

Examples for Testing of the MicroSimulation Tool (MIST)

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Introduction

This document contains a set of examples that demonstrates the simulation capabilities of the MicroSimulation Tool (MIST). These capabilities are demonstrated by a set of examples that are presented in increasing level of complexity. These tests have known results and are used for testing the system integrity. In addition to the example descriptions, the results of each example are shown and the appendix for this document contains programs that show how these results were calculated.

These examples are incorporated in the file InputExample.py to verify system integrity. They are also shown in the file testing.zip that can be loaded by the system.

Each example in this file is shown in the following format:

Example #: The example title and number

Model

Containing the diagram that shows the states and transitions. Transition probabilities are presented below the diagram.

Population:

Defines the structure of the population the simulation works on.

Simulation Rules:

Defines additional simulation rule that can be added to the simulation. Also defined are the Number of Repetitions and the Max Time Iterations / simulation steps.

Expected Outcome:

Contains the expected outcome. Usually this includes the mean counts of population at each stage at the end of simulation. The appendix at the end of the document contains Matlab code that calculates these means. In addition, to these expected outcomes, each example may contain additional tests that verify integrity of the example. These tests are implemented in the verification script InputExample.py.

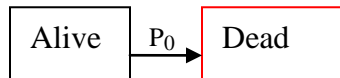
For further information about the project, please visit the author web site:

<http://sites.google.com/site/jacobbarhak/>

Examples for Simulation Module Testing

Example 1: Simple Example:

Model



Where:

$$p_0 = 0.0717$$

Population:

10 Individuals with the following characteristics:
All Alive except one, all with Age = 30

Simulation Rules:

Phase 1: Pre-State Transition Rules:

$$\text{Age} = \text{Age} + 1$$

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 100

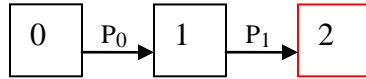
Max Time Iterations: 3

Expected Outcome:

- Age in all alive people should be 33.
- Average age at death = 31.2540
- Distribution at the end of simulation:
 - 719.9587 Alive
 - 280.0413 Dead

Example 2: Multiple Transitions in a Chain

Model



Where:

$$p_0 = 0.1$$

$$p_1 = 0.2$$

Population:

2 Individuals with the following characteristics:

1 in state 0, 1 in state 1

Age = 30

Simulation Rules:

Phase 1: Pre-State Transition Rules:

Age = Age +1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 500

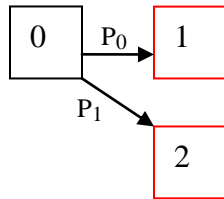
Max Time Iterations: 5

Expected Outcome:

- Distribution at the end of simulation:
 - 295.2450 State 0,
 - 295.2450 State 1
 - 409.5100 State 2
- Age in all alive people should be 35.

Example 3: A fork state

Model



Where:

$$p_0 = 0.3$$

$$p_1 = 0.6$$

Population:

- 1 Individual with the following characteristics:
 - All in state 0
 - Age = 30

Simulation Rules:

Phase 1: Pre-State Transition Rules:

$$\text{Age} = \text{Age} + 1$$

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 1000

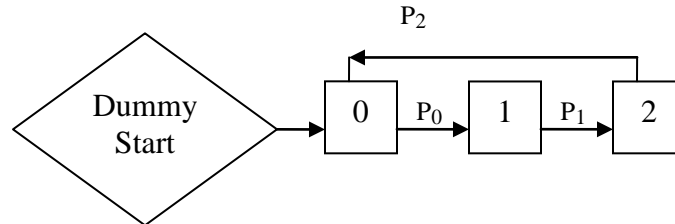
Max Time Iterations: 2

Expected Outcome:

- At the end of simulation, the distribution should be:
 - 10.0000 State 0
 - 330.0000 State 1
 - 660.0000 State 2

Example 4: Funny Loop Example

Model



Where:

$$p_0 = 0.1$$

$$p_1 = 0.2$$

$$p_2 = 0.3$$

Population:

3 Individuals with the following characteristics:

Age = 30 Starting at state 0

Age = 40 Starting at state 1

Age = 50 Starting at state 2

Simulation Rules:

Phase 1: Pre-State Transition Rules:

Age = Age +1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 500

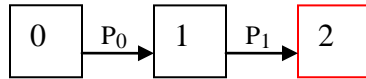
Max Time Iterations: 5

Expected Outcome:

- The Dummy Start Event state is never entered or set as it exists as a start indicator alone, rather than a meaningful state.
- All Individuals should be at ages 35, 45, 55 – no termination before the end
- At the end of simulation, the distribution should be:
 - 791.1000 State 0
 - 393.1950 State 1
 - 315.7050 State 2

Example 5a: Multiple Transitions in a Chain with an Expression and Boolean Covariate - (Extending the example from figure 2d in Isaman, 2006)

Model



Where:

$$P_0 = \exp(-(b_o + b_1 * Z)) \quad Z \text{ Gender} \quad b_o = .4 \quad b_1 = .3$$

$$P_1 = \exp(-(g_o + g_1 * Z)) \quad Z \text{ Gender} \quad g_o = .4 \quad g_1 = .5$$

Population:

- 1 man (Z=1) starting at state 0
- 1 woman (Z=0) starting at state 0
- ages should be irrelevant in this example

Simulation Rules:

Phase 1: Pre-State Transition Rules:

None

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 1000

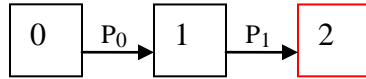
Max Time Iterations: 2

Expected Outcome:

- Distribution at the end of simulation:
 - 253.4264 men, 108.6889 women in State 0
 - 544.6771 men, 441.9822 women in State 1
 - 201.8965 men, 449.3290 women in State 2

Example 5b: Multiple Transitions in a Chain with an Expression and Continuous Covariate - (Extending the example from figure 2d in Isaman, 2006)

Model



Where:

$$p_0 = \exp(-(b_0 + b_1 * Z)) \quad Z \text{ Age} \quad b_0 = .04 \quad b_1 = .03$$

$$p_1 = \exp(-(g_0 + g_1 * Z)) \quad Z \text{ Age} \quad g_0 = .04 \quad g_1 = .05$$

Population:

- 1 man (Z=45) starting at state 0
- 1 woman (Z=60) starting at state 0
- gender should be irrelevant in this example

Simulation Rules:

Phase 1: Pre-State Transition Rules:

Age=Age+1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 1000

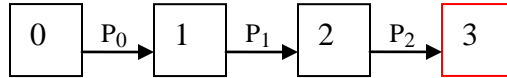
Max Time Iterations: 2

Expected Outcome:

- Distribution at the end of simulation:
 - 580.4146 men (age=47), 719.3598 women (age=62) in State 0
 - 397.4372 men, and 273.9693 women in State 1
 - 22.1482 men, and 6.6709 women in State 2

Example 6: Multiple Transitions in a Long Chain with an Expression Containing a Continuous Covariate - (Extending the example from figure 2a,2b in Isaman, 2006)

Model



Where:

$$\begin{aligned}
 p_0 &= \exp(-(b_o + b_1 * Z)) & Z \text{ Age} & \quad b_o = .04 \quad b_1 = .03 \\
 p_1 &= \exp(-(g_o + g_1 * Z)) & Z \text{ Age} & \quad g_o = .04 \quad g_1 = .05 \\
 p_2 &= \exp(-(g_o + g_1 * Z)) & Z \text{ Age} & \quad g_o = .04 \quad g_1 = .05
 \end{aligned}$$

Population:

- 1 man (Z=45) starting at state 0
- 1 woman (Z=60) starting at state 0

Simulation Rules:

Phase 1: Pre-State Transition Rules:

Age=Age+1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 10000

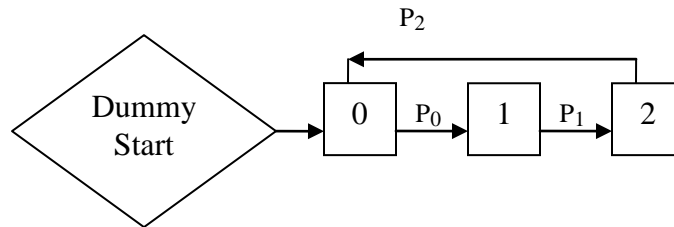
Max Time Iterations: 3

Expected Outcome:

- Distribution at the end of simulation:
 - 4482.904 men (age=48), 6149.460 women (age=63) in State 0
 - 4949.205 men, and 3671.033 women in State 1
 - 548.587 men, and 176.761 women in State 2
 - 19.305 men, and 2.747 women in State 3

Example 7: Funny Loop Example with an Expression - (Extending the example from figure 2c in Isaman, 2006)

Model



Where:

$$p_0 = \exp(-(b_o + b_1 * Z)) \quad Z \text{ Age} \quad b_o = .02 \quad b_1 = .02$$

$$p_1 = \exp(-(g_o + g_1 * Z)) \quad Z \text{ Age} \quad g_o = .02 \quad g_1 = .01$$

$$p_2 = \exp(-(g_o + g_1 * Z)) \quad Z \text{ Age} \quad g_o = .02 \quad g_1 = .01$$

Population:

1 man (Z=45) starting at state 0

1 woman (Z=60) starting at state 0

Simulation Rules:

Phase 1: Pre-State Transition Rules:

Age=Age+1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 1000

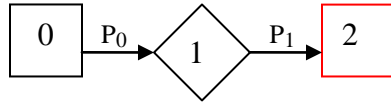
Max Time Iterations: 3

Expected Outcome:

- Distribution at the end of simulation:
 - 380.0611 men (age=48), 447.1718 women (age=63) in State 0
 - 292.4802 men, and 303.2561 women in State 1
 - 327.4586 men, and 249.5721 women in State 2

Example 8: An Event State in a Chain

Model



Where:

$$p_0 = 0.0717$$

$$p_1 = 1$$

Population:

10 Individuals with the following characteristics:

All in states 0 except one at state 2. all with Age = 30,

Simulation Rules:

Phase 1: Pre-State Transition Rules:

$$\text{Age} = \text{Age} + 1$$

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 100

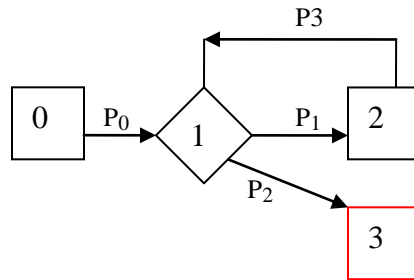
Max Time Iterations: 3

Expected Outcome:

- Similar to Example 1
- The Event state indicator is never set in the results.
- The Entered indicator of the event state remains set at the transition to the final state.

