Simul8 User Guide for Critical Care Unit

The aim of this document is to provide a high level overview of the main stages of building a Discrete Event Simulation model of a Critical Care Unit using Simul8. The template is structured in line with the requirements of our research, and that of the unit and the data with which we utilised.

This however can be manipulated to meet your requirements and the main stages in doing so, are outlined below. Due to confidentiality, we have removed the exact data values used in our model and set all to zero. Again, the stages of replacing these are outlined in this document.

1. General model specifications

To choose the running time for the simulation, select the **Data and Rules tab – Properties**. Here the days per week, start time and duration of the day can be set. It is recommended that a warm up period is set to achieve a steady state of the number of patients to be established within the system. Currently the warm up period is set to 30 days with the simulation running for 2 years.

Time Units		🖌 ок
 Seconds Minute 	s O Hours O Days	
For units smaller than seconds us	e decimals of units e.g. 0.001 = 1 millisecond	💥 Cancel
Time format		🕜 Help
O Simple unit count from zero	O Percent O Time only	Annlu
Decimals: 0	Time Day	
Description:		More
	Digital O Clock Face	Calendar
● HH:MM ○ HH:MM.000	O HH:MM:SS O HH:MM:SS.000	
Days		
Day O Date Day, Week	⊠Won, Tues, ⊠Wed Days per week: 7	
Running Time		
Start time each day (HH:MM):	00:00	
Duration of day (HH:MM):	24:00	
Warm Up Period	Results Collection Period	
The simulation will run for Co	the total of Warm Up Period + Results Illection Period	

It is also useful to check all travel times are set to zero by selecting **File – Preferences – Distances – Set to zero**. This will ensure the length of arrows in the simulation do not account for any time within the running of the simulation. In some scenarios, where time travelled between departments needs to be considered, this may need to be altered.

2. Patient Arrivals

Arrivals are calculated using inter-arrival times, the time between each arrival. The simplest way to calculate this from most data sources is from the arrival rate. This is calculated as followed:

Inter-arrival rate = 1 / Arrival rate

For example, an arrival rate of two patients per hour, would result in an inter-arrival rate of one patient per 30 minutes.

To change the arrival rate within each 'Start Point' node, **either double click or right click the icon and select Properties** on the individual node.

Here, admissions can also arrive via distributions – to decide on the distribution to best suit your data, online distribution fitters are readily available. A number of pre-set distributions exist in Sumul8 or you can add your own probability distribution under the **Data and Rules tab – Create Distribution**.

Complete this for each start point. In our model we have a different entry point for both planned and unplanned arrivals to allow a different arrival pattern for each of these scenarios.

lanned Admission	
put Work Item Type:	
1ain Work Item Type	
nter-arrival times (minutes) – Average:	🗸 ок
0	💥 Cancel
	🕜 Help
	Memo
Distribution:	Results
Average 🗸 🗸	Batching
New Detail	Develope Out
First at start time	Houting Out
Unlimited arrivals	Actions
None 🗌 File	Graphics
Schedule Sheet	Carbon
_ From WI State Chart] Dav Planner	Constraints
Finance	

3. Classification

The classification node is a dummy node used for routing purposes with a fixed distribution of 0 (this should not be modified). The **Routing Out** discipline can be changed to a percentage to route patients depending on the levels of care they will receive. Based on our data we are allocating a percentage to each level of care.

If wanting to have a priority on the patients entering the system, i.e. unplanned (emergency) patients over planned (elective) patients, this can be performed within the **Routing In** button.

