

Start: Front page

C:/PSR/latest/PathSimR_Shiny - Shiny
http://127.0.0.1:4264/ | Open in Browser

Navigation Bar Introduction Overview & Glossary W1. Setup W2. Data Entry Service Distribution Tool


PathSimR

A versatile tool for modelling pathway capacity in R

Start Pathway Wizard

Start Simulation Tool

PathSimR is a simulation tool designed to give insights into how care pathways are performing and enable 'what if' analysis to identify more effective and efficient service configurations.

An overview of the tool and a glossary of key terms can be found in the Overview & Glossary tab in the Navigation Bar (accessible at all times). Moreover, throughout the tool, there are  symbols which provide additional information on specific topics.

New users are advised to read through the overview and glossary when first using the tool to familiarise themselves with the relevant terminology and ideas.




All data must be entered in a consistent time unit (e.g. all data uploaded is on the scale of either days or hours, but not a mixture of the two - if using hours, enter a day as 24 time units, a week as 168 etc.). Users can choose a label for their time unit on the Network Import and Visualisation tab - this will not be used in calculations, but will be added to output tables and graphs.

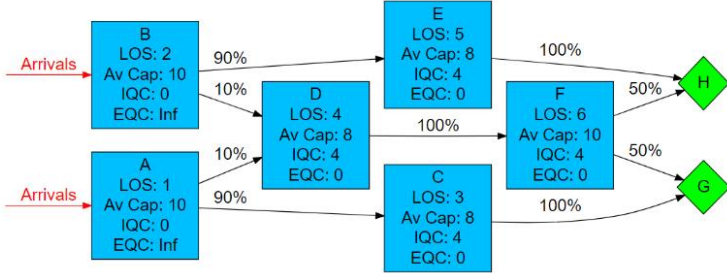
Proceed through the tabs in the navigation bar at the top of the page, completing each tab in sequence. Once all inputs have been entered and confirmed on a tab, the subsequent tab will appear. The tabs can be navigated either using the 'previous' and 'next' buttons at the bottom of the page or clicking on the tabs themselves at the top of the page. Instructions are given on every page regarding how to use the tool. Users may return to any previous tab and update inputs, simply rerun any uploads/processes on subsequent tabs before moving on.

The Pathway Wizard has been designed to help users collate the necessary information required to run a simulation. Like the simulation tool, complete each tab in sequence and then proceed into PathSimR.

To zoom out, press control+- and to zoom in press control+shift+=

For more information or guidance on how to use the tool, please contact the Modelling and Analytics team at BNSSG CCG.





```
graph LR
    Arrivals1[Arrivals] --> A[A  
LOS: 1  
Av Cap: 10  
IQC: 0  
EQC: Inf]
    Arrivals2[Arrivals] --> B[B  
LOS: 2  
Av Cap: 10  
IQC: 0  
EQC: Inf]
    A -- 10% --> D[D  
LOS: 4  
Av Cap: 8  
IQC: 4  
EQC: 0]
    A -- 90% --> C[C  
LOS: 3  
Av Cap: 8  
IQC: 4  
EQC: 0]
    B -- 10% --> D
    B -- 90% --> E[E  
LOS: 5  
Av Cap: 8  
IQC: 4  
EQC: 0]
    D -- 100% --> F[F  
LOS: 6  
Av Cap: 10  
IQC: 4  
EQC: 0]
    E -- 100% --> F
    F -- 50% --> H{H}
    F -- 50% --> G{G}
```

Example patient pathway (built in PathSimR)

1. Select "Start Pathway Wizard"
2. Otherwise select "Start Simulation Tool" to input templates directly (see step 9)

Pathway wizard: Wizard start

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Navigation Bar Introduction Overview & Glossary W1. Setup

Instructions

Step 1: Enter names of all Service Points

'A' is currently listed as an example Service Point. Enter names in the 'Service Point' column by selecting an empty cell or editing an existing one. The entry form will automatically grow when the limit is reached. To refresh, click away and then enter new name. [What is a Service Point?](#)

Step 2: Enter names of all Exits

'B' is currently listed as an example Exit. Enter names in the 'Exit' column by selecting an empty cell or editing an existing one. The entry form will automatically grow when the limit is reached. To refresh, click away and then enter new name. [What is an Exit?](#)

Step 3: Check the resulting tables and ensure all entries are included

Step 4: Proceed by pressing the 'Next' button.

If you require to add/remove any names during the wizard process, you can return to this page and edit the inputs to restart the wizard.

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Service Points

Enter Names in Right Column

Cons

Acute

Rehab

	Service Points
1	Cons
2	Acute
3	Rehab

Exits

Enter Names in Right Column

Home

	Exits
1	Home

3. Enter pathway service and exit nodes to be modelled
4. Then select "Next" to begin calibration

Pathway wizard: Input info (first service node)

Instructions

For each named tab on the right, fill out all the information

Step 1: Enter a Length of Service distribution and parameters for the Service Point

Select the distribution from the drop-down below and then enter the parameter values (as numbers) to the right, in the correct named box. If the distribution and parameters for the service point are not known, use the Service Distribution tool (in the navigation bar above) to either fit models to uploaded data or scale against BNSSG data and then enter resulting distributions and parameters. [What is a Length of Service and how does it connect to distributions and parameters?](#)

Step 2: Enter information about maximum queue lengths

Enter numeric values into both boxes. [What counts as a queue?](#)

Step 3: Enter Transition Proportions and Transition Delays

Enter a value between and including 0 and 1 in the proportion box to represent the proportion of patients who move to that service point. All proportion values should sum to 1 on each Service Point. If there is a Transition Delay associated with the move, select the describing distribution and enter the necessary parameters. A fixed Transition Delay can be modelled using the uniform distribution and entering the same value into the min and max boxes. [What is a Delay and how are they important?](#)

Step 4: Complete the Calendars

The External Arrival Rate & Capacity are able to change at given times throughout the simulation. These changes occur at times set in the respective calendars. Both calendars require at least 1 row to be filled. [How do I fill the calendar?](#)

Step 5: Repeat Steps 1 to 4 for each Service Point Tab

Step 6: Once all Service Point Tabs are complete, proceed by pressing the 'Next' button

A new tab will also appear at the top of the page. If you require to edit any data entered on any tab during the wizard process, you can return to this page and edit the inputs. If you do, then ensure that the subsequent pages are refreshed.