Example 9: Combined Fork Loop and Event state

Model



Where:

$$p_0 = 0.1$$

$$p_1 = 0.8$$

$$p_2 = 1 - p_1 = 0.2$$

$$p_3 = 0.1$$

Population:

10 Individuals with the following characteristics:

4 in State 0, Age = 40

5 in State 2, Age = 50

1 in State 3, Age = 60

Simulation Rules:

Phase 1: Pre-State Transition Rules:

Age = Age +1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 100

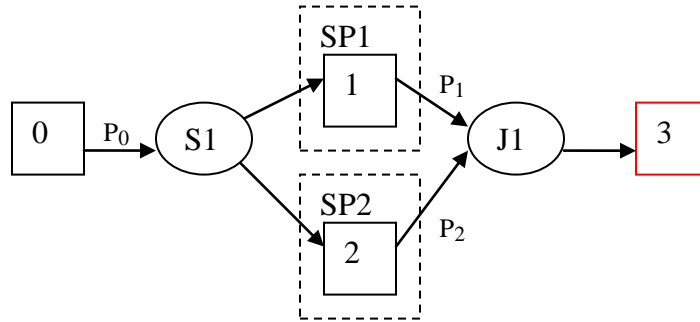
Max Time Iterations: 10

Expected Outcome:

- No individuals in the event state
- The event State indicator for Entered is set for every transition the occurred and is reset otherwise
- Distribution at the end of simulation:
 - 139.4714 at State 0
 - 595.8942 at State 2
 - 264.6345 at State 3

Example 10: Split, Join, Simple Test

Model



Where:

$$p_0 = 0.1$$

$$p_1 = p_2 = 1 - \frac{2}{5}\sqrt{5}. \text{ Note that } p_1 + p_1(1 - p_1) = 0.2 \text{ as in example 2}$$

Population:

2 Individuals with the following characteristics:

1 in state 0, 1 in states 1 and 2 together

Age = 30

Simulation Rules:

Phase 1: Pre-State Transition Rules:

Age = Age + 1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 500

Max Time Iterations: 5

Expected Outcome:

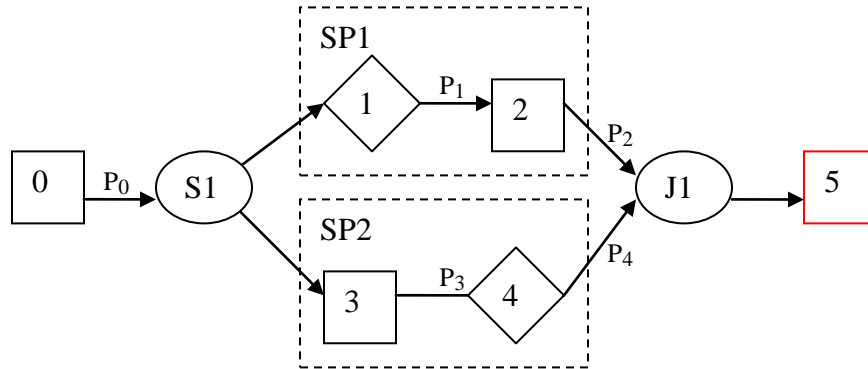
- Similar to the results of example 2, where state 3 corresponds to state 2 in Example 2 and all states and subprocesses SP1 and SP2 both correspond to State 1 in Example 2. Note that the number of people in the subprocess should be counted to figure out if the population sum is correct as states may remain set at the time of reaching the terminal state.
- The subprocess indicators for Sp1 and Sp2 are equal
- The main subprocess indicator is always set
- If the state indicator in state 1 or 2 are set, then the other one and the indicators for the subprocesses SP1 and SP2 are also set, unless the indicator for the terminal state is set, in which case, the other one is reset and both subprocess states are reset. All States may be reset.
- If a subprocess indicator in SP1, SP2 are set, then state indicators 1 and 2 are set.

Examples for Testing of the MIncroSimulation Tool (MIST)

- The entered indicators of the subprocess and the subprocess states equal to the entered indicator of the splitter state
 - The indicator of the splitter and joiner states are never set
 - The entered indicator of the joiner state is equal to the terminal state indicator which is equal to the entered indicator of the terminal state.
-

Example 11: Split, Join, and Event Test

Model



Where:

$$p_0 = 0.1$$

$$p_1 = 1$$

$$p_2 = p_3 = 1 - \frac{2}{5}\sqrt{5} \text{ Note that } p_2 + p_2(1 - p_2) = 0.2 \text{ as in example 2}$$

$$p_4 = 1$$

Population:

2 Individuals with the following characteristics:
 1 in state 0, 1 in states 2 and 3 together
 Age = 30

Simulation Rules:

Phase 1: Pre-State Transition Rules:

$$\text{Age} = \text{Age} + 1$$

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 500

Max Time Iterations: 5

Expected Outcome:

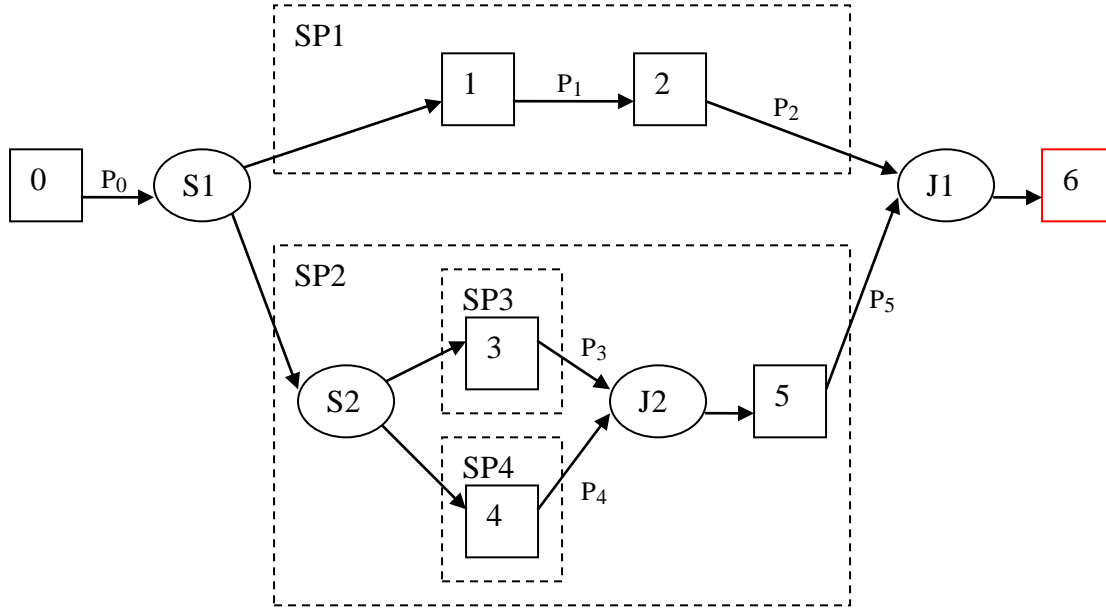
- Similar to the results of example 2, where state 5 corresponds to state 2 in Example 2 and all states and subprocesses SP1 and SP2 both correspond to State 1 in Example 2. Note that the number of people in the subprocess should be counted to figure out if the population sum is correct as states may remain set at the time of reaching the terminal state.
- The subprocess indicators for Sp1 and Sp2 are equal
- The main subprocess indicator is always set

Examples for Testing of the MIncroSimulation Tool (MIST)

- If the state indicator in state 2 or 3 are set, then the other one and the indicators for the subprocesses SP1 and SP2 are also set, unless the indicator for the terminal state 5 is set, in which case, the other one is reset and both subprocess states are reset. All States may be reset.
 - If a subprocess indicator in SP1, SP2 are set, then state indicators 2 and 3 are set.
 - State 3 and state 5 are never set together unless state 2 is reset
 - The entered indicators of the subprocesses and states 1,2,3 equal to the entered indicator of the splitter state
 - The indicator of the splitter, joiner, and event states are never set
 - The entered indicator of the joiner state is equal to the terminal state indicator which is equal to the entered indicator of the terminal state.
-

Example 12: Nested split/join test

Model



Where:

$$p_0 = 0.1$$

$$p_1 = 0.2$$

$$p_2 = p_5 = 1 - \sqrt{7/10} \text{ Note that } p_2 + p_2(1 - p_2) = 0.3$$

$$p_3 = p_4 = 1 - \frac{2}{5}\sqrt{5} \text{ Note that } p_3 + p_3(1 - p_3) = p_1$$

Population:

2 Individuals with the following characteristics:

Age = 30

One starts in state 0 and one in states 1,3,4.

