This is a simple production problem with trap states and stochastic problem dimensions. Its purpose is to illustrate the construction of an event tree, both by the use of the SMPL format, and with the proposed new OSiL schema.

The problem description follows. In the first stage, a quantity of a single product is produced, subject to some capacity constraints. Then the demand is observed, which could be low, medium or high.

If the demand is low, the product is sold and no new product is made in the second stage. Any leftover product is disposed of, and the company goes out of business.

If the demand is medium, more product is produced in the second stage and added to any leftover stock. Backorders are not allowed.

If the demand is high, a second product is introduced and made, subject also to capacity constraints. The two products are complementary and have correlated demand.

If medium demand was observed in the second stage, the third stage unfolds in a like manner: If demand is low, the company goes out of business; if demand is medium, a single product is produced, and if demand is high, the second product is introduced in the third stage.

If the demand in the second stage was high, both products are again produced in the third stage.

The fourth and last stage is a simple bookkeeping stage. The demand is observed and satisfied; unfilled demand is considered lost, and any surplus product is disposed of.

The SMPS formulation requires three separate files, a “time” file, which describes the stage structure, the “core” file, which gives the deterministic parts of the problem, and the “stoch” file, which contains the stochastic elements. In the case of nodal trees, the time and core files can be minimal.

TIME file (Note that this time file contains just enough information to set up the root node)

TIME Node\_ex

PROD0 OBJ

ENDATA

CORE file (Node 0)

CORE Node\_ex

ROWS

N OBJ

COLUMNS

PROD0 OBJ -3.0

RHS

BOUNDS

UP BOUND1 PROD0 10.0

ENDATA

The stoch file describes 45 nodes altogether. The node structure is given in the picture below.

Node 0

Node 3

Node 2

Node 1

Node 5

Node 4

6

7

8

9

10

11

12

13

16

15

14

17 … 23

24 … 44

STOCH Node\_ex

\* NODE0 was defined in the core file

NODES

CP NODE0 'ROOT' 1.0 'CORFIL'

\* ---------------------------------------------

MK NODE1 NODE0 0.3

\* Observe low demand; shut down (simple recourse)

ROWS

E PRODBAL1

G SALECAP1

COLUMNS

PROD0 PRODBAL1 1.0 SALECAP1 -1.0

SALE1 PRODBAL1 -1.0 SALECAP1 1.0

SALE1 OBJ 4.0

SHORT1 PRODBAL1 1.0

SURPL1 PRODBAL1 -1.0 OBJ 1.0

RHS

BOUNDS

UP BOUND1 SALE1 3.0

ENDNODE

\* ---------------------------------------------

MK NODE2 NODE0 0.5

\* Observe medium demand; produce again

ROWS

E PRODBAL2

G SALECAP2

COLUMNS

PROD0 PRODBAL2 1.0 SALECAP2 -1.0

SALE2 SALECAP2 1.0 PRODBAL2 -1.0

SALE2 OBJ 4.0

PROD2 PRODBAL2 1.0 OBJ -3.0

INV2 PRODBAL2 -1.0 OBJ 0.5

RHS

BOUNDS

UP BOUND1 SALE2 5.0

UP BOUND1 PROD2 10.0

ENDNODE

\* ---------------------------------------------

MK NODE3 NODE0 0.2

\* Observe high demand; introduce second product

ROWS

E PRODBAL3

G SALECAP3

COLUMNS

PROD0 PRODBAL3 1.0 SALECAP3 -1.0

SALE3 SALECAP3 1.0 PRODBAL3 -1.0

SALE3 OBJ 4.0

PROD3 PRODBAL3 1.0 OBJ -3.0

INV3 PRODBAL3 -1.0 OBJ 0.5

PROD3b OBJ -3.0

RHS

BOUNDS

UP BOUND1 SALE3 7.0

UP BOUND1 PROD3 10.0

UP BOUND1 PROD3b 10.0

ENDNODE

\* ---------------------------------------------

\* Third stage: Nodes 4 through 13

\* ---------------------------------------------

MK NODE4 NODE2 0.3

\* Observe low demand; shut down (simple recourse)

