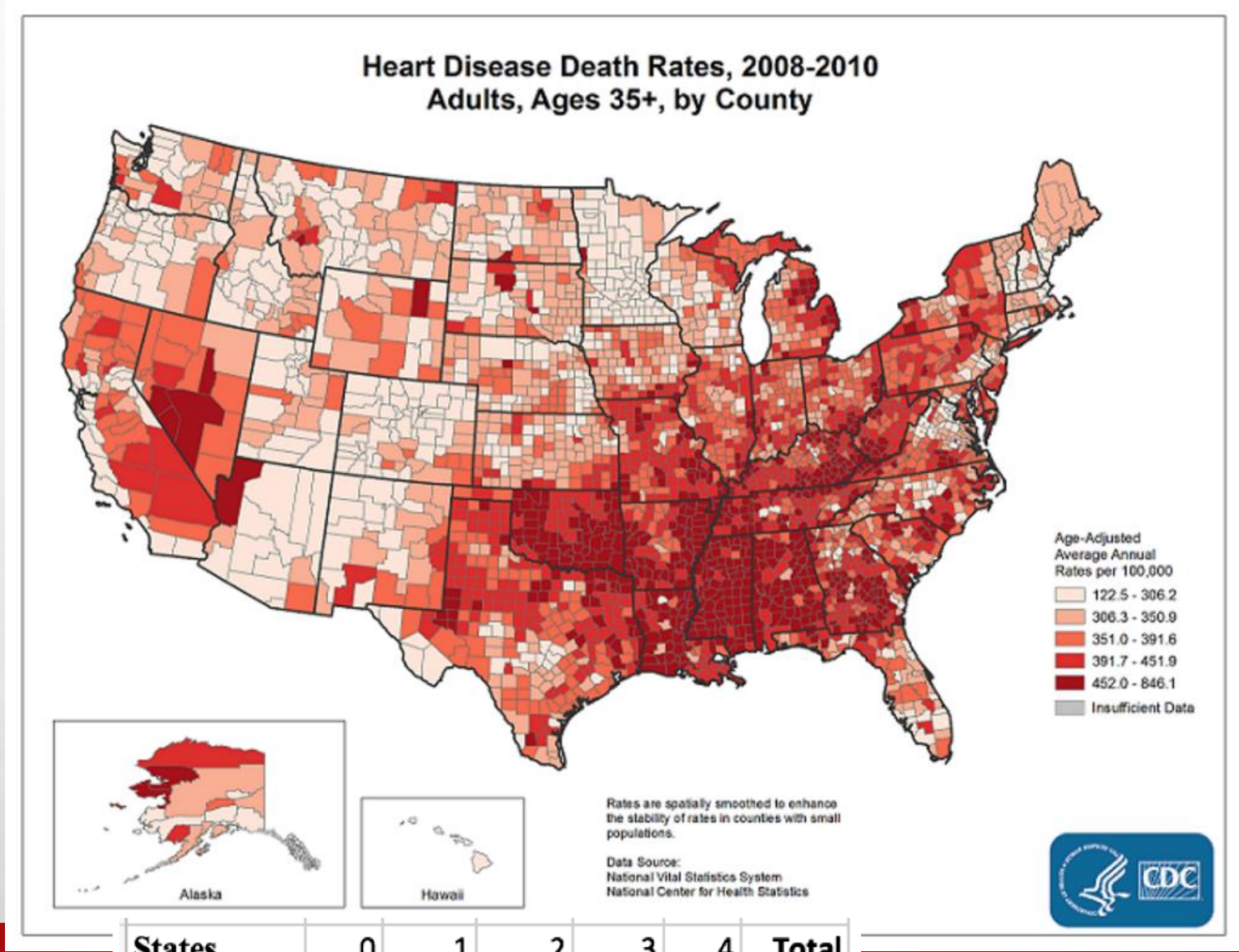