← Previous

Next →

Cons Acute Rehab

Service Point Name: Cons

Length of Service Information

Select a distribution

Uniform

Min

0.0125

Max

0.0125

Queue Information

External Queue Capacity

99999

Internal Queue Capacity

99999

Transitions & Departure Delays

Cons

Proportion from Cons to Cons

0

Distribution for Transition Delay from Cons to Cons

None

No Parameters Required

NA

Acute

Proportion from Cons to Acute

0.5

Distribution for Transition Delay from Cons to Acute

None

No Parameters Required

NA

Rehab

Proportion from Cons to Rehab

0

Distribution for Transition Delay from Cons to Rehab

None

No Parameters Required

NA

Home

Proportion from Cons to Home

0.5

Distribution for Transition Delay from Cons to Home

None

No Parameters Required

NA

External Arrival Rate Calendar

For more information, consult the instructions sidebar (Step 4) and 'How do I fill the calendar?' info button

Start Time	End Time	Arrival Rate
0		1

Capacity Calendar

For more information, consult the instructions sidebar (Step 4) and 'How to fill out the calendar?' info button

Start Time	End Time	Capacity
0	0.125	2
0.125	7	0

5. Then move onto "Acute" service node tab once all populated

Pathway wizard: Input info (second service node)

Instructions

For each named tab on the right, fill out all the information

Step 1: Enter a Length of Service distribution and parameters for the Service Point

Select the distribution from the drop-down below and then enter the parameter values (as numbers) to the right, in the correct named box. If the distribution and parameters for the service point are not known, use the Service Distribution tool (in the navigation bar above) to either fit models to uploaded data or scale against BNSSG data and then enter resulting distributions and parameters. [What is a Length of Service and how does it connect to distributions and parameters?](#)

Step 2: Enter information about maximum queue lengths

Enter numeric values into both boxes. [What counts as a queue?](#)

Step 3: Enter Transition Proportions and Transition Delays

Enter a value between and including 0 and 1 in the proportion box to represent the proportion of patients who move to that service point. All proportion values should sum to 1 on each Service Point. If there is a Transition Delay associated with the move, select the describing distribution and enter the necessary parameters. A fixed Transition Delay can be modelled using the uniform distribution and entering the same value into the min and max boxes. [What is a Delay and how are they important?](#)

Step 4: Complete the Calendars

The External Arrival Rate & Capacity are able to change at given times throughout the simulation. These changes occur at times set in the respective calendars. Both calendars require at least 1 row to be filled. [How do I fill the calendar?](#)

Step 5: Repeat Steps 1 to 4 for each Service Point Tab

Step 6: Once all Service Point Tabs are complete, proceed by pressing the 'Next' button

A new tab will also appear at the top of the page. If you require to edit any data entered on any tab during the wizard process, you can return to this page and edit the inputs. If you do, then ensure that the subsequent pages are refreshed.

← Previous

Next →

Cons Acute **Rehab**

Service Point Name: Acute

Length of Service Information

Select a distribution

log-Normal

meanlog

1.5

sdlog

0.5

Queue Information

External Queue Capacity

0

Internal Queue Capacity

99999

Transitions & Departure Delays

Cons

Proportion from Acute to Cons

0

Distribution for Transition Delay from Acute to Cons

None

No Parameters Required

NA

Acute

Proportion from Acute to Acute

0

Distribution for Transition Delay from Acute to Acute

None

No Parameters Required

NA

Rehab

Proportion from Acute to Rehab

0.8

Distribution for Transition Delay from Acute to Rehab

None

No Parameters Required

NA

Home

Proportion from Acute to Home

0.2

Distribution for Transition Delay from Acute to Home

None

No Parameters Required

NA

External Arrival Rate Calendar

For more information, consult the instructions sidebar (Step 4) and 'How do I fill the calendar?' info button

Start Time

End Time

Arrival Rate

0

1

Capacity Calendar

For more information, consult the instructions sidebar (Step 4) and 'How to fill out the calendar?' info button

Start Time

End Time

Capacity

0

7

6. Then move onto "Rehab" service node tab once all populated

Pathway wizard: Input info (third service node)

Instructions

For each named tab on the right, fill out all the information

Step 1: Enter a Length of Service distribution and parameters for the Service Point

Select the distribution from the drop-down below and then enter the parameter values (as numbers) to the right, in the correct named box. If the distribution and parameters for the service point are not known, use the Service Distribution tool (in the navigation bar above) to either fit models to uploaded data or scale against BNSSG data and then enter resulting distributions and parameters. [What is a Length of Service and how does it connect to distributions and parameters?](#)

Step 2: Enter information about maximum queue lengths

Enter numeric values into both boxes. [What counts as a queue?](#)

Step 3: Enter Transition Proportions and Transition Delays

Enter a value between and including 0 and 1 in the proportion box to represent the proportion of patients who move to that service point. All proportion values should sum to 1 on each Service Point. If there is a Transition Delay associated with the move, select the describing distribution and enter the necessary parameters. A fixed Transition Delay can be modelled using the uniform distribution and entering the same value into the min and max boxes. [What is a Delay and how are they important?](#)

Step 4: Complete the Calendars

The External Arrival Rate & Capacity are able to change at given times throughout the simulation. These changes occur at times set in the respective calendars. Both calendars require at least 1 row to be filled. [How do I fill the calendar?](#)

Step 5: Repeat Steps 1 to 4 for each Service Point Tab

Step 6: Once all Service Point Tabs are complete, proceed by pressing the 'Next' button

A new tab will also appear at the top of the page. If you require to edit any data entered on any tab during the wizard process, you can return to this page and edit the inputs. If you do, then ensure that the subsequent pages are refreshed.