Simulation Rules:

Phase 1: Pre-State Transition Rules:

Age = Age + 1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 500

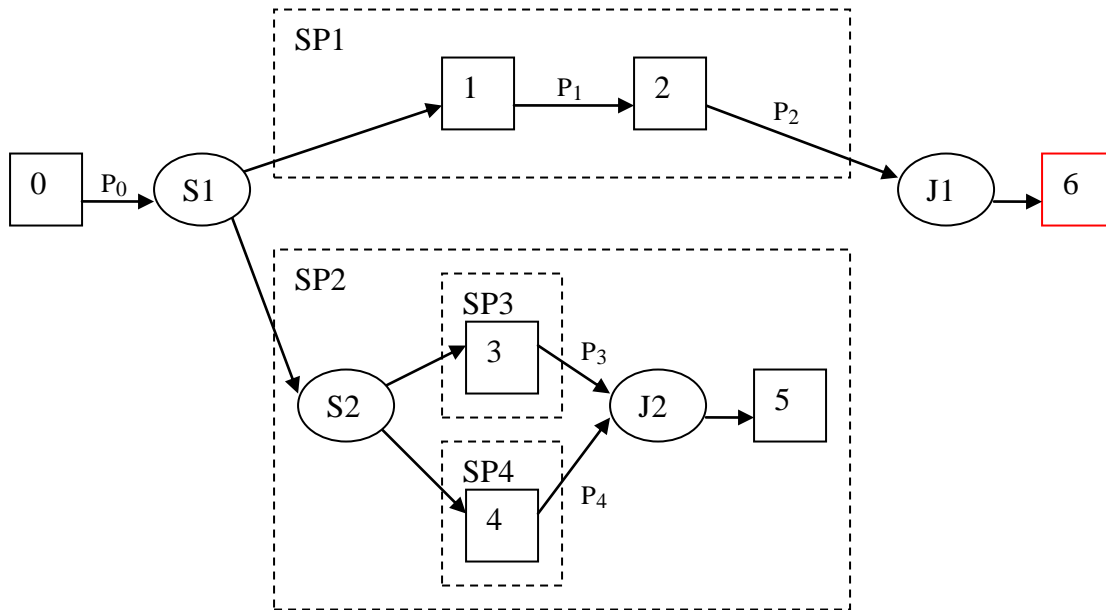
Max Time Iterations: 10

Expected Outcome:

- At the end of simulation, the distribution should be:
 - 174.3392 State 0
 - 125.6437 State 1 while SP1 is set
 - 157.7785 State 2 while SP1 is set
 - 542.2386 State 6
 - Age of all alive people should be 40
 - The number of people only in active processes should be counted to figure out if the population sum is correct as states may remain set at the time of reaching the terminal state.
 - The subprocess indicators for Sp1 and Sp2 are equal
 - The subprocess indicators for Sp3 and Sp4 are equal
 - The main subprocess indicator is always set
 - If the state indicator in state 1 or 3 are set, then the indicators for the subprocesses SP1 and SP2 are also set, unless the indicator for the terminal state 6 is set, in which case, both subprocess states are reset. All States may be reset, also both subprocesses may be set together without setting states 1,3.
 - If a subprocess indicator in SP1, SP2 are set, then state indicators (1 or 2) and (3 or 4 or 5) are set, while 3,4,5 are never set together. Also 2,3,4,5,6 can be set without SP1 and SP2 begin set.
 - State 3 and state 6 are never set together unless state 2 is reset
 - States 3,4,5 are never all set together.
 - The entered indicators of subprocesses SP1, SP2, SP3, SP4 and states 1,3,4 equal to the entered indicator of the splitter states S1 and S2.
 - The indicator of the splitter and joiner states S1, S2, J1, J2 are never set
 - The entered indicator of the joiner state J1 is equal to the terminal state indicator which is equal to the entered indicator of the terminal state 6.
-

Example 13: Split and join test without termination in a subprocess

Model



Where:

$$p_0 = 0.1$$

$$p_1 = 0.2$$

$$p_2 = 0.3$$

$$p_3 = p_4 = 1 - \frac{2}{5}\sqrt{5} \text{ Note that } p_3 + p_3(1 - p_3) = p_1$$

Population:

2 Individuals with the following characteristics:

Age = 30

One starts in state 0 and one in states 1,3,4.

Simulation Rules:

Phase 1: Pre-State Transition Rules:

Age = Age +1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 500

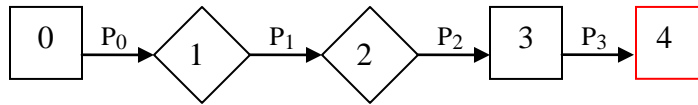
Max Time Iterations: 10

Expected Outcome:

- At the end of simulation, the distribution should be:
 - 174.3392 State 0
 - 174.3392 State 1 while SP1 is set
 - 160.2155 State 2 while SP1 is set
 - 491.1061 State 6
- Age of all alive people should be 40
- The number of people only in active processes should be counted to figure out if the population sum is correct as states may remain set at the time of reaching the terminal state.
- The subprocess indicators for Sp1 and Sp2 are equal
- The subprocess indicators for Sp3 and Sp4 are equal
- The main subprocess indicator is always set
- If the state indicator in state 1 or 3 are set, then the indicators for the subprocesses SP1 and SP2 are also set, unless the indicator for the terminal state 6 is set, in which case, both subprocess states are reset. All States may be reset, also both subprocesses may be set together without setting states 1,3.
- If a subprocess indicator in SP1, SP2 are set, then state indicators (1 or 2) and (3 or 4 or 5) are set, while 3,4,5 are never set together. Also 2,3,4,5,6 can be set without SP1 and SP2 begin set.
- State 3 and state 6 are never set together unless state 2 is reset
- States 3,4,5 are never all set together.
- The entered indicators of subprocesses SP1, SP2, SP3, SP4 and states 1,3,4 equal to the entered indicator of the splitter states S1 and S2.
- The indicator of the splitter and joiner states S1, S2, J1, J2 are never set
- The entered indicator of the joiner state J1 is equal to the terminal state indicator which is equal to the entered indicator of the terminal state 6.
- If State 6 is set then either State 5 or State 4 are also set. In other words, there is no path from state 5 to state 6 and State 6 can be reached only from state 2.

Example 14: Multiple events

Model



Where:

$$p_0 = p_1 = p_2 = p_3 = 1$$

Population:

1 Individual in State 0

Simulation Rules:

Phase 1: Pre-State Transition Rules:

None

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 100

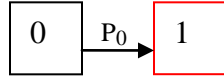
Max Time Iterations: 1

Expected Outcome:

- Distribution at the end of simulation:
 - 100 in State 3
 - 100 with State 1 Entered and State 2 Entered
 - 0 in State 1, 2, 4

Example 15: Simple Table Example

Model



Where:

p_0 is defined by the following table

	Gender = 0	Gender = 1
Age ≤ 20	0.1	0.4
20 < Age ≤ 40	0.2	0.5
40 < Age	0.3	0.6

Population:

6 Individuals all in state 0 with the following characteristics:

- Gender = 0, Age = 5
- Gender = 0, Age = 25
- Gender = 0, Age = 45
- Gender = 1, Age = 5
- Gender = 1, Age = 25
- Gender = 1, Age = 45

Simulation Rules:

Phase 0: Pre-State Transition Rules:

AgeAtStart = Age

Phase 1: Pre-State Transition Rules:

Age = Age + 1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 100

Max Time Iterations: 3

Expected Outcome:

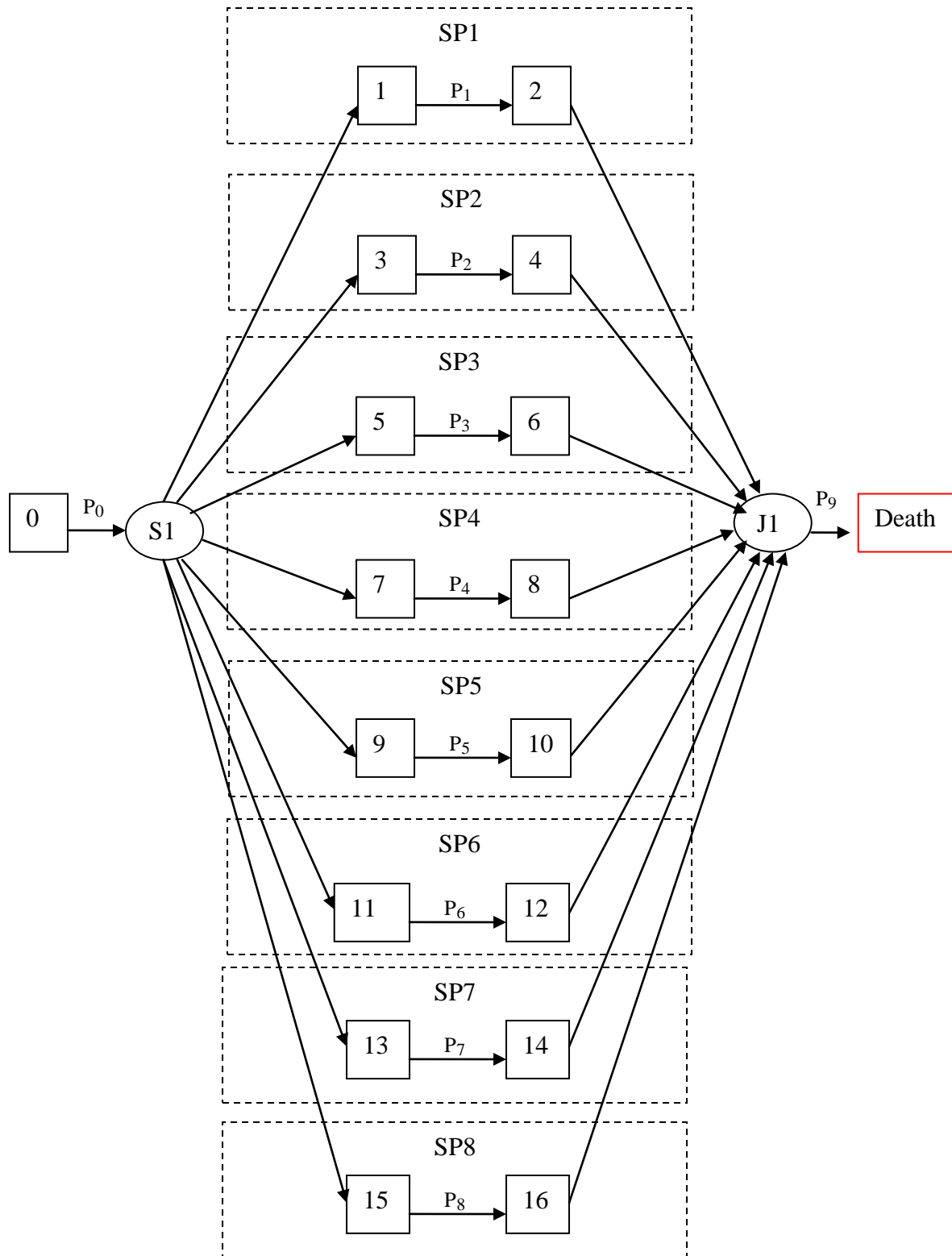
- Age in all people in state 0 should be either 8, 28, 48.
- Distribution at the end of simulation:
 - 198.9000 in State 0
 - 401.1000 in State 1
- Distribution at the end of simulation where Gender = 0 is:
 - 158.4000 in State 0
 - 141.6000 in State 1
- Distribution at the end of simulation where AgeAtStart ≤ 20 is:
 - 94.5000 in State 0
 - 105.5000 in State 1

