# Demand and capacity models

# High Complexity Model user guidance

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# Contents

# 1. What is the demand and capacity High Complexity Model?

The demand and capacity High Complexity Model (HCM) is an Excel tool that will assess the demand and capacity requirements for services with complex pathways.

The HCM is designed to model services where patients can be expected to move between different levels of intensity of treatment, with patients stepping up to a more intense level of treatment or stepping down to a lower level of treatment.

The HCM is suitable for any service that provides treatment and care for patients with a long-term condition, where the patient will receive different modes of treatment in different frequencies based on their particular circumstances and where several groups of patients are seen/treated at any time. Specifically, the HCM is applicable for services such as:

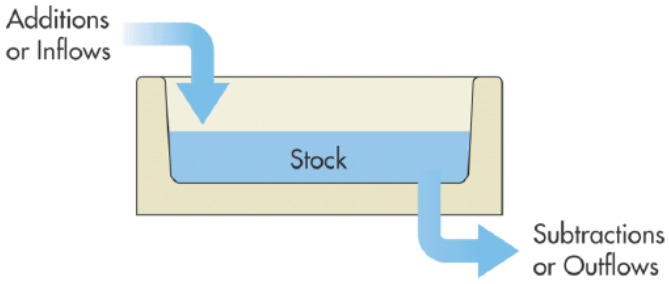
- mental health services
- community services
- chronic condition services

# 2. Methodology

The simple methodology for modelling demand and capacity used by the core model is not applicable to services that experience internal patient transfers between level of intensity of service.

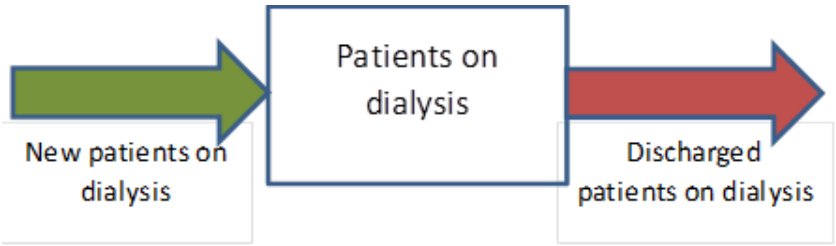
A more complex methodology must be used – the 'stock and flow' model.

Consider the bathtub shown below – water flows in at a certain rate (the inflow), and exits at another rate (the outflow):