← Previous

Next →

Cons Acute Rehab

Service Point Name: Rehab

Length of Service Information

Select a distribution

Gamma

Shape

3

Rate

0.2

Queue Information

External Queue Capacity

0

Internal Queue Capacity

0

Transitions & Departure Delays

Cons

Proportion from Rehab to Cons

0

Distribution for Transition Delay from Rehab to Cons

None

No Parameters Required

NA

Acute

Proportion from Rehab to Acute

0

Distribution for Transition Delay from Rehab to Acute

None

No Parameters Required

NA

Rehab

Proportion from Rehab to Rehab

0

Distribution for Transition Delay from Rehab to Rehab

None

No Parameters Required

NA

Home

Proportion from Rehab to Home

1

Distribution for Transition Delay from Rehab to Home

Uniform

Min

0.5

Max

1

External Arrival Rate Calendar

For more information, consult the instructions sidebar (Step 4) and 'How do I fill the calendar?' info button

Start Time

End Time

Arrival Rate

0

0

Capacity Calendar

For more information, consult the instructions sidebar (Step 4) and 'How to fill out the calendar?' info button

Start Time

End Time

Capacity

0

14

7. Then select "Next" service node tab once all populated

Simulation set-up: Confirm pathway and inputs

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Navigation Bar Introduction Overview & Glossary W1. Setup W2. Data Entry W3. Final Wizard Tables & Download Service Distribution Tool

Instructions

Step 1: Press the 'Create/Refresh tables' button to see a summary of the data entered & Issues Log.

There are 4 tables: Issues, Mean Length of Service (only appears when no issues), Network Template and Calendar template

Step 2: If there are any issues, return to the previous page and amend the data inputs.

The location of the issue is listed along with a brief description.

Step 3: Once there are no issues remaining, the option to download the templates for further use becomes available

The templates created in the wizard can be saved down and then directly used in PathSimR at a later date. Both templates are required for use in this way.

Step 4: Proceed by pressing the 'Move to Simulation Tool' button.

The inputs created in the wizard can be pulled through on the following page

Create / Refresh tables

Network Template Download Calendar Download

← Previous Move to Simulation Tool →

Issues Log

Location	Service Point	Issue
Complete	Complete	Complete

LoS Means

	Mean Length of Service
Cons	0.01
Acute	5.08
Rehab	15.00

Network Information

	Cons	Acute	Rehab	Home	serv_dist	serv_dist_param	ext_queue	int_queue	Cons_delay_dist	Acute_delay_dist	Rehab_delay_dist	Home_delay_dist	Cons_delay_params	Acute_delay_params	Rehab_delay_params	Home_delay
Cons	0	0.5	0	0.5	unif	0.0125,0.0125	99999	99999	NA	NA	NA	NA	NA	NA	NA	NA
Acute	0	0	0.8	0.2	lnorm	1.5,0.5	0	99999	NA	NA	NA	NA	NA	NA	NA	NA
Rehab	0	0	0	1	gamma	3,0.2	0	0	NA	NA	NA	unif	NA	NA	NA	0.5,1
Home	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Calendar Information

metric	node	start	end	value
ext_arr	Cons	0.00000	NA	1.00000
ext_arr	Acute	0.00000	NA	1.00000
ext_arr	Rehab	0.00000	NA	0.00000
cap	Cons	0.00000	0.12500	2.00000
cap	Cons	0.12500	7.00000	0.00000
cap	Acute	0.00000	NA	7.00000
cap	Rehab	0.00000	NA	14.00000

8. Should there be any errors (e.g. service node discharge probabilities not summing to 1) then user is notified, and not allowed to progress
9. User may also download csv templates for inputs, allowing them to bypass Wizard in future (see step 2 on page 1 above)
10. Select "Move to Simulation Tool" to progress to next step

Simulation set-up: Confirm pathway and inputs

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Navigation Bar: Introduction Overview & Glossary W1. Setup W2. Data Entry W3. Final Wizard Tables & Download Service Distribution Tool 1. Network Import & Visualisation 2. Simulation Setup & Run

Instructions
 Step 1: Upload csv templates or bring through Wizard results by selecting the checkbox
 Step 2: Press the 'Create visualisation' button to visualise the network.
 If there is an error in the template, the issues log will appear and highlight the issue.
 Optional Step: Toggle the checkboxes to see more information and refresh if appropriate
 Step 3: Once the network is created and correct, proceed to tab 2 (Simulation Setup & Run)

☒ Bring Through Wizard Results

Choose time unit
 weeks

Create / Refresh Visualisation

Understanding the Network Visualisation

☒ Display network input table
☒ Display calendar input table
☒ Display extra Service Point information (Requires refresh)

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Variable Inputs

	Cons	Acute	Rehab	Home	serv_dist	serv_dist_param	ext_queue	int_queue	Cons_delay_dist	Acute_delay_dist	Rehab_delay_dist	Home_delay_dist	Cons_delay_params	Acute_delay_params	Rehab_delay_params	Home_delay_params
Cons	0	0.5	0	0.5	unif	0.0125;0.0125	99999	99999	NA	NA	NA	NA	NA	NA	NA	NA
Acute	0	0	0.8	0.2	lnorm	1.5;0.5	0	99999	NA	NA	NA	NA	NA	NA	NA	NA
Rehab	0	0	0	1	gamma	3;0.2	0	0	NA	NA	NA	unif	NA	NA	NA	0.5;1
Home	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Calendar Inputs

metric	node	start	end	value
ext_arr	Cons	0.00	NA	1.00
ext_arr	Acute	0.00	NA	1.00
ext_arr	Rehab	0.00	NA	0.00
cap	Cons	0.00	0.12	2.00
cap	Cons	0.12	7.00	0.00
cap	Acute	0.00	NA	7.00
cap	Rehab	0.00	NA	14.00

11. Select time unit (e.g. minutes, days, weeks)
12. Select "Next" to progress to next step

Simulation set-up: Global options configuration (trial simulation)

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Navigation Bar Introduction Overview & Glossary W1. Setup W2. Data Entry W3. Final Wizard Tables & Download Service Distribution Tool 1. Network Import & Visualisation 2. Simulation Setup & Run

Instructions

Which Simulation Mode should I use?

Mode 1: Trial Simulation

Step 1: Input Simulation period below

What are the warm-up and simulation periods?