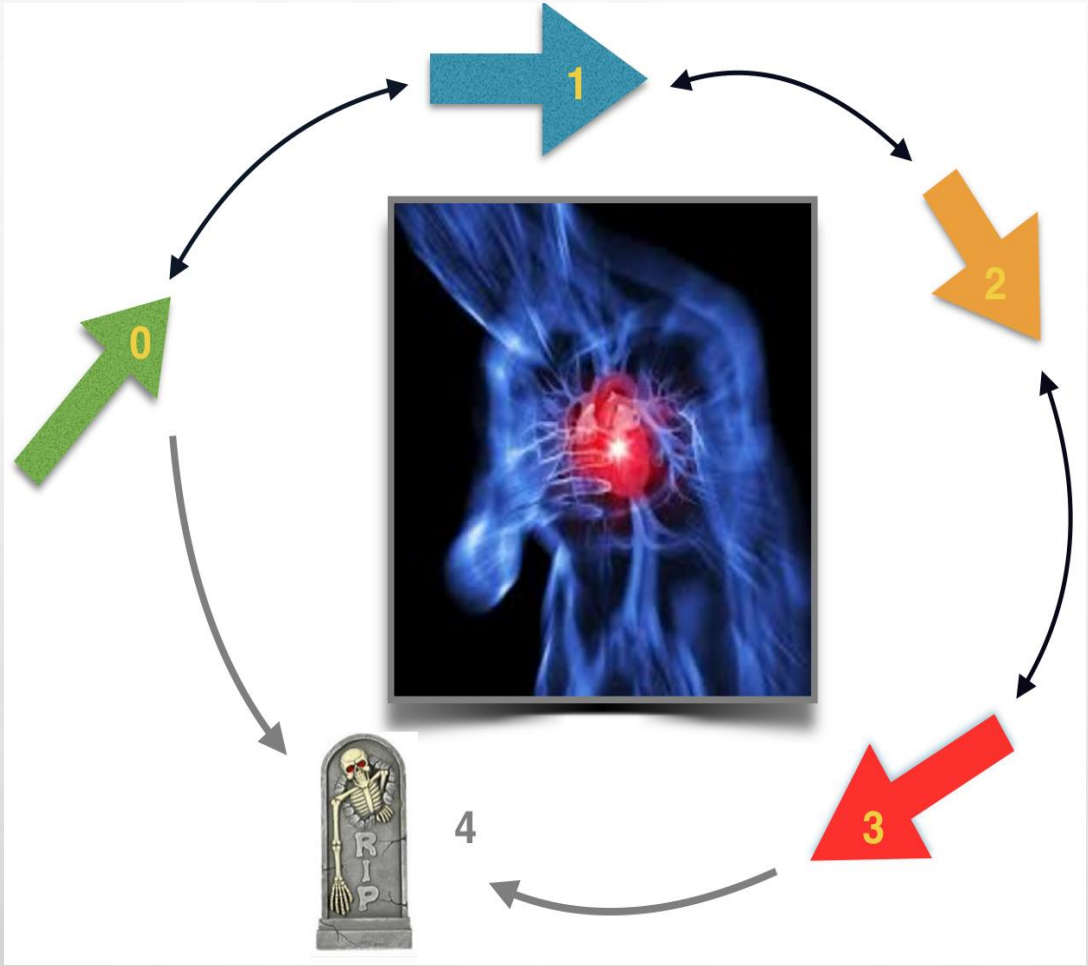
LIVE LONGER WITH HEART DISEASE