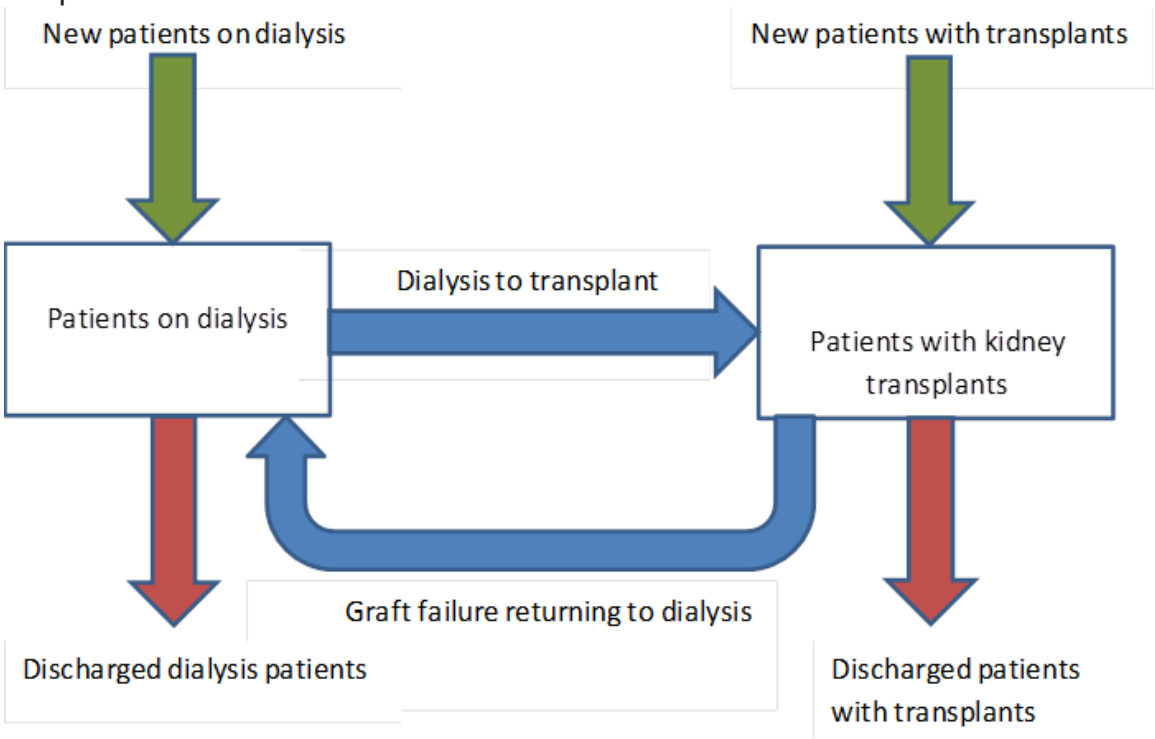

- when the inflow exceeds the outflow, the stock rises
- when the outflow exceeds the inflow, the stock falls
- the peaks and troughs of the stock occur when the net flow crosses zero
- the stock should not show any discontinuous jumps (instant change from full to empty) – it is a continuous process.

We can apply this analogy to any healthcare service – we can consider our 'stocks' to be the patient caseloads, and the inflows and outflows are patients moving in and out of these caseloads. A practical example involving dialysis is shown below.




This flow diagram shows new dialysis patients being referred into the service, which adds to the patient caseload. Patients may stay on the caseload for as long as clinically appropriate and are then discharged.

We will now add an extra level of treatment – patients who undergo a kidney transplant:




There are now several different possible pathways for patients:

- patients may be referred into the service as either dialysis or transplant patients
- patients on dialysis may be discharged, or become transplant patients
- transplant patients may return to dialysis or be discharged from the service.

To be able to predict the expected number of patients on dialysis and patients with kidney transplants in the next 52 weeks, we need to understand the flow rates for all the arrows in the previous graph. To measure this, we will use:

- the historic number of patients on the caseloads (stocks)
- the number of patients transferred between the two caseloads (blue arrows)
- the number of discharged patients from either caseload (red arrows).

We will estimate the rates using the historic data. For instance; if the number of 'patients on dialysis' at the end of week one is 100, and during the next week, three patients are transferred to 'patients with kidney transplants', the dialysis to transplant rate for that week is 3/100 = 3% per week.

This calculation will be iterated for all the blue and red arrows on a weekly basis to calculate seasonal and yearly rates as well.

External additions to the caseload (green arrows) do not depend on caseload flows – they can be considered external variables and can be analysed independently using a statistical process control (SPC) chart.

# 3. How to use this guide

This guide is a technical guide to the HCM. We assume that you already have some familiarity with basic concepts of demand and capacity management. This includes as a minimum:

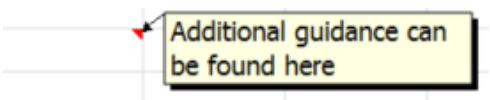
- An understanding the role of variation, and how to account for it when managing capacity (egg standard deviation, percentiles, SPC charts)
- An appreciation of the different levels of intensity/groups of patients
- An understanding of the methodology used in this model
- An understanding of the differentiation of internal transfers and external additions

As well as familiarity with the concepts of demand and capacity management, to effectively use this guide you will need knowledge of:

- Advanced excel functions, including 'index', 'match', 'offset', 'sumif(s)', 'countif(s)', 'averageif(s)', named ranges, data validation, objects (such as form controls)
- VBA programming

Guidance is also available within the model, and can be accessed in one of two ways:

- If you see the following icon  , you can click on it to bring up an information window. Click on the icon again to hide it.
- If you see a cell with a small red triangle in the upper right corner, hovering your mouse cursor over the cell will make an information window appear.