Examples for Testing of the MicroSimulation Tool (MIST)

- Distribution at the end of simulation where $20 < \text{AgeAtStart} \leq 40$ is:
 - 63.7000 in State 0
 - 136.3000 in State 1
-

Example 16: Function test

Model



Where:

$$\begin{aligned}
 p_0 &= 1 \\
 p_1 &= \text{Le}(\text{Ls}(\text{Eq}(\text{Eq}(-1,-1), \text{Ne}(-1,1)), 1), 0) * \text{Not}(\text{Or}(0,0) + \text{And}(0,1)) * \\
 &\quad \text{IsTrue}(.1) * .5 \\
 p_2 &= \text{Ge}(\text{Gr}(1,1), 0) * \text{Or}(0,0,0,1) * \text{And}(1,1,1,1) * .5 \\
 p_3 &= \text{IsInvalidNumber}(\text{NaN}) * \text{IsInfinteNumber}(-\text{Inf}) * \\
 &\quad \text{Not}(\text{IsFiniteNumber}(\text{Inf})) * (1/\text{Sqrt}(\text{Log}(16,2))) \\
 p_4 &= \text{Ln}(\text{Exp}(\text{Max}(.25,0,-3) + \text{Min}(.25,100,25))) \\
 p_5 &= \text{Pi}() + 1/\text{Log}10(10^{**}2) - 3.1415926535897931 \\
 p_6 &= \text{Abs}(-.5) * \text{Floor}(1.9) * \text{Ceil}(.1) * \text{Mod}(3,2) \\
 p_7 &= 4/\text{Pow}(2,3) \\
 p_8 &= .5 \\
 p_9 &= 1
 \end{aligned}$$

Note that p_1 through p_8 should all equal .5

Population:

One individual in state 0 with BP = 0

Simulation Rules:

Phase 1: Pre-State Transition Rules:

$$\begin{aligned}
 \text{BP} &= \text{BP} + \text{Le}(\text{Ls}(\text{Eq}(\text{Eq}(-1,-1), \text{Ne}(-1,1)), 1), 0) * \text{Not}(\text{Or}(0,0) + \text{And}(0,1)) * \text{IsTrue}(.1) * .5 + \\
 &\quad \text{Ge}(\text{Gr}(1,1), 0) * \text{Or}(0,0,0,1) * \text{And}(1,1,1,1) * .5 + \\
 &\quad \text{IsInvalidNumber}(\text{NaN}) * \text{IsInfiniteNumber}(-\text{Inf}) * \text{Not}(\text{IsFiniteNumber}(\text{Inf})) * (1/\text{Sqrt}(\text{Log}(16,2))) \\
 &\quad + \text{Ln}(\text{Exp}(\text{Max}(.25,0,-3) + \text{Min}(.25,100,25))) + \\
 &\quad \text{Pi}() + 1/\text{Log}10(10^{**}2) - 3.1415926535897931 + \text{Abs}(-.5) * \text{Floor}(1.9) * \text{Ceil}(.1) * \text{Mod}(3,2) + 4/\text{Pow}(2,3) + \\
 &\quad .5
 \end{aligned}$$

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 1,000

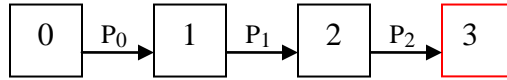
Max Time Iterations: 2

Expected Outcome:

- At the end of simulation, the distribution should be:
 - 500 in each of States 1 through 16
 - Final BP = ~8 always

Example 17: Tests Iif(), conditionals, and feedback to indicators

Model



Where:

$$p_0 = 1$$

$$p_1 = \text{Iif}(\text{Gr}(\text{Age}, 32), 1, 0)$$

$$p_2 = \text{Iif}(\text{State2_Diagnosed}, 1, 0)$$

Population:

1 Individual in State 0

Simulation Rules:

Phase 1: Pre-State Transition Rules:

- a. Age = Age + 1
- b. If State0:
 - Ex17TestCovariate = Ex17TestCovariate+1
- c. Occurrence Probability = Iif(State0, 1, 0):
 - Ex17TestCovariate2 = Iif(State0, Ex17TestCovariate2 + 1, Ex17TestCovariate2)

Phase 3: Post-State Transition Rules:

- a. If State2:
 - i. State2_Diagnosed = Iif(Gr(Age, 34), 1, 0)

Number of Repetitions: 50

Max Time Iterations: 10

Expected Outcome:

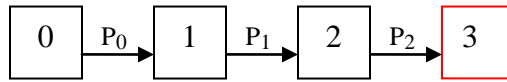
- Results according to the following table:

Iteration	0	1	2	3	4	5	6
Age	30	31	32	33	34	35	36
State0	1	0	0	0	0	0	0
State1	0	1	1	0	0	0	0
State2	0	0	0	1	1	1	0
State3	0	0	0	0	0	0	1
State2_Diagnosed	0	0	0	0	0	1	0
Ex17TestCovariate	0	1	1	1	1	1	1
Ex17TestCovariate2	0	1	1	1	1	1	1

- Distribution at the end of simulation:
 - 0 in State 0, 1, 2
 - 50 in State 3

Example 18: Tests Cost/QoL Wizard

Model



Where:

$$\begin{aligned}
 p_0 &= 1 \\
 p_1 &= 0.5 \\
 p_2 &= 0.5
 \end{aligned}$$

Population:

1 Individual in State 0 , with Ex18TestCost = 10 and Ex18TestQoL = 0.1

Simulation Rules:

Phase 1: Pre-State Transition Rules:

- a. Age = Age + 1

Phase 3: Post-State Transition Rules:

- b. Ex18TestCost=CostWizard(0,100,[State1,State2],[Iif(Gr(Age,31),3,0),Iif(Gr(Age,33),2,0)])
 - c. Ex18TestQoL=CostWizard(1,.5,[State1,State2],[Iif(Gr(Age,31),.1,0),Iif(Gr(Age,33),.2,0)])
- None