Erik N Tulasi R Youqing



States	0	1	2	3	4	Total
Cleveland	164	55	36	35	13	303
Switzerland	48	32	30	5	8	123

Progression of heart disease in different Stages



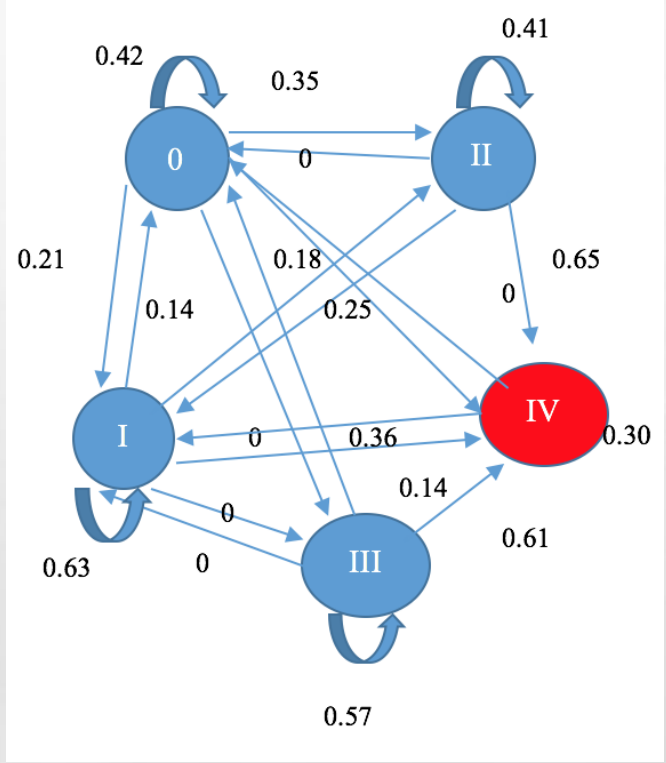
State 0: No-heart-issues
State 1: Mild
State 2: Moderate
State 3: Severe
State 4: Death