# 4. Technical Guidance Structure

This technical guidance is structured in the following way:

- Standard Model Configuration
- Model Sheet Functionality
    - GeneralBacking
    - Notes
    - Setup
    - List
    - Demand – External Transfers
    - Demand – Internal Transfers
    - Data Validation Backing (Hide)
    - Data Validation
    - Service
    - Caseload SPC Chart
    - Caseload SPC Chart Backing
    - External Additions SPC Chart
    - Ext. Add. SPC Chart Backing
    - Flow Rate (Hide)
    - Modified Flow Rate (Hide)

    - Capacity
    - Critical Resources
    - Capacity Setup
    - Critical Resources (Hide)
    - Capacity Calculation (Hide)
    - Capacity Tables (Hide)
    - Capacity Summary
    - Parameters
    - Parameters Backing
    - Demand Modelling – Control
    - Demand Modelling – Results
    - Results
    - Results Backing (Hide)
    - Aggregation Module (Hide)
- Model Macros
- Model Named Ranges
- Model Protection

# 5. Standard Model Configuration

The standard High Complexity Model is configured in the following way:

| **Visible Sheets** | **Hidden Sheets** |
|---|---|
| Version Control | GeneralBacking |
| Notes | List |
| Setup | Data Validation Backing (Hide) |
| Demand – External Transfers | Caseload SPC Chart Backing |
| Demand – Internal Transfers | Ext. Add. SPC Chart Backing |
| Data Validation | Flow Rate (Hide) |
| Service | Modified Flow Rate (Hide) |
| Caseload SPC Chart | Critical Resources |
| External Additions SPC Chart | Capacity Setup |
| Capacity | Critical Resources (Hide) |
| Capacity Summary | Capacity Calculation (Hide) |
| Parameters | Parameters Backing |
| Results | Demand Modelling – Control |
| | Demand Modelling – Results |
| | Results Backing (Hide) |
| | Aggregation Module (Hide) |

**Unlocked Sheets/Cells**

Visible sheets are locked to allow user input only in specified ranges, and hidden sheets are unlocked to enable full functionality. To unlock worksheets, use the password “demandcapacity”, without quotation marks.

# 6. Model Sheet Functionality

## a. GeneralBacking

### General Principles

The GeneralBacking worksheet is used to store general variables that are used throughout the model. These lists are often used for data validation cells throughout the model, but also include user entered values that need to be used throughout the workbook.

### Worksheet Structure

The tables in the GeneralBacking worksheet are as follows:

| Name | Description |
|---|---|
| Setup – Patient Groups | Controls the data validation for 'Number of intensity levels / patient groups' in the Setup worksheet. These values are locked at 2 to 5 |
| Setup – Intensity Levels | Defined by the user via the 'Name / Description' table in the Setup worksheet, these values are used throughout the model to name the patient groups in table headings etc. |
| Service – Modes of Treatment | Controls the data validation on the Service worksheet for the 'How many services / modes of treatment are used…' selection. These values are locked between 1 and 5. |
| Service – Units | Controls the data validation on the Service worksheet for the 'What are the units used per type of contact?' selection. These values are locked as Minutes, Contacts or Other. |
| Service – Group Sessions | Controls the data validation on the Service worksheet for the 'Group Session?' selections in the service table. |

| | |
|---|---|
| Service – Contact Frequency | Controls the data validation on the Service worksheet for the 'Contact Frequency' selection in the service table. These are pre-configured with some standard measurements, however this selection can be expanded. To calculate the numerical value of a frequency, divide the number of appointments per year by 52. |
| Intensity Levels Inc. Totals | Controls the data validation on a number of worksheets where a selection between the total service or displaying specific intensity levels is made. This includes the two SPC chart worksheets, as well as the Results worksheet. |
| SPC Chart – Units | Controls the data validation on the Caseload SPC Chart worksheet to define the units that are used in the charts. The first option is the selection made in the Service worksheet, and the second selection is always set to patients. |
| SPC Chart – Remaining Wks Use Season | Controls the data validation for the 'Remaining Wks Use Season' selection in the Caseload SPC Chart worksheet. These are set as 1 to 4. |
| SPC Chart – Seasonal Selection | Controls the data validation for the 'Display Type' selection in the Caseload SPC Chart worksheet. These values are defined as 'Total', 'Baseline' and 'Seasonal'. |
| SPC Chart – Display Units | Controls the data validation for the 'Display Units' selection in the Caseload SPC Chart worksheet. These values are defined as 'Patients' and the service unit selected in the Service worksheet. |
| Results Charts – Graph Type | Controls the data validation for the 'Show Data For:' selection in the Results worksheet. These values are defined as 'Patient Caseload', 'Estimated Demand – Non Group Session', 'Estimated Demand – Group Session'. |
| Results Charts – Period | Controls the data validation for the 'View' selection in the Results worksheet. These values are defined as 'All data' and 'Predicted data'. |