Number of Repetitions: 100

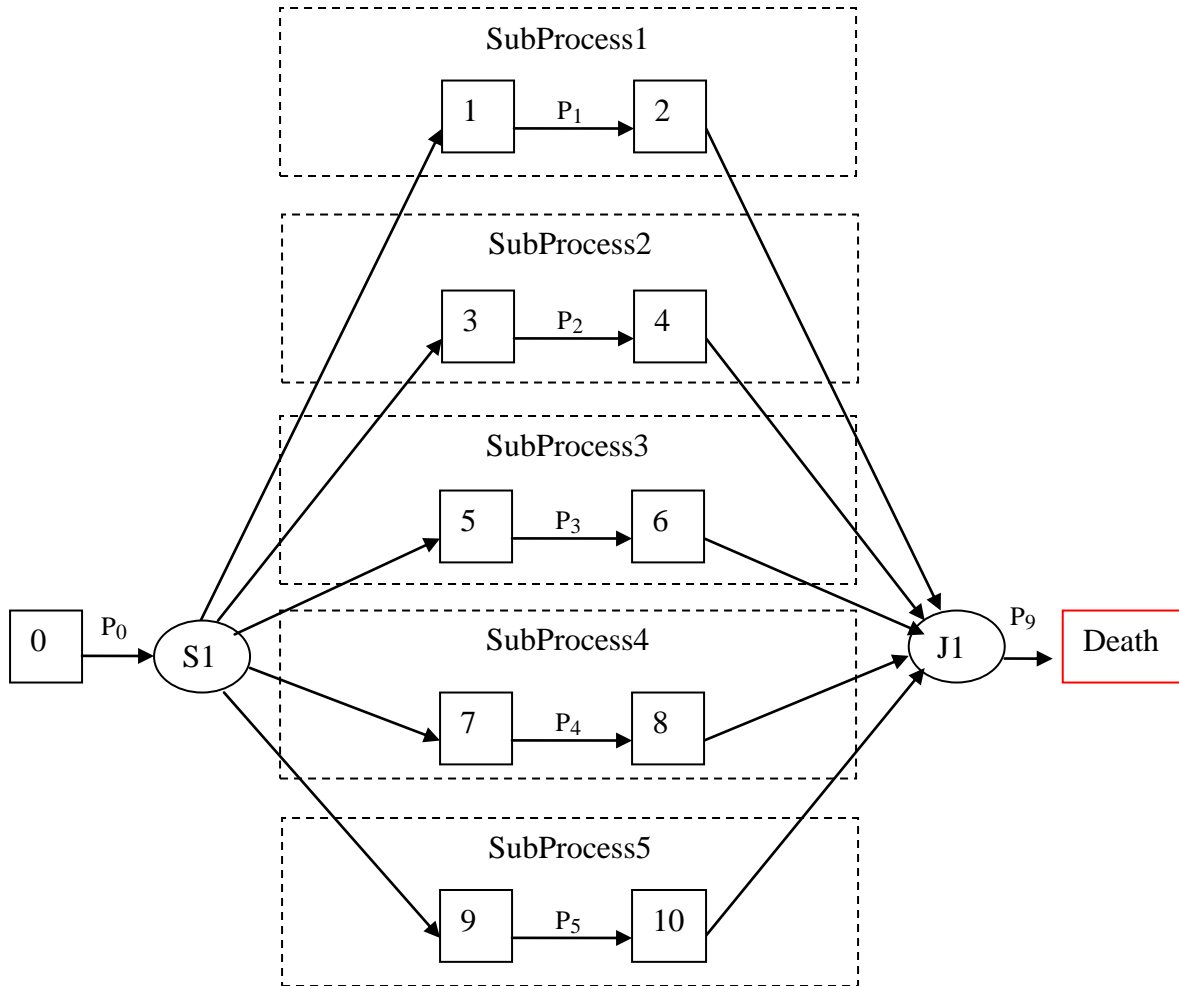
Max Time Iterations: 5

Expected Outcome:

- If state 1 and age>31 then:
 - Ex18TestCost = 100000 , Ex18TestQoL = 0.6
- If state 2 and age>33 then:
 - Ex18TestCost = 10000, Ex18TestQoL = 0.7
- If state 3 or (state 1 and age<=31) or (state 2 and age<=33) then:
 - Ex18TestCost = 100, Ex18TestQoL = 0.5
- If state 0 then:
 - Ex18TestCost = 10, Ex18TestQoL = 0.1
- Distribution at the end of simulation:
 - 0 in State 0
 - 6.25 in State 1
 - 25 in State 2
 - 68.75 in State 3

Example 19: Equivalent Parallel Process Test and Distribution Function Rule Test

Model



Where:

$$p_0 = 1$$

$$p_1 = 0.5$$

$$p_2 = 0.5$$

$$p_3 = 0.5$$

$$p_4 = 0.5$$

$$p_5 = 0.5$$

$$p_9 = 1$$

Note that p_1 through p_5 should all equal 0.5

Population:

One individual in state 0 with:

- CovTemp1=0
- CovTemp2=0
- CovTemp3=0
- CovTemp4=0
- CovTemp5=0

Simulation Rules:

Phase 1: Pre-State Transition Rules:

- TestCov1 = Le(Bernoulli(0.5), 0.5)
- TestCov2 = Le(Binomial(3,0.5), 1)
- TestCov3 = Le(Geometric(1-0.5**0.5), 2)
- TestCov4 = Le(Uniform(0,2),1)
- TestCov5 = Le(Gaussian(3,1), 3)

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 1,000

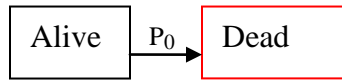
Max Time Iterations: 2

Expected Outcome:

- At the end of simulation, the distribution should be:
 - 500 in each of States 1 through 10
 - At the end of simulation, the sum of each covariate over the population TestCov1..5 contains 500 individuals.

Example 20: Simple Example with Initial Population Defined by Distributions:

Model



Where:

$$p_0 = 0.0717$$

Population:

Individuals defined by distributions with the following characteristics:

Alive=Bernoulli(0.9)

Dead=1-Alive

Age = Min(Max(20,Gaussian(30,5)),40)

Simulation Rules:

Phase 1: Pre-State Transition Rules:

Age = Age +1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 1000 (defines population size)

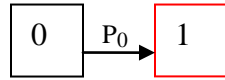
Max Time Iterations: 3

Expected Outcome:

- Age in all records should be between 20 and 43.
- There should be 25 individuals at age 20 - check this is correct within 3 STD
- Distribution at the end of simulation - Same as example 1:
 - 719.9587 Alive
 - 280.0413 Dead

Example 21: Initial Population Defined by Distributions and simple Objectives:

Model



Where:

p_0 is defined by the following table

	Gender = 0	Gender =1
Age≤ 20	0.1	0.4
20<Age≤40	0.2	0.5
40<Age	0.3	0.6

Population:

600 Individuals all in state 0 defined by distributions with the following characteristics:

Age = Uniform(1,59)

Gender = Bernoulli(0.6)

The following objectives will be used – disregarding the test error:

Filter Expression	Statistics Expression	Statistics Function	Target	Weight	Test Error
Le(Age,20)	Age	MEAN	5	1	2
And(Gr(Age,20), Le(Age,40))	Age -25	MEAN	0	1	2
Gr(Age,40)	Age	MEAN	45	1	2
1	Gender	MEAN	0.5	1	0.05
1	Age*(Gender-0.5)	MEDIAN	0	1	1
Le(Age,20)	Age	STD	1	0.1	1
And(Gr(Age,20), Le(Age,40))	Age	PERCENT25	24	0.1	1
And(Gr(Age,20), Le(Age,40))	Age	PERCENT75	26	0.1	2
Gr(Age,40)	Age	MIN	42	0.1	2
Gr(Age,40)	Age	MAX	48	0.1	6
And(Le(Age,20), Eq(Gender,0))	1	SUM	100	0.02	10
And(Gr(Age,20), Le(Age,40) , Eq(Gender,0))	1	SUM	100	0.02	10
And(Gr(Age,40) , Eq(Gender,0))	1	SUM	100	0.02	10
And(Le(Age,20), Eq(Gender,1))	Age **2	COUNT	100	0.02	10
And(Gr(Age,20), Le(Age,40) , Eq(Gender,1))	Age **2	COUNT	100	0.02	10
And(Gr(Age,40) , Eq(Gender,1))	Age **2	COUNT	100	0.02	10

Simulation Rules:

Phase 0: Pre-State Transition Rules:

AgeAtStart = Age

Phase 1: Pre-State Transition Rules:

Age = Age +1

Phase 3: Post-State Transition Rules:

None

Number of Repetitions: 600 (defines population size)

Max Time Iterations: 3

Expected Outcome:

- Distribution at the end of simulation:
 - 198.9000 in State 0
 - 401.1000 in State 1
- Distribution at the end of simulation where Gender =0 is:
 - 158.4000 in State 0
 - 141.6000 in State 1
- Distribution at the end of simulation where AgeAtStart ≤ 20 is:
 - 94.5000 in State 0
 - 105.5000 in State 1
- Distribution at the end of simulation where 20 < AgeAtStart ≤ 40 is:
 - 63.7000 in State 0
 - 136.3000 in State 1
- Distribution at the end of simulation where 40 < AgeAtStart ≤ 60 is:
 - 40.7000 in State 0
 - 159.3000 in State 1
- At the end of simulation the average AgeAtStart of individuals of 0 < AgeAtStart ≤ 20 should be between 4 and 6 - this is an approximated range not absolute
- At the end of simulation the average Age of individuals of 20 < AgeAtStart ≤ 40 should be between 24 and 26 - this is an approximated range not absolute
- At the end of simulation the average Age of individuals of 40 < AgeAtStart should be between 44 and 46 - this is an approximated range not absolute
- Check that objectives have been reached within a reasonable margins noted as Test Error in the Objectives table
 - A critical test is that the first 3 objectives should be the same as the previous three tests for AgeAtStart – this tests the code is ok
 - The rest of the tests are not critical

APPENDIX:

Matlab code to generate the mean expected results

```
% This file contains analytic results to which the simulation results
% should be compared to.
```

```
% Example 1: Simple Example:
```

```
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 1: Simple Example:')
disp ('*****')
disp ('*****')
disp ('*****')
P0 = 0.0717
t = 3
Pop = [9 1]*100
```

```
Mat = [1-P0 , P0; 0 , 1]
```

```
Result = Pop*(Mat^t)
```

```
OldDeadNum = 0
for i = 0:t,
    DeadNum = Pop*Mat^i;
    DeadAtYear(i+1) = DeadNum(2) - OldDeadNum;
    OldDeadNum = DeadNum(2);
end
```

```
AverageAgeAtDeath = sum((30+(0:t)).*DeadAtYear)/sum(DeadAtYear)
```

```
% Example 2: Multiple Transitions in a Chain
```

```
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 2: Multiple Transitions in a Chain')
disp ('*****')
disp ('*****')
disp ('*****')
```

```
P0 = 0.1
```

```
P1 = 0.2
```

```
t = 5
```

```
Pop = [1 1 0]*500
```

```
Mat = [1-P0 , P0 , 0 ; 0 , 1-P1, P1 ; 0, 0, 1]
```

```
Result = Pop*(Mat^t)
```