Methodology

Probability Transition Table

Transition	Data	Probability
0 to 0	70/164	0.42
0 to I	35/164	0.21
0 to II	59/164	0.35
0 to III	0	0
0 to IV	0	0
I to 0	8/55	0.14
I to I	35/55	0.63
I to II	10/55	0.18
I to III	0	0
I to IV	2/55	0.36
II to 0	0	0
II to I	9/36	0.25
II to II	15/36	0.41
II to III	10/36	0.27
II to IV	2/36	0.055
III to 0	0	0
III to I	0	0
III to II	10/35	0.28
III to III	20/35	0.57
III to IV	5/35	0.14
IV to 0	0	0
IV to I	0	0
IV to II	0	0
IV to III	8/13	0.61
IV to IV	5/13	0.38

Markov Model



Matrix form

$$\begin{matrix} 0.42 & 0.21 & 0.35 & 0.00 & 0.00 \\ 0.14 & 0.63 & 0.18 & 0.00 & 0.36 \\ 0.00 & 0.25 & 0.41 & 0.27 & 0.05 \\ 0.00 & 0.00 & 0.28 & 0.57 & 0.14 \\ 0.00 & 0.00 & 0.00 & 0.61 & 0.38 \end{matrix}$$

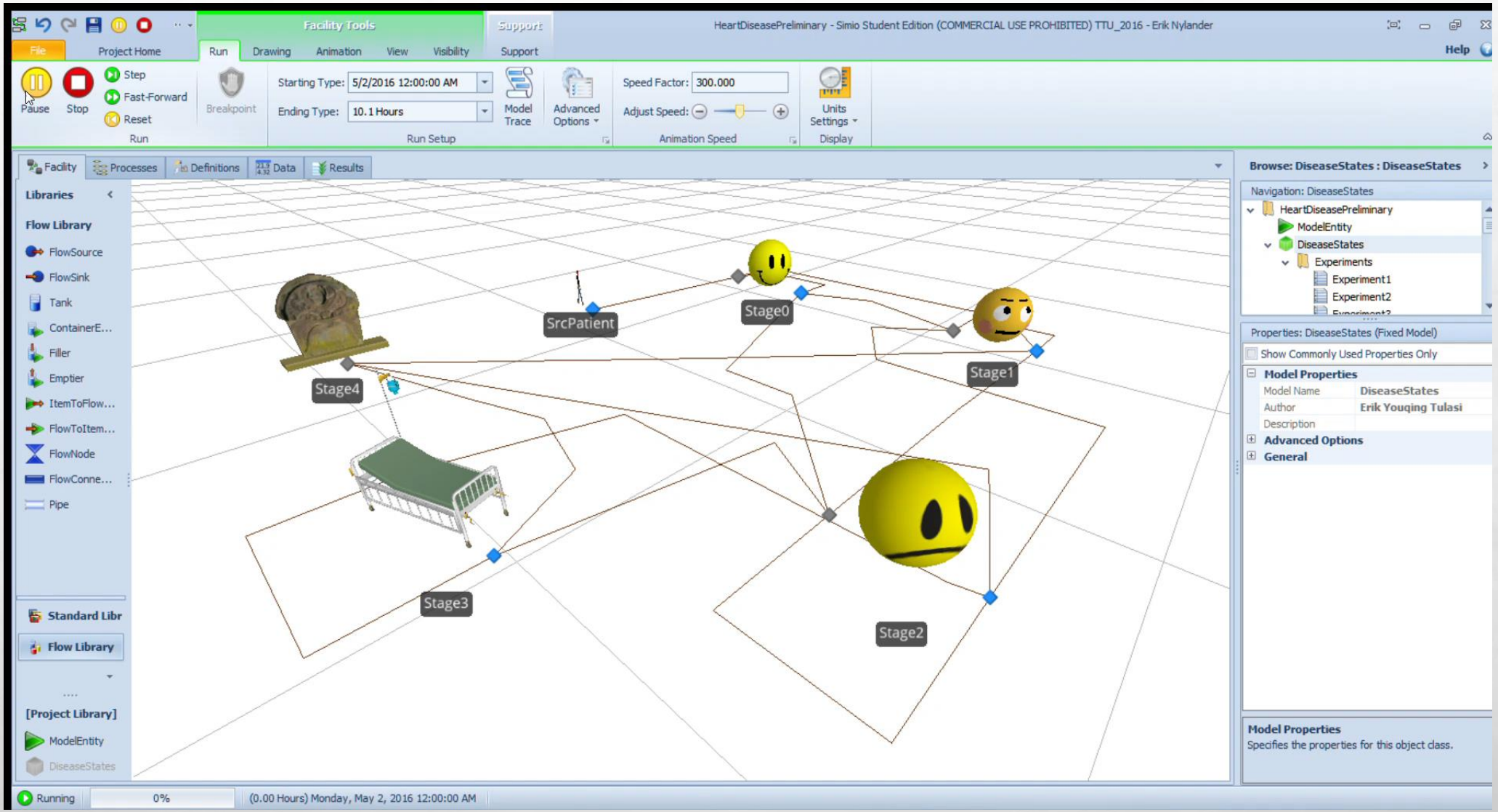
ASSUMPTIONS

- Markov states.
- An initial distribution → State 1: 0.43
  State 2: 0.15
  State 3: 0
  State 4: 0
  State 5: 0
- Can die in any state.
- Transitions - from low to a way higher state and vice versa

Simio Model

Model Components

- Source: General population
- Servers: Different States of the Disease
  - Infinite capacity