Step 2: Create checklist and ensure all values are correct

Step 3: Press the 'Run Simulation' button to produce trial results based on a small number of replications

Step 4: Check the Simulation Outputs tab to evaluate the results of the trial simulation to help estimate the warm-up period (using the warm-up period assistance and average through time tabs). Proceed to 'Full Simulation' mode if simulation period is suitable or return to 'Trial Simulation' mode, update the inputs and re-run

Mode 2: Full Simulation

Step 1: Input warm-up period below based on the output from the warm-up period assistance tab

Step 2: Input number of simulation replications below

Step 3: Refresh checklist and ensure all values are correct

Step 4: Start the simulation by pressing the 'Run Simulation' button

Step 5: Simulation Outputs and Download Outputs tabs are now available

Select Mode
Trial Simulation

Length of simulation period
200

Create / Refresh Checklist

Run Simulation

Previous

Checklist

Metric	Value
Simulation Replications	NA
Warm-up Period	0
Simulation Period	200
Total Simulation length	200
Number of Service points	3

Arrivals

Cons
LOS: 0.01
Av Cap: 1
IQC: 99999
EQC: 99999

Acute
LOS: 5.08
Av Cap: 7
IQC: 99999
EQC: 0

Rehab
LOS: 15
Av Cap: 14
IQC: 0
EQC: 0

Home

50% 80% 20% 100% 50%

13. Select "Trial Simulation" and enter "Length of simulation period"
14. Select "Run Simulation" to begin

Simulation set-up: Global options configuration (trial simulation)

Instructions

Which Simulation Mode should I use?

Mode 1: Trial Simulation

Step 1: Input Simulation period below

What are the warm-up and simulation periods?

Step 2: Create checklist and ensure all values are correct

Step 3: Press the 'Run Simulation' button to produce trial results based on a small number of replications

Step 4: Check the Simulation Outputs tab to evaluate the results of the trial simulation to help estimate the warm-up period (using the warm-up period assistance and average through time tabs). Proceed to 'Full Simulation' mode if simulation period is suitable or return to 'Trial Simulation' mode, update the inputs and re-run

Mode 2: Full Simulation

Step 1: Input warm-up period below based on the output from the warm-up period assistance tab

Step 2: Input number of simulation replications below

Step 3: Refresh checklist and ensure all values are correct

Step 4: Start the simulation by pressing the 'Run Simulation' button

Step 5: Simulation Outputs and Download Outputs tabs are now available

Select Mode

Trial Simulation

Length of simulation period

200

Create / Refresh Checklist

Run Simulation

Previous

Metric	Value
Simulation Replications	NA
Warm-up Period	0
Simulation Period	200
Total Simulation length	200
Number of Service points	3

Arrivals

Cons
LOS: 0.01
Av Cap: 1
IQC: 99999
EQC: 99999

50%

Acute
LOS: 5.08
Av Cap: 7
IQC: 99999
EQC: 0

80%

20%

50%

Rehab
LOS: 15
Av Cap: 14
IQC: 0
EQC: 0

100%

Home

Simulation Running
(Started at : 2020-04-09 12:43:56)

The simulation is now running. If there is an error, a new message box will appear with advice.

Simulation set-up: Global options configuration (trial simulation)

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Navigation Bar Introduction Overview & Glossary W1. Setup W2. Data Entry W3. Final Wizard Tables & Download Service Distribution Tool 1. Network Import & Visualisation 2. Simulation Setup & Run 3. Simulation Outputs

Instructions

Which Simulation Mode should I use?

Mode 1: Trial Simulation

Step 1: Input Simulation period below

What are the warm-up and simulation periods?

Step 2: Create checklist and ensure all values are correct

Step 3: Press the 'Run Simulation' button to produce trial results based on a small number of replications

Step 4: Check the Simulation Outputs tab to evaluate the results of the trial simulation to help estimate the warm-up period (using the warm-up period assistance and average through time tabs). Proceed to 'Full Simulation' mode if simulation period is suitable or return to 'Trial Simulation' mode, update the inputs and re-run

Mode 2: Full Simulation

Step 1: Input warm-up period below based on the output from the warm-up period assistance tab

Step 2: Input number of simulation replications below

Step 3: Refresh checklist and ensure all values are correct

Step 4: Start the simulation by pressing the 'Run Simulation' button

Step 5: Simulation Outputs and Download Outputs tabs are now available

Select Mode
Trial Simulation

Length of simulation period
200

Create / Refresh Checklist

Run Simulation

Previous Next

Checklist

Metric	Value
Simulation Replications	NA
Warm-up Period	0
Simulation Period	200
Total Simulation length	200
Number of Service points	3

Arrivals

Cons
LOS: 0.01
Av Cap: 1
IQC: 99999
EQC: 99999

Acute
LOS: 5.08
Av Cap: 7
IQC: 99999
EQC: 0

Rehab
LOS: 15
Av Cap: 14
IQC: 0
EQC: 0

Home

50% 80% 20% 100% 50%

Simulation Complete
(2020-04-09 12:45:16)

OK

Completed in 74.6 seconds**

15. Select "OK"

Simulation set-up: Global options configuration (trial simulation)

Instructions

Which Simulation Mode should I use?

Mode 1: Trial Simulation

Step 1: Input Simulation period below

What are the warm-up and simulation periods?

Step 2: Create checklist and ensure all values are correct

Step 3: Press the 'Run Simulation' button to produce trial results based on a small number of replications

Step 4: Check the Simulation Outputs tab to evaluate the results of the trial simulation to help estimate the warm-up period (using the warm-up period assistance and average through time tabs). Proceed to 'Full Simulation' mode if simulation period is suitable or return to 'Trial Simulation' mode, update the inputs and re-run

Mode 2: Full Simulation

Step 1: Input warm-up period below based on the output from the warm-up period assistance tab

Step 2: Input number of simulation replications below

Step 3: Refresh checklist and ensure all values are correct

Step 4: Start the simulation by pressing the 'Run Simulation' button

Step 5: Simulation Outputs and Download Outputs tabs are now available

Metric	Value
Simulation Replications	NA
Warm-up Period	0
Simulation Period	200
Total Simulation length	200
Number of Service points	3