Activity Properties		Routing Out From:	
Classification		Discipline To: Add Remove	ΟΚ
Timing (minutes)	OK:	Ignore Blocked Houtes Circulate Circulate	Cancel
	Close	C uniform Z: Queue for Enter, Leave Level 2 S: Queue for Enter Level 3, Leave Level 2	2
[`	🕜 Help	O Percent 4: Queue for Enter, Leave Level 3 5: Queue for Enter Level 2, Leave Level 1	I Help
	Memo	O Priority 6: Queue for Enter Level 3, Leave Level 1 7: Queue for All three levels	Travel
Distribution:	Results	O Label Detail	Place Ar
Fixed ~	Resources		
New Detail	Efficiency		
High Volume	Routing In Out	O Jobs Matrix = 100	
Finance	Actions		More >>
Erase	Priority	Batching	
Carbon	Replicate = 1	F. On Work Complete	
	Contents		
3	Graphics	Exit Work Item Type: Index with Group	c
[™] On State Change	Shifts	Main Work Item Type V (None) Hold work here until more input work is ready Prioritize exit by work item	~

As well as the main classification node, there are a number of dummy nodes to allocate the length of stay to each patient based on their current level of care.

Patients who enter the unit either as a Level 1 or 2 patient, often have a shorter length of stay and their time distribution can be changed within **Properties – Actions**. The time distribution can then be set to a distribution that fits the length of stay for that patient type.

Activity Properties		Actions		
Enter, Leave Level 1		Change: 🖒 👼	Action	IK.
Timing (minutes) Fixed Value:	OK.	Image:L Time Distribution	Increment Decrement Set to:	💥 Cancel
0	Help		O Add to: Value 0 H	🕜 Help
D. LL C	Memo		O Time Stamp Unique	
Fixed ~	Resources		O Ask VB O No Change	
New Detail	Efficiency	Add a Label to Change	IF Visual Logic	
High Volume	Routing In Out	Change Anything		
Finance	Actions	Remove Selected		
Erase	Priority			
Carbon	Replicate = 1			
22	Contents			
	Graphics			
"C On State Change	Shifts			

The Level 3 patients are more seriously ill and therefore have longer length of stays. The routing of the patients on whether they had a long or short length of stay is determined by a percentage, again chosen within the routing out option. The time distribution can again be set for each pathway according to their length of stay within the system.

Activity Properties		Actions		
Short LOS patients: Leave Level 2		Change: 🙆 🛱	Action	🗸 ок
Timing (minutes)	0K	Time Distribution	O Increment	💥 Cancel
			Set to:	A Help
	🕜 Help		O Add to: Value	U Holp
	Memo		O Time Stamp	
Distribution:	Results		O Unique O Ask VB	
Fixed ~	Resources		O No Change	
New Detail	Efficiency	Add a Label to Change	F Visual Logic	
🗌 High Volume	Routing In Out	Change Anything		
Finance	Actions	Remove Selected		
Erase	Priority	1	1	
Carbon	Replicate = 1			
	Contents			
1	Graphics			
F On State Change	Shifts			

4. Treatment

The number of treatment beds can be set within the **Replicate** option – this is currently set to 23 beds. The **Routing In** options have priorities set, so patients downgrading levels and being discharged have priority over those waiting in the queue for a bed. The routing out options for the system is already predetermined by the labels given in the Classification stage.

Patients in the treatment bed node, will remain there for the duration of their length of stay within the level of care in which they entered. Once completed, there is the option for a patient to be downgraded to a lower level of care, or be physically fit for discharge. This again, is allocated based on proportions.

reatment beds	1	Selection Method	d Options Change Over		🗸 ок
Timing (minutes)	OK.	Add	Remove	Place At	Close
V	Close	1: Que	ue for Treatment: Level 2's	1	
	🕜 Help	2: Que 3: Que	ue for Treatment: Level 1's ue for Discharge bed		😈 нер
	Memo	4: Que	ue for Treatment		
Distribution:	Results				
Distribution ~	Resources	Discip Price	line prity		
New Detail	Efficiency	O Col	lect	1	
High Volume	Routing In Out	O Pa:	ssive	More>>	
Finance	Actions	Routing Out From:			
Free	Priority	Discipline	To: Add Remove		
Elase	Replicate = 23	Circulate	1: Queue for Level 1 Classification	on on 💥 Car	ncel
Larbon	Contents	O Uniform O Percent	3: Discharged or Died 4: Queue for Discharge	(2) He	qle
	Graphics	O Priority		Тюж	el
F On State Change	Shifts	O Shortest Queue O Passive	n.,	Hade	
		O Jobs Matrix O Cycle Matrix O By Type Deta	a = 100 A Batching	More >:	
		Visual Logic	ete Finn Before Exit	n Esit	
		Exit Work Iten	o Tune Indexu	with Group:	

5. Downgrade

The downgrade option reclassifies patients to a different length of stay. Again, this acts as a dummy variable so has a fixed distribution of zero. The time distribution can be set to reclassify patients with either a Level 2 or Level 1 length of stay, who still require treatment. Similar to previously, this is achieved through **Actions** within **Properties**, and the time distribution can be set to a different distribution.