| | |
|---|---|
| Capacity – Selection | Controls the data validation for elements of the Capacity sections of the model that require assigning. This includes assigning clinics to specific Intensity Levels in the Capacity worksheet and assigning Ad-Hoc clinics to specific weeks in the Capacity Summary worksheet. |
| Capacity – Core Clinic Lookup for Graph | Controls the data validation for the 'Display Core Capacity' selections in the Capacity Summary worksheet. The first two options are Total and None, and following those the clinics are taken from the entered data on the Capacity worksheet in the Core table. |
| Capacity – Adhoc Clinic Lookup | Controls the data validation for the 'Display Ad Hoc Capacity' selections in the Capacity Summary worksheet. As with the core selection, the first two options are set as Total and None, and then clinics are taken from the Capacity worksheet Ad Hoc table. |
| Parameters – Set Parameters By | Controls the data validation for the 'Set Parameters By:' selection in the Parameters worksheet. The values are set to 'Total Service' or 'Level of Intensity'. |
| Parameters – Enter Parameters By | Controls the data validation for the 'Enter Values By:' selection in the Parameters worksheet. The values are set to '%' or 'Volume'. |
| Parameters – Units | Controls the data validation for the 'Units:' selection in the Parameters worksheet. The values are set to 'Contacts' and 'Minutes'. |
| Required/Available Capacity | Controls the data validation for the 'Show By: Breakdown:' selection in the Results worksheet. The values are set to 'By Time' and 'Overall'. |
| Required/Available Capacity – Type | Controls the data validation for the 'Show By: Show Data For:' selection in the Results worksheet. The values are set to 'Req Capacity – Non Group Sessions', 'Req Capacity – Group Sessions', 'Req Capacity – Total'. |

| | |
|---|---|
| Results – Lower Percentile | Controls the data validation for the 'Set Lower Percentile' selection in the Results worksheet. The second column is also used as a lookup for the selected value within the Results Backing worksheet, to calculate the percentile value to be used. These are set to the 65$^{th}$, 70$^{th}$, 75$^{th}$ and 80$^{th}$ percentile, but could be edited by a user to fit their service. |
| List for Flow Rate week table | Simple list used by the drop-down object in the Parameters worksheet for changing the week displayed in the weekly flow rate table. |
| List for Flow Rate monthly | Simple list used by the drop-down object in the Parameters worksheet for changing the month displayed in the monthly flow rate table. |
| List for Flow Rate seasonal | Simple list used by the drop-down object in the Parameters worksheet for changing the season displayed in the seasonal flow rate table. |