Arrivals → Cons
LOS: 0.01
Av Cap: 1
IQC: 99999
EQC: 99999

50% → Acute
LOS: 5.08
Av Cap: 7
IQC: 99999
EQC: 0

80% → Rehab
LOS: 15
Av Cap: 14
IQC: 0
EQC: 0

20% → Home

50% → Home

100% → Home

****Simulation completed in 74.6 seconds****

Select Mode

Trial Simulation

Length of simulation period

200

Create / Refresh Checklist

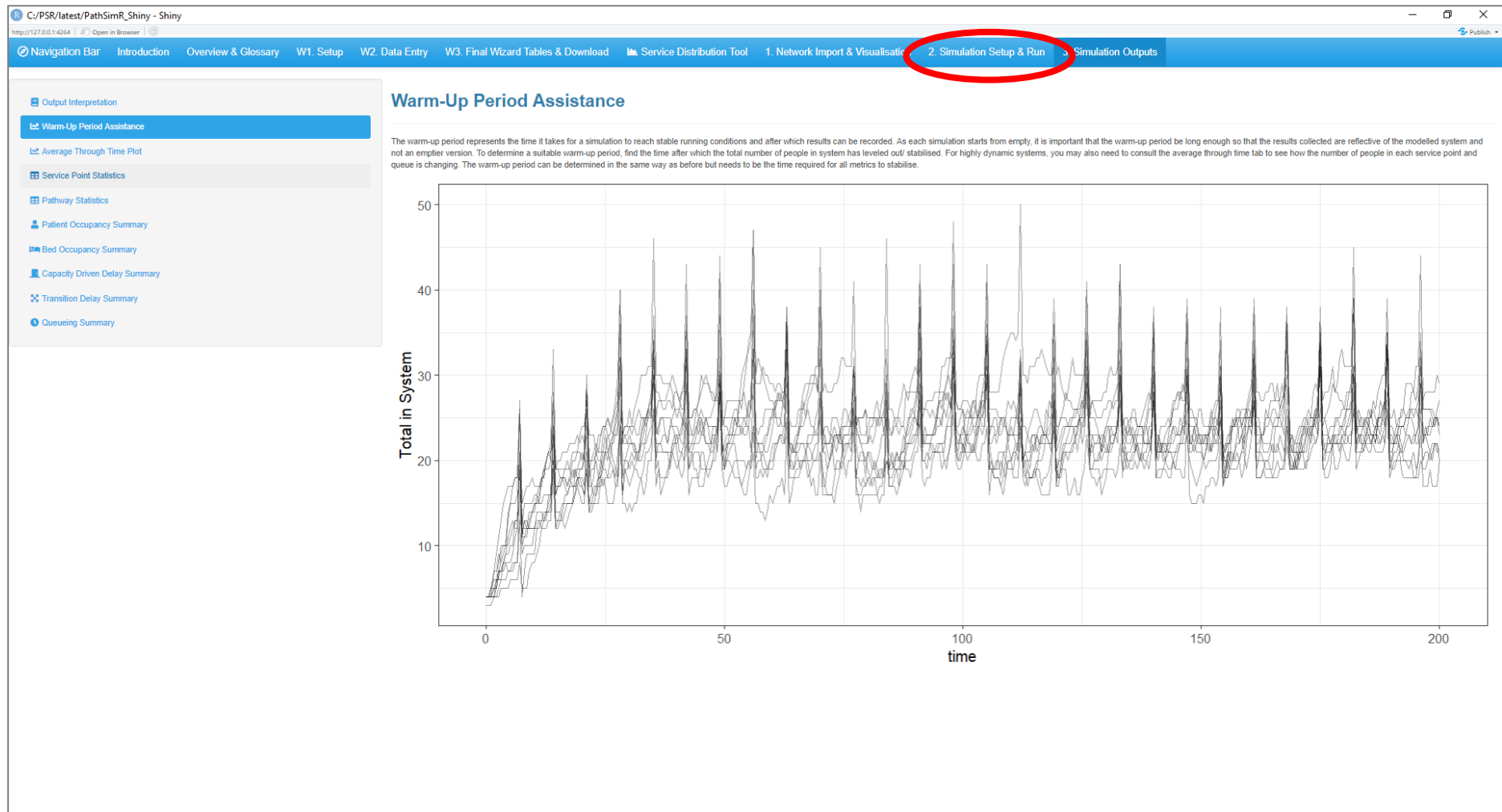
Run Simulation

Previous

Next

16. Select "Next"

Simulation set-up: Warm-up period detection



17. It is clear from visual inspection that a warm-up period of 50 days is sufficient

18. Navigate back to “Simulation Setup & Run” tab

Simulation set-up: Global options configuration (full simulation)

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Navigation Bar: Introduction Overview & Glossary W1. Setup W2. Data Entry W3. Final Wizard Tables & Download Service Distribution Tool 1. Network Import & Visualisation 2. Simulation Setup & Run 3. Simulation Outputs

Instructions

Which Simulation Mode should I use?

Mode 1: Trial Simulation

Step 1: Input Simulation period below

What are the warm-up and simulation periods?

Step 2: Create checklist and ensure all values are correct

Step 3: Press the 'Run Simulation' button to produce trial results based on a small number of replications

Step 4: Check the Simulation Outputs tab to evaluate the results of the trial simulation to help estimate the warm-up period (using the warm-up period assistance and average through time tabs). Proceed to 'Full Simulation' mode if simulation period is suitable or return to 'Trial Simulation' mode, update the inputs and re-run

Mode 2: Full Simulation

Step 1: Input warm-up period below based on the output from the warm-up period assistance tab

Step 2: Input number of simulation replications below

Step 3: Refresh checklist and ensure all values are correct

Step 4: Start the simulation by pressing the 'Run Simulation' button

Step 5: Simulation Outputs and Download Outputs tabs are now available

Select Mode: Full Simulation

Length of warm-up period: 50

Length of simulation period: 365

Number of simulation replications: 100

Create / Refresh Checklist

Run Simulation

Previous Next

Checklist

Metric	Value
Simulation Replications	NA
Warm-up Period	0
Simulation Period	200
Total Simulation length	200
Number of Service points	3

Simulation Flowchart:

```
graph LR; Arrivals --> Cons[Cons  
LOS: 0.01  
Av Cap: 1  
IQC: 99999  
EQC: 99999]; Cons -- 50% --> Acute[Acute  
LOS: 5.08  
Av Cap: 7  
IQC: 99999  
EQC: 0]; Cons -- 50% --> Home{Home}; Acute -- 80% --> Rehab[Rehab  
LOS: 15  
Av Cap: 14  
IQC: 0  
EQC: 0]; Acute -- 20% --> Home; Rehab -- 100% --> Home
```

****Simulation completed in 74.6 seconds****

19. Select "Full Simulation" and enter warm-up period (50 days), length of simulation, and number of replications
20. Select "Run Simulation" to begin

Simulation set-up: Global options configuration (full simulation)

Instructions

Which Simulation Mode should I use?

Mode 1: Trial Simulation

Step 1: Input Simulation period below

What are the warm-up and simulation periods?