Examples for Testing of the MicroSimulation Tool (MIST)

```
% Example 3: A fork state
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 3: A fork state')
disp ('*****')
disp ('*****')
disp ('*****')

P0 = 0.3
P1 = 0.6

t = 2
Pop = [1 0 0]*100

Mat = [1-P0-P1, P0 , P1 ; 0, 1, 0 ; 0, 0, 1]

Result = Pop*(Mat^t)

% Example 4: Funny Loop Example
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 4: Funny Loop Example')
disp ('*****')
disp ('*****')
disp ('*****')

P0 = 0.1
P1 = 0.2
P2 = 0.3

t = 5
Pop = [1 1 1]*500

Mat = [1-P0, P0 , 0 ; 0, 1-P1, P1 ; P2, 0, 1-P2]

Result = Pop*(Mat^t)

% Example 5a: Multiple Transitions in a Chain with an Expression and
% Boolean Covariate
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 5a: Multiple Transitions in a Chain with an Expression
and Boolean Covariate')
disp ('*****')
disp ('*****')
disp ('*****')
```

Examples for Testing of the MicroSimulation Tool (MIST)

MaxTime=2

```

for Gender = 0:1,
    Pop = [1 0 0]*1000
    MultMat = eye(3)
    for t= 1:MaxTime

        P0 = exp(-(0.4 + 0.3*Gender))
        P1 = exp(-(0.4 + 0.5*Gender))

        Mat = [1-P0 , P0 , 0 ; 0 , 1-P1, P1 ; 0, 0, 1]
        MultMat = MultMat * Mat
    end
    disp (sprintf ('Results for Gender = %g', Gender))
    Result = Pop*(MultMat)
end

```

% Example 5b: Multiple Transitions in a Chain with an Expression and
 % Continuous Covariate - (Extending the example from figure 2d in
 Isaman, 2006)

```

disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 5b: Multiple Transitions in a Chain with an Expression  

and Continuous Covariate')
disp ('*****')
disp ('*****')
disp ('*****')

```

MaxTime=2

```

Ages = [60,45]
for Gender = 0:1,
    Age = Ages(Gender+1)
    Pop = [1 0 0]*1000
    MultMat = eye(3)
    for t= 1:MaxTime
        Age = Age + 1
        P0 = exp(-(0.04 + 0.03*Age))
        P1 = exp(-(0.04 + 0.05*Age))
        Mat = [1-P0 , P0 , 0 ; 0 , 1-P1, P1 ; 0, 0, 1]
        MultMat = MultMat * Mat
    end
    disp (sprintf ('Results for Gender = %g', Gender))
    Result = Pop*(MultMat)
end

```

% Example 6: Multiple Transitions in a Long Chain with an Expression
 Containing a Continuous Covariate - (Extending the example from figure
 2a,2b in Isaman, 2006))

```

disp ('*****')

```

Examples for Testing of the MicroSimulation Tool (MIST)

```

disp ('*****')
disp ('*****')
disp ('Example 6: Multiple Transitions in a Long Chain with an
Expression Containing a Continuous Covariate')
disp ('*****')
disp ('*****')
disp ('*****')

MaxTime = 3

Ages = [60,45]
for Gender = 0:1,
    Age = Ages(Gender+1)
    Pop = [1 0 0 0]*1000
    MultMat = eye(4)
    for t= 1:MaxTime
        Age = Age + 1
        P0 = exp(-(0.04 + 0.03*Age))
        P1 = exp(-(0.04 + 0.05*Age))
        P2 = exp(-(0.04 + 0.05*Age))
        Mat = [1-P0 , P0 , 0 , 0 ; 0 , 1-P1, P1 ,0 ; 0, 0, 1-P2, P2;
0, 0, 0, 1]
        MultMat = MultMat * Mat
    end
    disp (sprintf ('Results for Gender = %g', Gender))
    Result = Pop*(MultMat)
end

```

```

% Example 7: Funny Loop Example with an Expression - (Extending the
example from figure 2c in Isaman, 2006)
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 7: Funny Loop Example with an Expression - (Extending
the example from figure 2c in Isaman, 2006)')
disp ('*****')
disp ('*****')
disp ('*****')

```

```

MaxTime = 3

Ages = [60,45]
for Gender = 0:1,
    Age = Ages(Gender+1)
    Pop = [1 0 0]*1000
    MultMat = eye(3)
    for t= 1:MaxTime
        Age = Age + 1
        P0 = exp(-(0.02 + 0.02*Age))
        P1 = exp(-(0.02 + 0.01*Age))
        P2 = exp(-(0.02 + 0.01*Age))
        Mat = [1-P0 , P0 , 0 ; 0 , 1-P1, P1 ; P2, 0, 1-P2]
    end
end

```

Examples for Testing of the MicroSimulation Tool (MIST)

```

        MultMat = MultMat * Mat
    end
    disp (sprintf ('Results for Gender = %g', Gender))
    Result = Pop*(MultMat)
end

% Example 9: Combined Fork Loop and Event state
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 9: Combined Fork Loop and Event state')
disp ('*****')
disp ('*****')
disp ('*****')

P0 = 0.1
P1 = 0.8
P2 = 1 - P1
P3 = 0.1

t = 10
Pop = [4 5 1]*100

Mat = [1-P0, P0*P1 , P0*P2 ; 0, 1-P3*P2, P3*P2 ; 0, 0, 1]

Result = Pop*(Mat^t)

% Example 12: Nested split/join test
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 12: Nested split/join test ')
disp ('*****')
disp ('*****')
disp ('*****')

P0 = 0.1
P1 = 0.2
P2 = 0.3

% calculate probability for the two joiners to be the same as P1
disp 'Joiner Probabilities P3,P4 Should be:'
syms JoinProb
solve ( JoinProb + JoinProb* (1-JoinProb) - P1 , JoinProb )

t = 10
Pop = [1 0 0 0]*1000

```

Examples for Testing of the MicroSimulation Tool (MIST)

```
Mat = [1-P0 , P0 , 0 , 0 ; 0 , 1-P1, P1, 0 ; 0, 0, 1-P2, P2; 0, 0, 0,
1]
```

```
Result = Pop*(Mat^t)
```

```
% Example 12: Nested split/join test
% This example is simulated as a simpler chain of 4 stages similar to
% example 6
disp ('Example 12: Nested split/join test ')
```

```
MaxTime = 10
```

```
P0 = 0.1
P1 = 0.2
P2 = 1 - sqrt(7/10)    %0.3
P3 = 1 - 2/5*sqrt(5)  % 0.2
P4 = P3
P5 = P2
```

```
% Combined probabilities of transfer
P34 = P3+(1-P3)*P4
P25 = P2+(1-P2)*P5
P134 = P1*P34
```

```
% The following mapping of states occurs:
% A = 0
% B = 1,3,4
% C = 2,3,4
% D = 1,5
% E = 2,5
% F = 6
```

```
% Define the mapping Matrix from A-F to 0-6
%
Mapping = [ A B C D E F
1 0 0 0 0 0 %0
0 1 0 1 0 0 %1
0 0 1 0 1 0 %2
0 1 1 0 0 0 %3
0 1 1 0 0 0 %4
0 0 0 1 1 0 %5
0 0 0 0 0 1 ] %6
```

```
Pop = [1 1 0 0 0 0]*500
```

```
%
%      A      B      C      D      E      F
Mat=[1-P0      P0      0      0      0      0
%A      0 1-P1-P34+P134      P1*(1-P34)      P34*(1-P1)      P134      0
%B      0      0 1-P2-P34+P2*P34      0 P34*(1-P2)      P2
%C      0      0      0 1-P1-P5+P1*P5      P1*(1-P5)      P5
%D
```

Examples for Testing of the MicroSimulation Tool (MIST)

```

0          0          0          0          1-P25  P25
%E
0          0          0          0          0      1
]%F

MultMat = Mat ^ MaxTime
DetailedResult = Pop*(MultMat)

% Convert the detailed result back to the mapped result
Result = DetailedResult * Mapping'

Res = Result ([1,2,3,7])

% Example 13: Split and join test without termination in a subprocess
% This example is similar to example 12 when there is no transition
from
% one sub-process
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 13: Nested split/join test ')
disp ('*****')
disp ('*****')
disp ('*****')

MaxTime = 10

P0 = 0.1
P1 = 0.2
P2 = 0.3
P3 = 1 - 2/5*sqrt(5) % 0.2
P4 = P3
P5 = 0

% Combined probabilities of transfer
P34 = P3+(1-P3)*P4
P25 = P2+(1-P2)*P5
P134 = P1*P34

% The following mapping of states occurs:
% A = 0
% B = 1,3,4
% C = 2,3,4
% D = 1,5
% E = 2,5
% F = 6

% Define the mapping Matrix from A-F to 0-6
%
Mapping = [ 1 0 0 0 0 0 %0
           0 1 0 1 0 0 %1
           0 0 1 0 1 0 %2
           0 1 1 0 0 0 %3
           0 1 1 0 0 0 %4