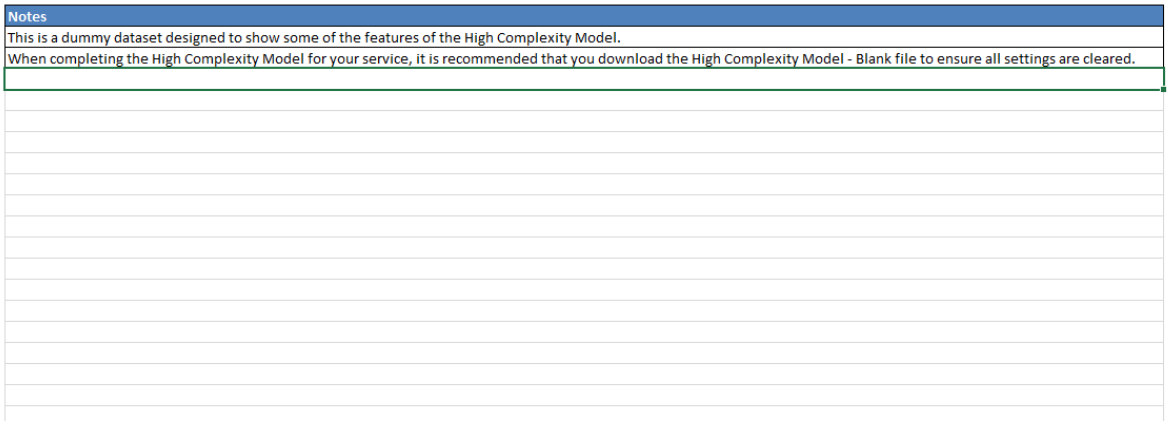
## Related Worksheets

The GeneralBacking worksheet feeds data validation to most other worksheets in the model and will be referenced throughout this guidance.

# b. Notes

## General Principles

The Notes section is a basic entry sheet for the user to enter assumptions and notes whilst completing the model. There are 160 lines available, and conditional formatting is used to highlight rows that have had information entered in to them.



| Notes |
| --- |
| This is a dummy dataset designed to show some of the features of the High Complexity Model. |
| When completing the High Complexity Model for your service, it is recommended that you download the High Complexity Model - Blank file to ensure all settings are cleared. |
| |

## Related Worksheets

The Notes worksheet does not interact on any of the other worksheets within the model.

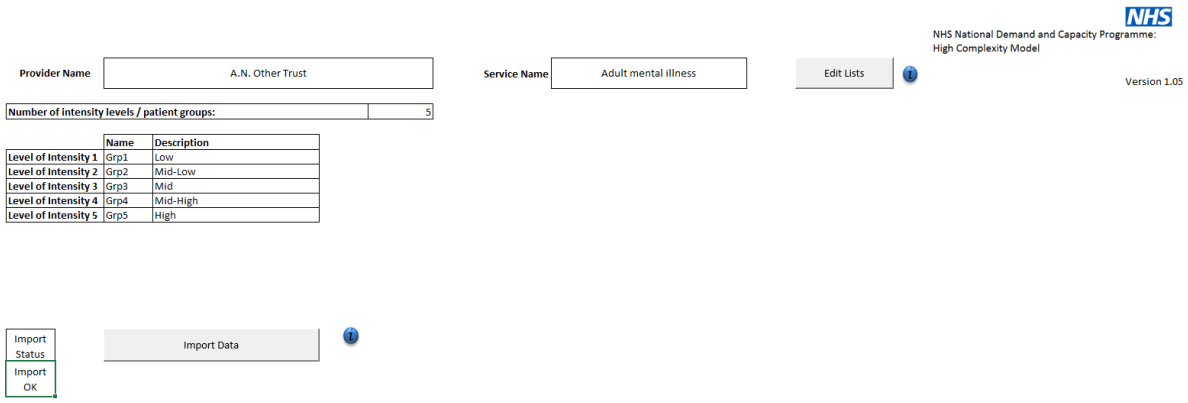
# c. Setup

## General Principles

The Setup worksheet is used to configure the functionality of the model. The Number of Intensity Levels / Patient Groups selection in the Setup worksheet carries through to the entire model, and changing the selection triggers a worksheet_change macro. Full details on the worksheet_change macro functionality can be found in Appendix A.

The Setup worksheet also includes the Import Data functionality, which allows the transfer of data from older versions of the High Complexity Model in to the current version. It runs the 'Import' macro, further details of which can be found in Appendix A.

The Edit List button triggers the customise_list macro, and unhides the List worksheet. The List worksheet functionality is described below, and the information on the macro can be found in Appendix A.