Step 2: Create checklist and ensure all values are correct

Step 3: Press the 'Run Simulation' button to produce trial results based on a small number of replications

Step 4: Check the Simulation Outputs tab to evaluate the results of the trial simulation to help estimate the warm-up period (using the warm-up period assistance and average through time tabs). Proceed to 'Full Simulation' mode if simulation period is suitable or return to 'Trial Simulation' mode, update the inputs and re-run

Mode 2: Full Simulation

Step 1: Input warm-up period below based on the output from the warm-up period assistance tab

Step 2: Input number of simulation replications below

Step 3: Refresh checklist and ensure all values are correct

Step 4: Start the simulation by pressing the 'Run Simulation' button

Step 5: Simulation Outputs and Download Outputs tabs are now available

Select Mode

Full Simulation

Length of warm-up period

50

Length of simulation period

365

Number of simulation replications

100

Create / Refresh Checklist

Run Simulation

Previous

Next

Metric	Value
Simulation Replications	NA
Warm-up Period	0
Simulation Period	200
Total Simulation length	200
Number of Service points	3

Arrivals

Cons
LOS: 0.01
Av Cap: 1
IQC: 99999
EQC: 99999

50%

Acute
LOS: 5.08
Av Cap: 7
IQC: 99999
EQC: 0

80%

20%

50%

Rehab
LOS: 15
Av Cap: 14
IQC: 0
EQC: 0

100%

Home

Simulation Running
(Started at : 2020-04-09 12:56:40)

The simulation is now running. If there is an error, a new message box will appear with advice.

Simulation set-up: Global options configuration (full simulation)

C:/PSR/latest/PathSimR_Shiny - Shiny

Navigation Bar Introduction Overview & Glossary W1. Setup W2. Data Entry W3. Final Wizard Tables & Download Service Distribution Tool 1. Network Import & Visualisation 2. Simulation Setup & Run 3. Simulation Outputs 4. Download Outputs

Instructions

Which Simulation Mode should I use?

Mode 1: Trial Simulation

Step 1: Input Simulation period below

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Step 3: Press the 'Run Simulation' button to produce trial results based on a small number of replications

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Mode 2: Full Simulation

Step 1: Input warm-up period below based on the output from the warm-up period assistance tab

Step 2: Input number of simulation replications below

Step 3: Refresh checklist and ensure all values are correct

Step 4: Start the simulation by pressing the 'Run Simulation' button

Step 5: Simulation Outputs and Download Outputs tabs are now available

Select Mode

Full Simulation

Length of warm-up period

50

Length of simulation period

365

Number of simulation replications

100

Create / Refresh Checklist

Run Simulation

Previous Next

Checklist

Metric	Value
Simulation Replications	NA
Warm-up Period	0
Simulation Period	200
Total Simulation length	200
Number of Service points	3

Arrivals

Cons
LOS: 0.01
Av Cap: 1
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50%

Acute
LOS: 5.08
Av Cap: 7
IQC: 99999
EQC: 0

80%

20%

50%

Rehab
LOS: 15
Av Cap: 14
IQC: 0
EQC: 0

100%

Home

Simulation Complete
(2020-04-09 13:05:54)

OK

Completed in 540.6 seconds**

21. Select "OK"

Simulation set-up: Global options configuration (full simulation)

Instructions

Which Simulation Mode should I use?

Mode 1: Trial Simulation

Step 1: Input Simulation period below

What are the warm-up and simulation periods?

Step 2: Create checklist and ensure all values are correct

Step 3: Press the 'Run Simulation' button to produce trial results based on a small number of replications

Step 4: Check the Simulation Outputs tab to evaluate the results of the trial simulation to help estimate the warm-up period (using the warm-up period assistance and average through time tabs). Proceed to 'Full Simulation' mode if simulation period is suitable or return to 'Trial Simulation' mode, update the inputs and re-run

Mode 2: Full Simulation

Step 1: Input warm-up period below based on the output from the warm-up period assistance tab

Step 2: Input number of simulation replications below

Step 3: Refresh checklist and ensure all values are correct

Step 4: Start the simulation by pressing the 'Run Simulation' button

Step 5: Simulation Outputs and Download Outputs tabs are now available

Select Mode

Full Simulation

Length of warm-up period

50

Length of simulation period

365

Number of simulation replications

100

Create / Refresh Checklist

Run Simulation

Previous

Next

Metric	Value
Simulation Replications	NA
Warm-up Period	0
Simulation Period	200
Total Simulation length	200
Number of Service points	3

Arrivals

Cons
LOS: 0.01
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EQC: 0

80%

20%

50%

Rehab
LOS: 15
Av Cap: 14
IQC: 0
EQC: 0

100%

Home

****Simulation completed in 540.6 seconds****

22. Select "Next"

Outputs: Output inspection

The screenshot shows the PathSimR Shiny application interface. The browser address bar indicates the URL is `http://127.0.0.1:4264`. The navigation bar at the top includes links for Navigation Bar, Introduction, Overview & Glossary, W1. Setup, W2. Data Entry, W3. Final Wizard Tables & Download, Service Distribution Tool, 1. Network Import & Visualisation, 2. Simulation Setup & Run, 3. Simulation Outputs, and 4. Download Outputs. The left sidebar, titled 'Output Interpretation', lists several output categories: Warm-Up Period Assistance, Average Through Time Plot, Service Point Statistics, Pathway Statistics, Patient Occupancy Summary, Bed Occupancy Summary, Capacity Driven Delay Summary (highlighted with a red circle), Transition Delay Summary, and Queueing Summary. The main content area is titled 'Output Interpretation' and contains the following text:

The pages on the left show the key results from the simulation, a description of which can be found below. Depending on the number of replications run, the graphs and tables may take a moment to render (Click through the tabs to ensure the rendering begins). Return to the previous pages using the navigation bar above.

Warm-Up Period Assistance (Only available in Trial Simulation Mode)

The warm-up period represents the time it takes for a simulation to reach stable running conditions and after which results can be recorded. As each simulation starts from empty, it is important that the warm-up period be long enough so that the results collected are reflective of the modelled system and not an emptier version. To determine a suitable warm-up period, the Warm-Up Period Assistance tab shows the total number of people in the system through time. This metric can be used to work out how long the warm-up period needs to be.