```


Examples for Testing of the MicroSimulation Tool (MIST)

```

0 0 0 1 1 0 %5
0 0 0 0 0 1 ] %6

Pop = [1 1 0 0 0 0]*500

%      A      B      C      D      E      F
Mat=[1-P0      P0      0      0      0      0
%A
      0 1-P1-P34+P134      P1*(1-P34)      P34*(1-P1)      P134      0
%B
      0      0 1-P2-P34+P2*P34      0 P34*(1-P2)      P2
%C
      0      0      0 1-P1-P5+P1*P5      P1*(1-P5)      P5
%D
      0      0      0      0      1-P25      P25
%E
      0      0      0      0      0      1
]%F

MultMat = Mat ^ MaxTime
DetailedResult = Pop*(MultMat)

% Convert the detailed result back to the mapped result
Result = DetailedResult * Mapping'

Res = Result ([1,2,3,7])

% Example 15: Simple Table Example:
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 15: Simple Table Example:')
disp ('*****')
disp ('*****')
disp ('*****')

Pop = [1 0]*100
t = 3
Outcome = [0 0];
P0=0;
IndividualResult = [];
for Gender = 1:2,
    for AgeGroup = 1:3,
        P0 = P0 + 0.1
        Mat = [1-P0 , P0; 0 , 1]
        ResultAdd = Pop*(Mat^t)
        IndividualResult(:,Gender,AgeGroup) = ResultAdd;
    end
end
Outcome = sum(sum(IndividualResult,3),2)
OutcomeGender1 = sum(IndividualResult(:,1,:),3)

```

Examples for Testing of the MicroSimulation Tool (MIST)

```
OutcomeAgeGroup1 = sum(IndividualResult(:, :, 1), 2)
OutcomeAgeGroup2 = sum(IndividualResult(:, :, 2, :), 2)

% Example 18: Tests Cost/QoL Wizard
disp ('*****')
disp ('*****')
disp ('*****')
disp ('Example 4: Tests Cost/QoL Wizard')
disp ('*****')
disp ('*****')
disp ('*****')

P0 = 1
P1 = 0.5
P2 = 0.5

t = 5
Pop = [1 0 0 0]*100

Mat = [1-P0, P0, 0, 0; 0, 1-P1, P1, 0; 0, 0, P2, 1-P2; 0, 0, 0, 1]

Result = Pop*(Mat^t)
```

Results generated by running this code:

```
*****
*****
*****
Example 1: Simple Example:
*****
*****
*****
```

P0 =

0.0717

t =

3

Pop =

900 100

Mat =

0.9283	0.0717
0	1.0000

Result =

719.9587 280.0413

OldDeadNum =

0

AverageAgeAtDeath =

31.2540

Examples for Testing of the MicroSimulation Tool (MIST)

```
*****
*****
*****
```

Example 2: Multiple Transitions in a Chain

```
*****
*****
*****
```

P0 =

0.1000

P1 =

0.2000

t =

5

Pop =

500 500 0

Mat =

0.9000	0.1000	0
0	0.8000	0.2000
0	0	1.0000

Result =

295.2450 295.2450 409.5100

```
*****
*****
*****
```

Example 3: A fork state

```
*****
*****
*****
```

Examples for Testing of the MicroSimulation Tool (MIST)

P0 =

0.3000

P1 =

0.6000

t =

2

Pop =

100 0 0

Mat =

0.1000	0.3000	0.6000
0	1.0000	0
0	0	1.0000

Result =

1.0000 33.0000 66.0000

Example 4: Funny Loop Example

P0 =

0.1000

P1 =

0.2000

Examples for Testing of the MicroSimulation Tool (MIST)

P2 =

0.3000

t =

5

Pop =

500 500 500

Mat =

0.9000	0.1000	0
0	0.8000	0.2000
0.3000	0	0.7000

Result =

791.1000 393.1950 315.7050

```
*****
*****
*****
Example 5a: Multiple Transitions in a Chain with an
Expression and Boolean Covariate
*****
*****
*****
```

MaxTime =

2

Pop =

1000 0 0

Examples for Testing of the MicroSimulation Tool (MIST)

MultMat =

1	0	0
0	1	0
0	0	1

P0 =

0.6703

P1 =

0.6703

Mat =

0.3297	0.6703	0
0	0.3297	0.6703
0	0	1.0000

MultMat =

0.3297	0.6703	0
0	0.3297	0.6703
0	0	1.0000

P0 =

0.6703

P1 =

0.6703

Mat =

0.3297	0.6703	0
0	0.3297	0.6703
0	0	1.0000

Examples for Testing of the MicroSimulation Tool (MIST)

MultMat =

0.1087	0.4420	0.4493
0	0.1087	0.8913
0	0	1.0000

Results for Gender = 0

Result =

108.6889	441.9822	449.3290
----------	----------	----------

Pop =

1000	0	0
------	---	---

MultMat =

1	0	0
0	1	0
0	0	1

P0 =

0.4966

P1 =

0.4066

Mat =

0.5034	0.4966	0
0	0.5934	0.4066
0	0	1.0000

MultMat =

0.5034	0.4966	0
0	0.5934	0.4066

Examples for Testing of the MicroSimulation Tool (MIST)

0 0 1.0000

P0 =

0.4966

P1 =

0.4066

Mat =

0.5034	0.4966	0
0	0.5934	0.4066
0	0	1.0000

MultMat =

0.2534	0.5447	0.2019
0	0.3522	0.6478
0	0	1.0000

Results for Gender = 1

Result =

253.4264 544.6771 201.8965

```
*****
*****
*****
Example 5b: Multiple Transitions in a Chain with an
Expression and Continuous Covariate
*****
*****
*****
```

MaxTime =

2

Ages =

Examples for Testing of the MicroSimulation Tool (MIST)

60 45

Age =

60

Pop =

1000 0 0

MultMat =

1	0	0
0	1	0
0	0	1

Age =

61

P0 =

0.1541

P1 =

0.0455

Mat =

0.8459	0.1541	0
0	0.9545	0.0455
0	0	1.0000

MultMat =

0.8459	0.1541	0
0	0.9545	0.0455

Examples for Testing of the MicroSimulation Tool (MIST)

0 0 1.0000

Age =

62

P0 =

0.1496

P1 =

0.0433

Mat =

0.8504	0.1496	0
0	0.9567	0.0433
0	0	1.0000

MultMat =

0.7194	0.2740	0.0067
0	0.9132	0.0868
0	0	1.0000

Results for Gender = 0

Result =

719.3598 273.9693 6.6709

Age =

45

Pop =

1000 0 0

Examples for Testing of the MicroSimulation Tool (MIST)

MultMat =

1	0	0
0	1	0
0	0	1

Age =

46

P0 =

0.2417

P1 =

0.0963

Mat =

0.7583	0.2417	0
0	0.9037	0.0963
0	0	1.0000

MultMat =

0.7583	0.2417	0
0	0.9037	0.0963
0	0	1.0000

Age =

47

P0 =

0.2346

Examples for Testing of the MicroSimulation Tool (MIST)

P1 =

0.0916

Mat =

0.7654	0.2346	0
0	0.9084	0.0916
0	0	1.0000

MultMat =

0.5804	0.3974	0.0221
0	0.8209	0.1791
0	0	1.0000

Results for Gender = 1

Result =

580.4146 397.4372 22.1482

```
*****
*****
*****
Example 6: Multiple Transitions in a Long Chain with an
Expression Containing a Continuous Covariate
*****
*****
*****
```

MaxTime =

3

Ages =

60 45

Age =

60

Examples for Testing of the MicroSimulation Tool (MIST)

Pop =

1000	0	0	0
------	---	---	---

MultMat =

1	0	0	0
0	1	0	0
0	0	1	0
0	0	0	1

Age =

61

P0 =

0.1541

P1 =

0.0455

P2 =

0.0455

Mat =

0.8459	0.1541	0	0
0	0.9545	0.0455	0
0	0	0.9545	0.0455
0	0	0	1.0000

MultMat =

0.8459	0.1541	0	0
0	0.9545	0.0455	0
0	0	0.9545	0.0455

Examples for Testing of the MicroSimulation Tool (MIST)

0 0 0 1.0000

Age =

62

P0 =

0.1496

P1 =

0.0433

P2 =

0.0433

Mat =

0.8504	0.1496	0	0
0	0.9567	0.0433	0
0	0	0.9567	0.0433
0	0	0	1.0000

MultMat =

0.7194	0.2740	0.0067	0
0	0.9132	0.0848	0.0020
0	0	0.9132	0.0868
0	0	0	1.0000

Age =

63

P0 =

0.1451

Examples for Testing of the MicroSimulation Tool (MIST)

P1 =

0.0412

P2 =

0.0412

Mat =

0.8549	0.1451	0	0
0	0.9588	0.0412	0
0	0	0.9588	0.0412
0	0	0	1.0000

MultMat =

0.6149	0.3671	0.0177	0.0003
0	0.8756	0.1190	0.0055
0	0	0.8756	0.1244
0	0	0	1.0000

Results for Gender = 0

Result =

614.9460	367.1033	17.6761	0.2747
----------	----------	---------	--------

Age =

45

Pop =

1000	0	0	0
------	---	---	---

MultMat =

1	0	0	0
---	---	---	---

Examples for Testing of the MicroSimulation Tool (MIST)

0	1	0	0
0	0	1	0
0	0	0	1

Age =

46

P0 =

0.2417

P1 =

0.0963

P2 =

0.0963

Mat =

0.7583	0.2417	0	0
0	0.9037	0.0963	0
0	0	0.9037	0.0963
0	0	0	1.0000

MultMat =

0.7583	0.2417	0	0
0	0.9037	0.0963	0
0	0	0.9037	0.0963
0	0	0	1.0000

Age =

47

P0 =

Examples for Testing of the MicroSimulation Tool (MIST)

0.2346

P1 =

0.0916

P2 =

0.0916

Mat =

0.7654	0.2346	0	0
0	0.9084	0.0916	0
0	0	0.9084	0.0916
0	0	0	1.0000

MultMat =

0.5804	0.3974	0.0221	0
0	0.8209	0.1703	0.0088
0	0	0.8209	0.1791
0	0	0	1.0000

Age =

48

P0 =

0.2276

P1 =

0.0872

P2 =

Examples for Testing of the MicroSimulation Tool (MIST)