ROWS

E PRODBAL4

G SALECAP4

COLUMNS

PROD2 PRODBAL4 1.0 SALECAP4 -1.0

SALE4 PRODBAL4 -1.0 SALECAP4 1.0

SALE4 OBJ 4.0

SHORT4 PRODBAL4 1.0

SURPL4 PRODBAL4 -1.0 OBJ 1.0

RHS

BOUNDS

UP BOUND1 SALE4 3.0

ENDNODE

\* ---------------------------------------------

MK NODE5 NODE2 0.5

\* Observe medium demand; produce again

ROWS

E PRODBAL5

G SALECAP5

COLUMNS

PROD2 PRODBAL5 1.0 SALECAP5 -1.0

SALE5 SALECAP5 1.0 PRODBAL5 -1.0

SALE5 OBJ 4.0

PROD5 PRODBAL5 1.0 OBJ -3.0

INV5 PRODBAL5 -1.0 OBJ -0.5

RHS

BOUNDS

UP BOUND1 SALE5 5.0

UP BOUND1 PROD5 10.0

ENDNODE

\* ---------------------------------------------

MK NODE6 NODE2 0.2

\* Observe high demand; introduce second product

ROWS

E PRODBAL6

G SALECAP6

COLUMNS

PROD2 PRODBAL6 1.0 SALECAP6 -1.0

SALE6 SALECAP6 1.0 PRODBAL6 -1.0

SALE6 OBJ 4.0

PROD6 PRODBAL6 1.0 OBJ -3.0

INV6 PRODBAL6 -1.0 OBJ -0.5

PROD6b OBJ -3.0

RHS

BOUNDS

UP BOUND1 SALE6 7.0

UP BOUND1 PROD6 10.0

UP BOUND1 PROD6b 10.0

ENDNODE

\* --------------------------------------------

MK NODE7 NODE3 0.15

\* Node 7: produce both products a second time

ROWS

E PRODBAL7

E PRDBAL7b

G SALECAP7

G SALCAP7b

COLUMNS

PROD3 PRODBAL7 1.0 SALECAP7 -1.0

PROD3b PRDBAL7b 1.0 SALCAP7b -1.0

SALE7 SALECAP7 1.0 PRODBAL7 -1.0

SALE7 OBJ 4.0

PROD7 PRODBAL7 1.0 OBJ -3.0

SALE7b SALCAP7b 1.0 PRDBAL7b -1.0

SALE7b OBJ 4.0

PROD7b PRDBAL7b 1.0 OBJ -3.0

INV7 PRODBAL7 -1.0 OBJ -0.5

INV7b PRDBAL7b -1.0 OBJ -0.5

RHS

BOUNDS

UP BOUND1 SALE7 3.0

UP BOUND1 SALE7b 3.0

UP BOUND1 PROD7 10.0

UP BOUND1 PROD7b 10.0

ENDNODE

\* --------------------------------------------

CP NODE8 NODE7 0.15 NODE7

UP BOUND1 SALE7 3.0

UP BOUND1 SALE7b 5.0

\* --------------------------------------------

CP NODE9 NODE7 0.15 NODE7

UP BOUND1 SALE7 5.0

UP BOUND1 SALE7b 3.0

\* --------------------------------------------

CP NODE10 NODE7 0.25 NODE7

UP BOUND1 SALE7 5.0

UP BOUND1 SALE7b 5.0

\* --------------------------------------------

CP NODE11 NODE7 0.10 NODE7

UP BOUND1 SALE7 7.0

UP BOUND1 SALE7b 5.0

\* --------------------------------------------

CP NODE12 NODE7 0.10 NODE7

UP BOUND1 SALE7 5.0

UP BOUND1 SALE7b 7.0

\* --------------------------------------------

CP NODE13 NODE7 0.10 NODE7

UP BOUND1 SALE7 7.0

UP BOUND1 SALE7b 7.0

\* ---------------------------------------------

\* Fourth (last) stage - Bookkeeping only (i.e., simple recourse)

\* ---------------------------------------------

MK NODE14 NODE5 0.2

\* Observe low demand; shut down (simple recourse)