Average Through Time Plot (Available in both Trial and Full Simulation Modes)

A summary plot showing how each of the 5 time varying parameters vary through time with mean values plotted with envelopes of 50%, 95% and 99% percentile data. This should allow the overarching trends in these metrics to be understood in a single figure and also how changes and shift in one metrics influence changes in others. Variation in the mean lines could be the result of two different factors: 1) Sample size being too small (increase # of replications) or 2) The system has inherent variation, either driven by random dynamics or the prescribed calendar schedule. This plot allows the user to quickly understand the dynamics of the system e.g. if a unit has reached capacity and stayed full, if the queue length has stabilised or if it is continuously increasing, whether the number of patients being delayed due to capacity is lower than expected values.

Service Point & Pathway Statistics (Only available in Full Simulation Mode)

These pages contains multiple tables looking at 7 key metrics of the patient experience (broken down by service node or summarised over the pathway):

1. Total time in system - Amount of time between arriving at the first node and leaving the last on a patient pathway.
2. Wait - Amount of time between arriving at a queue and starting service.
3. Time Delayed (Capacity Driven) - Amount of time experiencing a capacity driven delay.
4. Time Delayed (Transition) - Amount of time experiencing a transition delay.
5. Length of Stay - Amount of time between starting service and departing to the next service.
6. Delay to Transfer - Amount of time between finishing service and departure (i.e. end of any delays).
7. Rejection Rate - Number of external arrivals that were rejected due to full queues per time unit.

Metrics Through Time Summaries (Only available in Full Simulation Mode)

5 values are monitored throughout the simulation so their changes through time can be investigated through time:

- Patient Occupancy
- Bed Occupancy
- Capacity Driven Delay
- Transition Delay
- Queue

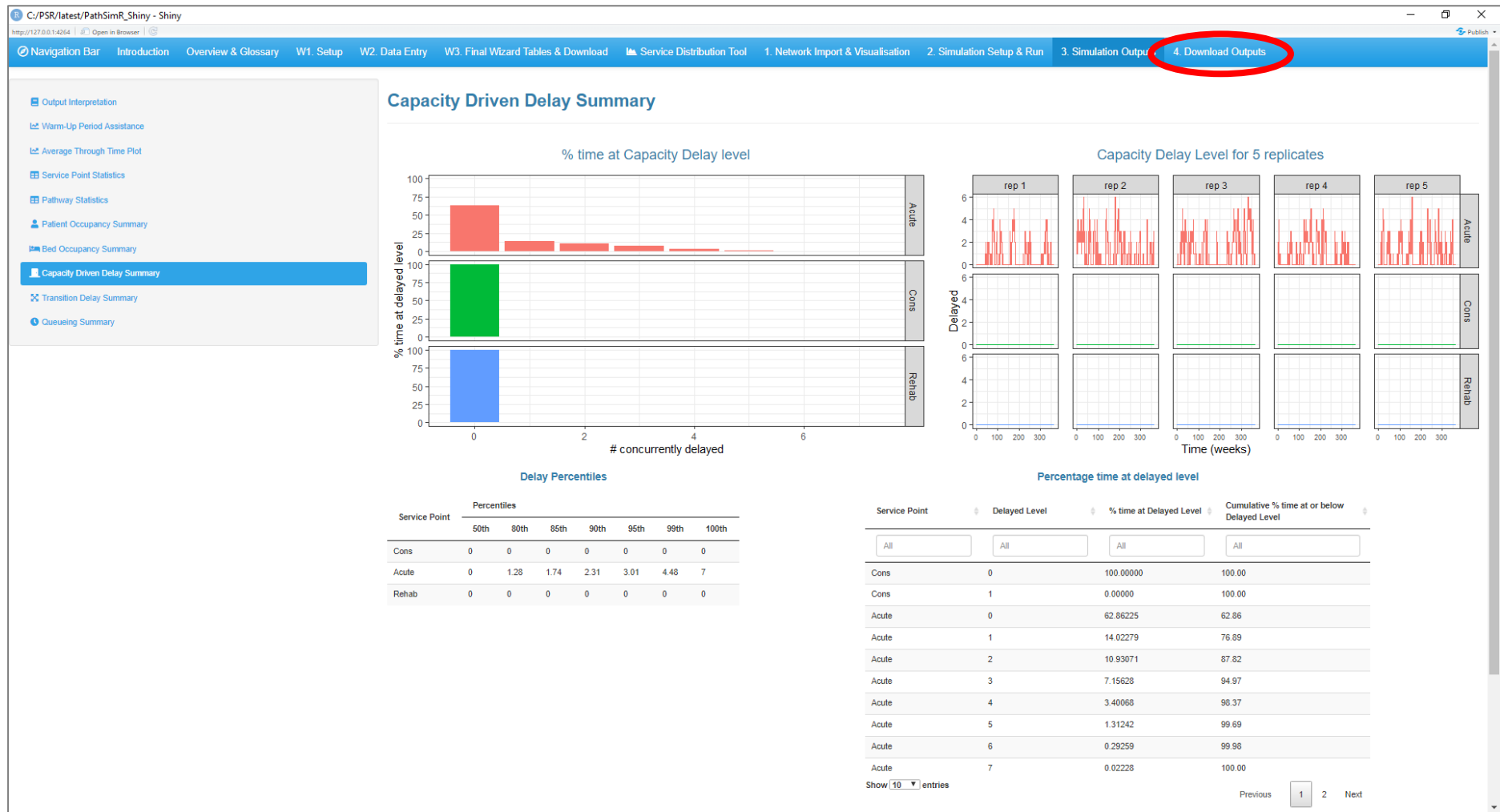
Each page on the left contains the same 5 tables/graphs:

- Top Left - Percentage time at level plot - A graph showing the amount of time each Service Point spent at level of the metric (e.g. Amount of time Service Point A had an occupancy of 5 patients). The distribution of bars informs how the metric has varied throughout the simulation, for example if the bars appear reasonably symmetric around a value then the system is showing signs of stability. On the other hand, if one bar dominates then the system is showing signs of underlying system dynamics e.g. constantly at full capacity or following a strict calendar.
- Top Right - Metric through time plot - A graph showing the metric in question through time, split by Service Point and replicate (max 5 random replications). These represent actual simulation runs that are then combined (across all replications) to form the summary outputs. These should not be used to infer specific results, but are intended to be illustrative of the variation found within simulation.
- Bottom Left - Percentiles summary table - A table outlining the values associated with different percentile levels e.g. 90% of the time, the Service Point has an occupancy of 5 or less
- Bottom Right - Percentage time at level table - Raw data used to construct 'Percentage time at level' plot. Can be filtered and sorted by any column and also contains a cumulative sum which can be used to calculate percentiles.
- Bottom Centre - Average Over Simulation - Average value for the metric in question when using the data from the entire simulation.