- Paths: Weighted to Represent Probabilities in the Transition Matrix
- Sink: State 4 (Death)


HeartDiseasePreliminary - Simio Student Edition (COMMERCIAL USE PROHIBITED) TTU_2016 - Erik Nylander
Facility Tools
Support
File
Project Home
Run
Drawing
Animation
View
Visibility
Support
Help
Pause
Stop
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Fast-Forward
Reset
Breakpoint
Starting Type: 5/2/2016 12:00:00 AM
Ending Type: 10.1 Hours
Model Trace
Advanced Options
Speed Factor: 300.000
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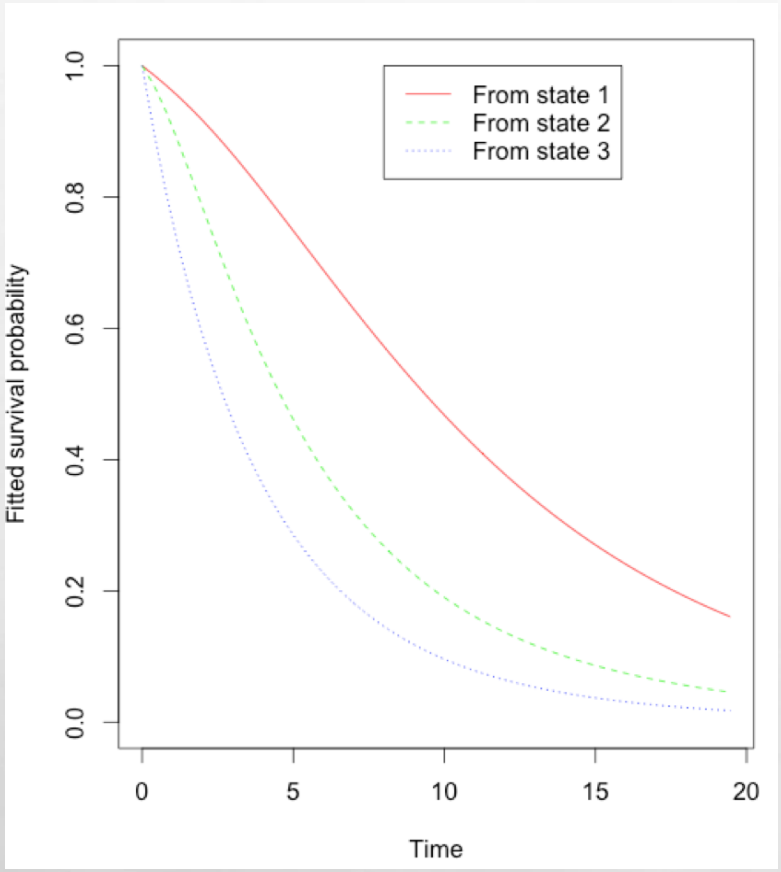
ModelEntity
DiseaseStates
SrcPatient
Stage0
Stage1
Stage2
Stage3
Stage4
Browse: DiseaseStates : DiseaseStates
Navigation: DiseaseStates
HeartDiseasePreliminary
ModelEntity
DiseaseStates
Experiments
Experiment1
Experiment2
Properties: DiseaseStates (Fixed Model)
Show Commonly Used Properties Only
Model Properties
Model Name DiseaseStates
Author Erik Youqing Tulasi
Description
Advanced Options
General
Model Properties
Specifies the properties for this object class.
Running
0%
(0.00 Hours) Monday, May 2, 2016 12:00:00 AM