## Related Worksheets

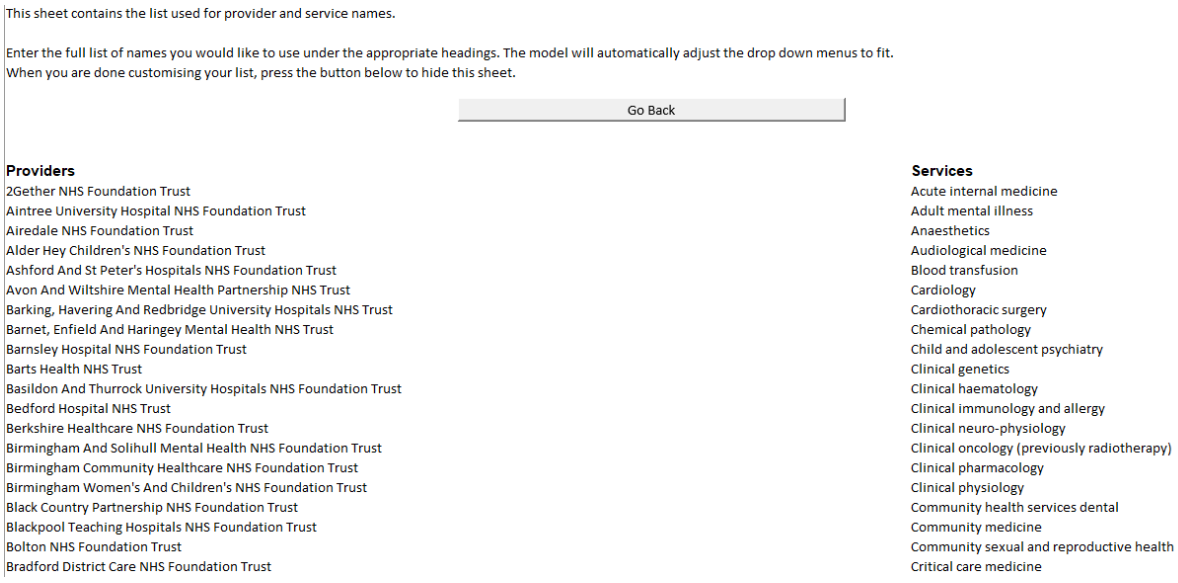
The Setup worksheet impacts on every other worksheet in the model as it defines the number of intensity levels/patient groups that the model will look at. The full changes made can be found by reviewing the worksheet_change macro for the worksheet.

# d. List

## General Principles

The List worksheet is unhidden when the Edit Lists button is clicked on the Setup worksheet. It is used to edit the data validation drop down lists on the Setup worksheet.

The Go Back button triggers the list_set macro and re-hides the List worksheet.



This sheet contains the list used for provider and service names.

Enter the full list of names you would like to use under the appropriate headings. The model will automatically adjust the drop down menus to fit.
When you are done customising your list, press the button below to hide this sheet.

Go Back

| Providers | Services |
|---|---|
| 2Gether NHS Foundation Trust | Acute internal medicine |
| Aintree University Hospital NHS Foundation Trust | Adult mental illness |
| Airedale NHS Foundation Trust | Anaesthetics |
| Alder Hey Children's NHS Foundation Trust | Audiological medicine |
| Ashford And St Peter's Hospitals NHS Foundation Trust | Blood transfusion |
| Avon And Wiltshire Mental Health Partnership NHS Trust | Cardiology |
| Barking, Havering And Redbridge University Hospitals NHS Trust | Cardiothoracic surgery |
| Barnet, Enfield And Haringey Mental Health NHS Trust | Chemical pathology |
| Barnsley Hospital NHS Foundation Trust | Child and adolescent psychiatry |
| Barts Health NHS Trust | Clinical genetics |
| Basildon And Thurrock University Hospitals NHS Foundation Trust | Clinical haematology |
| Bedford Hospital NHS Trust | Clinical immunology and allergy |
| Berkshire Healthcare NHS Foundation Trust | Clinical neuro-physiology |
| Birmingham And Solihull Mental Health NHS Foundation Trust | Clinical oncology (previously radiotherapy) |
| Birmingham Community Healthcare NHS Foundation Trust | Clinical pharmacology |
| Birmingham Women's And Children's NHS Foundation Trust | Clinical physiology |
| Black Country Partnership NHS Foundation Trust | Community health services dental |
| Blackpool Teaching Hospitals NHS Foundation Trust | Community medicine |
| Bolton NHS Foundation Trust | Community sexual and reproductive health |
| Bradford District Care NHS Foundation Trust | Critical care medicine |

## Related Worksheets

The List worksheet will change the data validation selection in the GeneralBacking worksheet, in turn updating the list selection available in the Setup worksheet.

# e. Demand – External Transfers

## General Principles

The Demand – External Transfers worksheet is a data entry sheet for Patient Caseloads, External Additions and External Discharges. If available, a week starting date can be entered, to assign the data to a date. The initial date is copied to the first row, and the week, year and month will update to match.