All plots show a maximum of 5 replicates and have the same legends and colour coding for Service Points

23. After reading, navigate to any of the output display windows

Outputs: Output inspection



24. User may also download outputs, through selecting the “Download Outputs” tab

Outputs: Download data, tables, reports

The screenshot displays the PathSimR Shiny application interface. The browser address bar shows the URL `http://127.0.0.1:4264`. The navigation bar at the top includes the following tabs: Navigation Bar, Introduction, Overview & Glossary, W1. Setup, W2. Data Entry, W3. Final Wizard Tables & Download, Service Distribution Tool, 1. Network Import & Visualisation, 2. Simulation Setup & Run, 3. Simulation Outputs, and 4. Download Outputs. The main content area is titled "Details" and contains a description of the output files. It is divided into three sections: "Data Tables", "Simulation Plots", and "Automated Report". Each section has a corresponding "Download" button, which is circled in red in the image. The "Data Tables" section describes an Excel workbook containing metrics at both replicate and simulation levels. The "Simulation Plots" section describes a single PDF file containing all plots. The "Automated Report" section describes an automated word document containing figures and data tables.

Details
A description of each of the files can be found in the [Output Library Document](#).

Data Tables
PathSimR produces an excel workbook which contains all metrics produced within the tool at both replicate level and simulation level. Each tab is clearly labelled, with the first half of the tabs relating to patient level metrics (e.g. wait times, Length of Stays etc) and the second half containing information regarding the through time metrics (e.g. Occupancy, Queues etc). The final tab contains all the data required to recreate the 'Average Through Time' plot.

[Download Tables](#)

Simulation Plots
All plots created in PathSimR are saved down in a single PDF that can then be manipulated as needed. All the figures shown in PathSimR can be recreated from the data provided in the Data Tables (download button above).

[Download Plots](#)

Automated Report
An automated word document is produced which includes a collection of figures and data tables from the simulation. These have been sorted into sections and a brief description of the metrics and figures is included. This report is designed to speed up the summary process and provides easy manipulation for the user.

[Download Report](#)

25. User can download the raw output data tables, plots, or MS Word report compiled automatically via R Markdown (this “knits” together the range of outputs as displayed through the visual GUI inspection, i.e. on previous page)

OPTIONAL – Pathway wizard: Node length of stay distribution fitting tool

Instructions

Which option do I need?

Option 1: Model fits to user data

Distribution & Parameters based on User data

Step 1: Select the 'Model fits to user data' tab

Step 2: Upload a single column csv that only includes LoS data - *No Header required*

Step 3: Press the 'Run Distribution Fit Tool' button

Step 4: Inspect the histogram plot and model fit curves, the details of which are displayed in the Ranked Model Table

Step 5: Copy the top ranking model information from the table into the data entry page (i.e. Select the Distribution from the dropdown and enter the parameters listed)

Option 2: Scale data by mean

Distribution & Parameters based on scaled data

Step 1: Select the 'Scale data by mean' tab

Step 2: Select a Service Point from the drop-down library that matches the Service Point being modelled

Step 3: Enter the mean LoS associated with the modelled Service Point

Step 4: Press the 'Run/Refresh Scaling Tool' Button

Step 5: Copy the model information from the table into the data entry page (i.e. Select the Distribution from the dropdown and enter the parameters listed)

Optional Step: Inspect the distribution plot to see a visual version of the Length of Service Distribution

Model fits to user data

Scale data by mean

Upload csv

Browse... los.csv

Upload complete

Run Distribution Fit Tool

Histogram and theoretical densities

Uploaded Data

Metric	Value
Mean	8.34
Standard Deviation	4.49
Inter-quartile range	4.91
90th Percentile	13.64

Ranked Model Table

The distributions below have been ranked in terms of best fit. The Rank 1 Distribution was found to fit closest to the provided data. Simply use the top ranking model and enter the details in the data entry tab. If the exponential distribution is the highest ranking, then there is only one parameter to copy across (rate), else there will be two. These are named in the table and should be copied to the relevant box on the data entry page. If the histogram appears completely flat, it may be that the uniform distribution is the best fitting model. In this case, ignore the rankings and take the parameters from that row. In the case where multiple distributions are found to have the same fit, some model fit lines may be obscured on the plot (i.e. plotting over each other). These models will still be ranked but should be treated as ranking equally.

Rank	Distribution	Parameter 1 Name	Parameter 1 Value	Parameter 2 Name	Parameter 2 Value
1	log-normal	meanlog	1.99	sdlog	0.51
2	gamma	shape	4.08	rate	0.49
3	weibull	shape	1.98	scale	9.45
4	exponential	rate	0.12	NA	NA
5	uniform	min	1.77	max	39.30

- If the distribution of length of stay and associated parameters are not known then user can upload a list of known lengths of stay and the tool will fit distributions to this, from which the user may select one
- Resulting parameters can thereafter be entered into the Wizard calibration tabs for the relevant service node

OPTIONAL – Pathway wizard: Node length of stay distribution fitting tool

Instructions

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Step 2: Select a Service Point from the drop-down library that matches the Service Point being modelled

Step 3: Enter the mean LoS associated with the modelled Service Point

Step 4: Press the 'Run/Refresh Scaling Tool' Button

Step 5: Copy the model information from the table into the data entry page (i.e. Select the Distribution from the dropdown and enter the parameters listed)

Optional Step: Inspect the distribution plot to see a visual version of the Length of Service Distribution

Model fits to user data

Scale data by mean

Distributions and Parameters have been found for a variety of PODs/ Service Points, which are listed in the Service Point Library. These were based on model fits to BNSSG data in order to match the shape of the Service time distribution. The data is rescaled based on the Average Service value entered to create the required distribution.

Service Point Library

Average Length of Service (Mean)

Cardiology - Non_Elective

5

Run/Refresh Scaling Tool

Names	Distribution	Parameter 1 Name	Parameter 1 Value	Parameter 2 Name	Parameter 2 Value
Cardiology - Non_Elective	log-normal	meanlog	0.88625	sdlog	1.2027

- Otherwise the user may select from a drop-down list of pre-populated distributions (based on fitting to England-wide data) and provide the mean to scale accordingly
- Resulting parameters can thereafter be entered into the Wizard calibration tabs for the relevant service node