0.0872

Mat =

0.7724	0.2276	0	0
0	0.9128	0.0872	0
0	0	0.9128	0.0872
0	0	0	1.0000

MultMat =

0.4483	0.4949	0.0549	0.0019
0	0.7493	0.2270	0.0237
0	0	0.7493	0.2507
0	0	0	1.0000

Results for Gender = 1

Result =

448.2904	494.9205	54.8587	1.9305
----------	----------	---------	--------

```
*****
*****
*****
Example 7: Funny Loop Example with an Expression -
(Extending the example from figure 2c in Isaman, 2006)
*****
*****
*****
```

MaxTime =

3

Ages =

60	45
----	----

Age =

60

Examples for Testing of the MicroSimulation Tool (MIST)

Pop =

1000	0	0
------	---	---

MultMat =

1	0	0
0	1	0
0	0	1

Age =

61

P0 =

0.2894

P1 =

0.5326

P2 =

0.5326

Mat =

0.7106	0.2894	0
0	0.4674	0.5326
0.5326	0	0.4674

MultMat =

0.7106	0.2894	0
0	0.4674	0.5326
0.5326	0	0.4674

Examples for Testing of the MicroSimulation Tool (MIST)

Age =

62

P0 =

0.2837

P1 =

0.5273

P2 =

0.5273

Mat =

0.7163	0.2837	0
0	0.4727	0.5273
0.5273	0	0.4727

MultMat =

0.5090	0.3384	0.1526
0.2808	0.2209	0.4982
0.6280	0.1511	0.2209

Age =

63

P0 =

0.2780

P1 =

0.5220

Examples for Testing of the MicroSimulation Tool (MIST)

P2 =

0.5220

Mat =

0.7220	0.2780	0
0	0.4780	0.5220
0.5220	0	0.4780

MultMat =

0.4472	0.3033	0.2496
0.4628	0.1837	0.3535
0.5687	0.2468	0.1845

Results for Gender = 0

Result =

447.1718 303.2561 249.5721

Age =

45

Pop =

1000 0 0

MultMat =

1	0	0
0	1	0
0	0	1

Age =

46

Examples for Testing of the MicroSimulation Tool (MIST)

P0 =

0.3906

P1 =

0.6188

P2 =

0.6188

Mat =

0.6094	0.3906	0
0	0.3812	0.6188
0.6188	0	0.3812

MultMat =

0.6094	0.3906	0
0	0.3812	0.6188
0.6188	0	0.3812

Age =

47

P0 =

0.3829

P1 =

0.6126

P2 =

Examples for Testing of the MicroSimulation Tool (MIST)

0.6126

Mat =

0.6171	0.3829	0
0	0.3874	0.6126
0.6126	0	0.3874

MultMat =

0.3760	0.3846	0.2393
0.3791	0.1477	0.4732
0.6154	0.2369	0.1477

Age =

48

P0 =

0.3753

P1 =

0.6065

P2 =

0.6065

Mat =

0.6247	0.3753	0
0	0.3935	0.6065
0.6065	0	0.3935

MultMat =

Examples for Testing of the MicroSimulation Tool (MIST)

0.3801	0.2925	0.3275
0.5238	0.2004	0.2758
0.4740	0.3242	0.2018

Results for Gender = 1

Result =

380.0611 292.4802 327.4586

```
*****
*****
*****
Example 9: Combined Fork Loop and Event state
*****
*****
*****
```

P0 =

0.1000

P1 =

0.8000

P2 =

0.2000

P3 =

0.1000

t =

10

Pop =

400 500 100

Examples for Testing of the MicroSimulation Tool (MIST)

Mat =

0.9000	0.0800	0.0200
0	0.9800	0.0200
0	0	1.0000

Result =

139.4714 595.8942 264.6345

```
*****
*****
*****
Example 12:  Nested split/join test
*****
*****
*****
```

P0 =

0.1000

P1 =

0.2000

P2 =

0.3000

Joiner Probabilities P3,P4 Should be:

ans =

$1-2/5*5^{(1/2)}$
 $1+2/5*5^{(1/2)}$

t =

10

Examples for Testing of the MicroSimulation Tool (MIST)

Pop =

1000	0	0	0
------	---	---	---

Mat =

0.9000	0.1000	0	0
0	0.8000	0.2000	0
0	0	0.7000	0.3000
0	0	0	1.0000

Result =

348.6784	241.3043	162.1776	247.8397
----------	----------	----------	----------

Example 12: Nested split/join test

MaxTime =

10

P0 =

0.1000

P1 =

0.2000

P2 =

0.1633

P3 =

0.1056

P4 =

Examples for Testing of the MicroSimulation Tool (MIST)

0.1056

P5 =

0.1633

P34 =

0.2000

P25 =

0.3000

P134 =

0.0400

Mapping =

1	0	0	0	0	0
0	1	0	1	0	0
0	0	1	0	1	0
0	1	1	0	0	0
0	1	1	0	0	0
0	0	0	1	1	0
0	0	0	0	0	1

Pop =

500	500	0	0	0	0
-----	-----	---	---	---	---

Mat =

0	0.9000	0.1000	0	0	0
0	0	0.6400	0.1600	0.1600	0.0400
0.1633	0	0	0.6693	0	0.1673

Examples for Testing of the MicroSimulation Tool (MIST)

	0	0	0	0.6693	0.1673
0.1633	0	0	0	0	0.7000
0.3000	0	0	0	0	0
1.0000					

MultMat =

	0.3487	0.1297	0.0745	0.0745	0.0958
0.2768	0	0.0115	0.0356	0.0356	0.1096
0.8077	0	0	0.0180	0	0.0557
0.9263	0	0	0	0.0180	0.0557
0.9263	0	0	0	0	0.0282
0.9718	0	0	0	0	0
1.0000					

DetailedResult =

174.3392	70.6010	55.0427	55.0427	102.7357
542.2386				

Result =

174.3392	125.6437	157.7785	125.6437	125.6437
157.7785	542.2386			

Res =

174.3392	125.6437	157.7785	542.2386
----------	----------	----------	----------

```

*****
*****
*****
Example 13: Nested split/join test
*****
*****
*****

```

Examples for Testing of the MicroSimulation Tool (MIST)

MaxTime =

10

P0 =

0.1000

P1 =

0.2000

P2 =

0.3000

P3 =

0.1056

P4 =

0.1056

P5 =

0

P34 =

0.2000

P25 =

0.3000

P134 =

Examples for Testing of the MicroSimulation Tool (MIST)

0.0400

Mapping =

1	0	0	0	0	0
0	1	0	1	0	0
0	0	1	0	1	0
0	1	1	0	0	0
0	1	1	0	0	0
0	0	0	1	1	0
0	0	0	0	0	1

Pop =

500	500	0	0	0	0
-----	-----	---	---	---	---

Mat =

0.9000	0.1000	0	0	0	
0	0	0.6400	0.1600	0.1600	0.0400
0	0	0	0.5600	0	0.1400
0.3000	0	0	0	0.8000	0.2000
0	0	0	0	0	0.7000
0.3000	0	0	0	0	0
1.0000					

MultMat =

0.3487	0.1297	0.0560	0.1116	0.1062	
0.2478	0	0.0115	0.0170	0.0958	0.1413
0.7344	0	0	0.0030	0	0.0252
0.9718	0	0	0	0.1074	0.1583
0.7344					

Examples for Testing of the MicroSimulation Tool (MIST)

```

          0          0          0          0          0.0282
0.9718
          0          0          0          0          0
1.0000

```

DetailedResult =

```

    174.3392    70.6010    36.5085   103.7382   123.7069
491.1061

```

Result =

```

    174.3392   174.3392   160.2155   107.1095   107.1095
227.4451   491.1061

```

Res =

```

    174.3392   174.3392   160.2155   491.1061

```

```

*****
*****
*****
Example 15:  Simple Table Example:
*****
*****
*****

```

Pop =

```

    100      0

```

t =

```

    3

```

P0 =

```

    0.1000

```

Mat =

Examples for Testing of the MicroSimulation Tool (MIST)

0.9000	0.1000
0	1.0000

ResultAdd =

72.9000	27.1000
---------	---------

P0 =

0.2000

Mat =

0.8000	0.2000
0	1.0000

ResultAdd =

51.2000	48.8000
---------	---------

P0 =

0.3000

Mat =

0.7000	0.3000
0	1.0000

ResultAdd =

34.3000	65.7000
---------	---------

P0 =

0.4000

Mat =

Examples for Testing of the MicroSimulation Tool (MIST)

0.6000	0.4000
0	1.0000

ResultAdd =

21.6000	78.4000
---------	---------

P0 =

0.5000

Mat =

0.5000	0.5000
0	1.0000

ResultAdd =

12.5000	87.5000
---------	---------

P0 =

0.6000

Mat =

0.4000	0.6000
0	1.0000

ResultAdd =

6.4000	93.6000
--------	---------

Outcome =

198.9000
401.1000

Examples for Testing of the MicroSimulation Tool (MIST)

OutcomeGender1 =

158.4000
141.6000

OutcomeAgeGroup1 =

94.5000
105.5000

OutcomeAgeGroup2 =

63.7000
136.3000

```
*****
*****
*****
Example 4: Tests Cost/QoL Wizard
*****
*****
*****
```

P0 =

1

P1 =

0.5000

P2 =

0.5000

t =

5

Pop =

Examples for Testing of the MicroSimulation Tool (MIST)

100 0 0 0

Mat =

0	1.0000	0	0
0	0.5000	0.5000	0
0	0	0.5000	0.5000
0	0	0	1.0000

Result =

0	6.2500	25.0000	68.7500
---	--------	---------	---------