R AND SIMIO

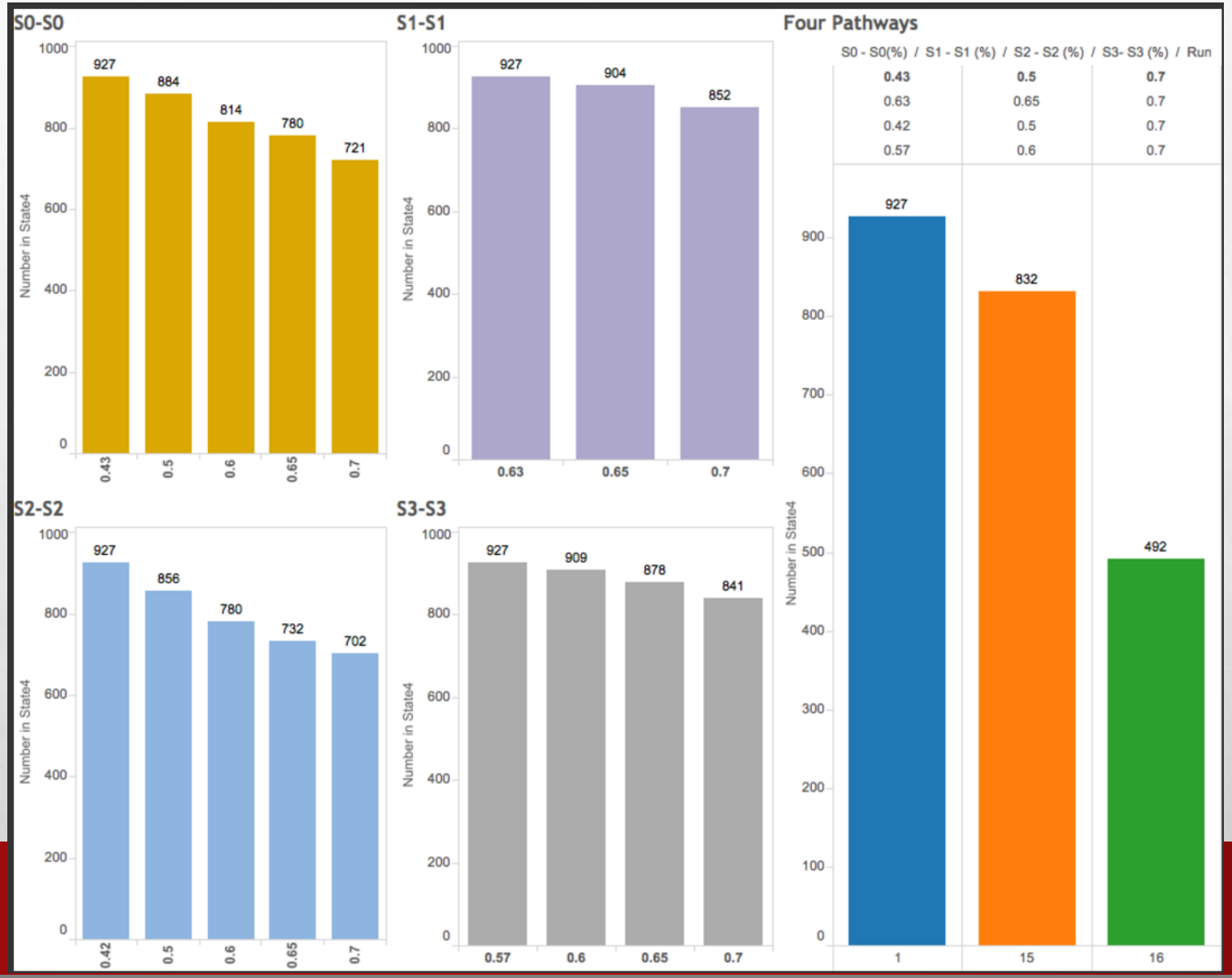


- 10 YEAR SIMULATION
  - SURVIVAL RATE: 67.8%
  - AVERAGE TIME WITH DISEASE: ~6 YEARS
  - MINIMUM SURVIVAL TIME: ~2 YEARS

Overview of Interventions In Model

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Run	S0 - S0	S0 - S1	S0 - S2	S1 - S1	S1 - S	S1 - S2	S1 - S4	S2 - S2	S2 - S	S2 - S3	S2 - S4	S3 - S3	S3 - S2	S3 - S4
1	0.43	0.21	0.36	0.63	0.15	0.18	0.04	0.42	0.25	0.27	0.06	0.57	0.29	0.14
2	0.57	0.21	0.36	0.63	0.15	0.18	0.04	0.42	0.25	0.27	0.06	0.57	0.29	0.14
3	0.86	0.21	0.36	0.63	0.15	0.18	0.04	0.42	0.25	0.27	0.06	0.57	0.29	0.14
4	1.06	0.21	0.36	0.63	0.15	0.18	0.04	0.42	0.25	0.27	0.06	0.57	0.29	0.14
5	1.33	0.21	0.36	0.63	0.15	0.18	0.04	0.42	0.25	0.27	0.06	0.57	0.29	0.14
6	0.43	0.21	0.36	0.69	0.15	0.18	0.04	0.42	0.25	0.27	0.06	0.57	0.29	0.14
7	0.43	0.21	0.36	0.86	0.15	0.18	0.04	0.42	0.25	0.27	0.06	0.57	0.29	0.14
8	0.43	0.21	0.36	0.63	0.15	0.18	0.04	0.58	0.25	0.27	0.06	0.57	0.29	0.14
9	0.43	0.21	0.36	0.63	0.15	0.18	0.04	0.87	0.25	0.27	0.06	0.57	0.29	0.14
10	0.43	0.21	0.36	0.63	0.15	0.18	0.04	1.08	0.25	0.27	0.06	0.57	0.29	0.14
11	0.43	0.21	0.36	0.63	0.15	0.18	0.04	1.35	0.25	0.27	0.06	0.57	0.29	0.14
12	0.43	0.21	0.36	0.63	0.15	0.18	0.04	0.42	0.25	0.27	0.06	0.65	0.29	0.14
13	0.43	0.21	0.36	0.63	0.15	0.18	0.04	0.42	0.25	0.27	0.06	0.8	0.29	0.14
14	0.43	0.21	0.36	0.63	0.15	0.18	0.04	0.42	0.25	0.27	0.06	1.0	0.29	0.14
15	0.57	0.21	0.36	0.69	0.15	0.18	0.04	0.58	0.25	0.27	0.06	0.65	0.29	0.14
16	1.33	0.21	0.36	0.86	0.15	0.18	0.04	1.35	0.25	0.27	0.06	1.0	0.29	0.14

Results - Single & Multiple Interventions



CHALLENGES

- Dataset with time-series was hard to find.
- We had somewhat limited data sets in time and location
- Given the Monte Carlo Nature this was easier to implement in R than Simio
- Simio did give us a nice way to look how individuals progressed through the transitions.

Future work

- Consistency, Efficiency
- Having patients that progress more or less quickly through the disease.
- Calculating transition probabilities based on characteristics of each patient.
- Including cost involved in patient care at each state of the disease.