Activity Properties		Actions		
Level 1 Classification		Change: 👲 📮	Action	🗸 ок
Timing (minutes)	OK.	Time Distribution	O Increment	💥 Cancel
Fixed Value:	Close	Image:L	Set to:	A Hein
	🕜 Help		O Mult by:	
	Memo		O Time Stamp	
Distribution:	Results		O Unique O Ask VB	
Fixed ~	Resources		🔿 No Change	
New Detail	Efficiency	Add a Label to Change	Free Visual Logic	
High Volume	Routing In Out	Change Anything		
Finance	Actions	Remove Selected		
Erase	Priority			
Carbon	Replicate = 1			
Calbon	Contenta			
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Fail On State Change	Shifts			

6. Discharge

Due to the labelling system built into the model, when a patient has completed its treatment length of stay and is physically ready to be discharged, the patient moves through the discharge node (a dummy variable with a fixed time of zero). The proportion of patients who classify as DTOC or discharged within four hours can then be set through the **Routing out** option.

Activity Properties		Routing Out From:		
Discharge		Discipline	To Add Remove	
Timing (minutes) Fixed Value:	Clope OK Clope O Help	Ignore Blocked Routes Circulate Uniform Percent	1: Queue for DTOC 2: Queue for discharge within 4 hours	Cancel Help
Distribution: Fixed	Memo Results Resources	Priority Label Detail Shortest Queue Passive		Travel Place At
High Volume	Routing In Out Actions	O Jobs Matrix O Cycle Matrix Detail O By Type Detail	= 100	More >>
Erase	Priority		Barching	
Carbon	Replicate = 1			
*	Contents Graphics			
IT. On State Change	Shifts			

The patients who are discharged within four hours can then have a time distribution set specifically so they do not stay longer than four hours, and therefore not classified as DTOC. This is achieved through the **Actions** within the node's properties.

Activity Properties		Actions		
Discharge within 4 hours Timing (minutes) Fixed Value:	OK Close O Help	Change: 🔬 👼 Time Distribution Image:L	Action Increment Decrement Set to: Add to: Value	V OK Cancel
Distribution:	Memo Results Resources		O Mult by: Time Stamp Unique Ask VB No Change	
High Volume	Efficiency Routing In Out	Add a Label to Change Change Anything	IF Visual Logic	
Finance Erase	Actions Priority	Remove Selected		
Carbon	Replicate = 1 Contents			
8	Graphics			
IF On State Change	Shifts			

For patients who classify as DTOC, and therefore have a length of stay of longer than four hours the time distribution can be set within the within **Actions**.

Activity Properties		Actions		
DTOC		Change: 🕑 👼	Action	ΟΚ
Timing (minutes) Fixed Value:	OK.	Time Distribution	O Increment	💥 Cancel
0	Close Help		Add to: Value	🕜 Help
	Memo		O Time Stamp	
Distribution:	Results		O Ask VB	
New Detail	Efficiency	Add a Label to Change	F Visual Logic	
High Volume	Routing In Out	Change Anything		
Finance	Actions	Remove Selected		
Erase	Priority			
Carbon	Replicate = 1			
	Contents			
25	Graphics			
IF On State Change	Shifts			

Patients will then re-enter the Treatment node and remain until their discharge and/or DTOC time has been completed in which the patient will then leave the system.

7. Results

Upon competition, results can be viewed in the **Results Tab.** This is managed under the options in the **Home - Results Manager** further to this trails can be managed under the **Run Trail** option. These results can be easily exported and managed using the option in the top right corner.



For further support see: https://www.simul8.com/support/help/doku.php?id=start