ROWS

E PRDBAL14

G SALCAP14

COLUMNS

PROD5 PRDBAL14 1.0 SALCAP14 -1.0

SALE14 PRDBAL14 -1.0 SALCAP14 1.0

SALE14 OBJ 4.0

SHORT14 PRDBAL14 1.0

SURPL14 PRDBAL14 -1.0 OBJ 1.0

RHS

BOUNDS

UP BOUND1 SALE14 3.0

ENDNODE

\* --------------------------------------------

CP NODE15 NODE5 0.5 NODE14

UP BOUND1 SALE14 5.0

\* --------------------------------------------

CP NODE16 NODE5 0.3 NODE14

UP BOUND1 SALE14 7.0

\* --------------------------------------------

MK NODE17 NODE6 0.15

\* Nodes 17-23: Demand for two products is correlated (see nodes 7-13)

\* In all cases, observe demand; then shut down (simple recourse)

ROWS

E PRODBAL7

G SALECAP7

E PRDBAL7b

G SALCAP7b

COLUMNS

PROD4 PRODBAL7 1.0 SALECAP7 -1.0

SALE7 PRODBAL7 -1.0 SALECAP7 1.0

SALE7 OBJ 4.0

SHORT7 PRODBAL7 1.0

SURPL7 PRODBAL7 -1.0 OBJ 1.0

\*

PROD4b PRDBAL7b 1.0 SALCAP7b -1.0

SALE7b PRDBAL7b -1.0 SALCAP7b 1.0

SALE7b OBJ 4.0

SHORT7b PRDBAL7b 1.0

SURPL7b PRDBAL7b -1.0 OBJ 1.0

RHS

BOUNDS

UP BOUND1 SALE7 3.0

UP BOUND1 SALE7b 3.0

ENDNODE

\* --------------------------------------------

CP NODE18 NODE6 0.15 NODE17

UP BOUND1 SALE7 3.0

UP BOUND1 SALE7b 5.0

\* --------------------------------------------

CP NODE19 NODE6 0.15 NODE17

UP BOUND1 SALE7 5.0

UP BOUND1 SALE7b 3.0

\* --------------------------------------------

CP NODE20 NODE6 0.25 NODE17

UP BOUND1 SALE7 5.0

UP BOUND1 SALE7b 5.0

\* --------------------------------------------

CP NODE21 NODE6 0.10 NODE17

UP BOUND1 SALE7 7.0

UP BOUND1 SALE7b 5.0

\* --------------------------------------------

CP NODE22 NODE6 0.10 NODE17

UP BOUND1 SALE7 5.0

UP BOUND1 SALE7b 7.0

\* --------------------------------------------

CP NODE23 NODE6 0.10 NODE17

UP BOUND1 SALE7 7.0

UP BOUND1 SALE7b 7.0

\* --------------------------------------------

\* Note: even though structure is identical to node 17,

\* it is more compact to use different base cases throughout

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CP NODE24 NODE7 0.25 NODE17

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CP NODE25 NODE7 0.5 NODE20

\* --------------------------------------------

CP NODE26 NODE7 0.25 NODE23

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CP NODE27 NODE8 0.25 NODE17

\* --------------------------------------------

CP NODE28 NODE8 0.5 NODE20

\* --------------------------------------------

CP NODE29 NODE8 0.25 NODE23

\* --------------------------------------------

CP NODE30 NODE9 0.25 NODE17

\* --------------------------------------------

CP NODE31 NODE9 0.5 NODE20

\* --------------------------------------------

CP NODE32 NODE9 0.25 NODE23

\* --------------------------------------------

CP NODE33 NODE10 0.25 NODE17

\* --------------------------------------------

CP NODE34 NODE10 0.5 NODE20

\* --------------------------------------------

CP NODE35 NODE10 0.25 NODE23

\* --------------------------------------------

CP NODE36 NODE11 0.25 NODE17

\* --------------------------------------------

CP NODE37 NODE11 0.5 NODE20

\* --------------------------------------------

CP NODE38 NODE11 0.25 NODE23

\* --------------------------------------------

CP NODE39 NODE12 0.25 NODE17

\* --------------------------------------------

CP NODE40 NODE12 0.5 NODE20

\* --------------------------------------------

CP NODE41 NODE12 0.25 NODE23

\* --------------------------------------------

CP NODE42 NODE13 0.25 NODE17

\* --------------------------------------------

CP NODE43 NODE13 0.5 NODE20

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CP NODE44 NODE13 0.25 NODE23