepresentativeScenario` returns the representative scenario of a scenario at some stage in the scenario tree belonging to a stochastic mathematical program.

```
GMP::Stochastic::GetRepresentativeScenario(
  GMP,          ! (input) a generated mathematical program
  stage,        ! (input) a scalar reference
  scenario      ! (input) a scenario
)
```

Arguments:

GMP

An element in the set `AllGeneratedMathematicalPrograms`.

stage

An integer scalar reference to a stage.

scenario

An element in the set `AllStochasticScenarios`.

Return value:

An element in the set `AllStochasticScenarios`.

Remarks:

The *GMP* should have been created by the function `GMP::Instance::GenerateStochasticProgram`.

See also:

The routines `GMP::Instance::GenerateStochasticProgram` and `GMP::Stochastic::GetRelativeWeight`. See Section 19.1 of the Language Reference for more details on scenario tree, scenarios and stages.

GMP::Stochastic::MergeSolution

The procedure `GMP::Stochastic::MergeSolution` merges a solution of a Benders problem into a solution of the stochastic mathematical program belonging to the Benders problem. Only the level values of the columns are merged. The objective level value is updated by using the objective definition and the level values in the solution.

```
GMP::Stochastic::MergeSolution(
  GMP,          ! (input) a generated mathematical program
  solution1,    ! (input) a solution
  solution2,    ! (input) a solution
  [updObj]     ! (optional) a binary scalar value
)
```

Arguments:

GMP

An element in the set `AllGeneratedMathematicalPrograms`.

solution1

An integer scalar reference to a solution of *GMP*.

solution2

An integer scalar reference to a solution of the stochastic mathematical program that belongs to *GMP*.

updObj

A binary scalar indicating whether the (stochastic) objective value should be updated. Its default value is 1 which means that the objective is updated.

Return value:

The procedure returns 1 on success, or 0 otherwise.

Remarks:

- The *GMP* should have been created by the function `GMP::Stochastic::CreateBendersRootproblem` or by the function `GMP::Stochastic::BendersFindReference`.
- It is most efficient to only update the objective value during the last call to `GMP::Stochastic::MergeSolution`, i.e., set *updObj* to 1 for the last call and to 0 for all preceding calls.

See also:

The routines `GMP::Instance::GenerateStochasticProgram`, `GMP::Stochastic::CreateBendersRootproblem` and `GMP::Stochastic::BendersFindReference`.

GMP::Stochastic::UpdateBendersSubproblem

The procedure `GMP::Stochastic::UpdateBendersSubproblem` updates the right hand side values of a Benders problem by using a solution of the parent Benders problem.

```
GMP::Stochastic::UpdateBendersSubproblem(
  GMP,          ! (input) a generated mathematical program
  solution      ! (input) a solution
)
```

Arguments:

GMP

An element in the set `AllGeneratedMathematicalPrograms`.

solution

An integer scalar reference to a solution.

Return value:

The procedure returns 1 on success, or 0 otherwise.

Remarks:

- The *GMP* should have been created by the function `GMP::Stochastic::CreateBendersRootproblem` or obtained by the function `GMP::Stochastic::BendersFindReference`.
- This procedure does not use the *solution* if the *GMP* belongs to the Benders problem at (the unique node at) stage 1, i.e., if it was created by the function `GMP::Stochastic::CreateBendersRootproblem`.

See also:

The routines `GMP::Instance::GenerateStochasticProgram`, `GMP::Stochastic::BendersFindReference` and `GMP::Stochastic::CreateBendersRootproblem`.