The available data entry area is based on the number of intensity levels / patient groups as defined in the Setup worksheet. At minimum of 52 data rows are required, and the model can accept a maximum 156 rows. There is a control column to ensure formatting is entered for at least 52 weeks. The data entered in this sheet is used by the model to drive the predictions for the patient caseload for the next 52 weeks.

The sheet counts the number of rows of data that have been entered, and the maximum number is the named range DEM_Max_Rows, which is used in a variety of calculations throughout the model.

Please enter your demand information using this tab and the following tab (Demand - Internal Transfers).
Set a start date below to enter demand for specific weeks. Alternatively, a reference week can be used by leaving the cell blank. You must enter at least 52 weeks of data.

Week Starting:

| | | | | Patients on caseload | | | | | External Additions | | | | | External Discharges | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Month | Week | Date | Grp1 | Grp2 | Grp3 | Grp4 | Grp5 | Grp1 | Grp2 | Grp3 | Grp4 | Grp5 | Grp1 | Grp2 | Grp3 | Grp4 | Grp5 |
| 1 | 1 | 1 | | 834 | 572 | 260 | 294 | 802 | 2 | 0 | 0 | 0 | 16 | 2 | 0 | 2 | 0 | 4 |
| | | 2 | | 848 | 582 | 312 | 306 | 718 | 2 | 0 | 0 | 0 | 6 | 0 | 0 | 2 | 2 | 0 |
| | | 3 | | 854 | 604 | 250 | 242 | 832 | 6 | 2 | 0 | 0 | 18 | 4 | 2 | 0 | 0 | 4 |
| | | 4 | | 866 | 594 | 220 | 232 | 872 | 0 | 2 | 0 | 0 | 18 | 2 | 8 | 2 | 2 | 4 |
| | 2 | 5 | | 844 | 580 | 158 | 272 | 948 | 0 | 2 | 0 | 0 | 22 | 2 | 2 | 0 | 2 | 0 |
| | | 6 | | 822 | 574 | 152 | 298 | 942 | 0 | 0 | 0 | 0 | 18 | 8 | 0 | 2 | 2 | 20 |
| | | 7 | | 800 | 522 | 204 | 324 | 936 | 0 | 0 | 0 | 0 | 26 | 8 | 10 | 2 | 0 | 8 |
| | | 8 | | 806 | 516 | 228 | 256 | 998 | 4 | 4 | 0 | 0 | 26 | 8 | 4 | 0 | 0 | 4 |
| | 3 | 9 | | 830 | 550 | 252 | 298 | 868 | 4 | 2 | 0 | 0 | 12 | 6 | 10 | 2 | 2 | 4 |
| | | 10 | | 816 | 572 | 246 | 296 | 872 | 2 | 2 | 0 | 0 | 14 | 2 | 6 | 2 | 0 | 4 |
| | | 11 | | 816 | 534 | 256 | 188 | 984 | 2 | 2 | 0 | 0 | 12 | 12 | 16 | 4 | 0 | 8 |
| | | 12 | | 808 | 536 | 184 | 272 | 980 | 4 | 0 | 0 | 2 | 18 | 6 | 6 | 0 | 2 | 8 |
| | | 13 | | 786 | 542 | 190 | 312 | 944 | 0 | 2 | 0 | 0 | 14 | 12 | 8 | 0 | 0 | 2 |
| | 4 | 14 | | 762 | 510 | 232 | 288 | 984 | 0 | 4 | 0 | 0 | 26 | 10 | 2 | 4 | 0 | 12 |
| | | 15 | | 760 | 520 | 232 | 276 | 1006 | 0 | 2 | 0 | 0 | 22 | 2 | 2 | 0 | 0 | 2 |
| | | 16 | | 762 | 508 | 222 | 268 | 1036 | 10 | 2 | 0 | 4 | 16 | 8 | 6 | 2 | 4 | 10 |
| | | 17 | | 780 | 500 | 230 | 260 | 1014 | 4 | 2 | 0 | 0 | 14 | 10 | 6 | 2 | 4 | 10 |

## Related Worksheets

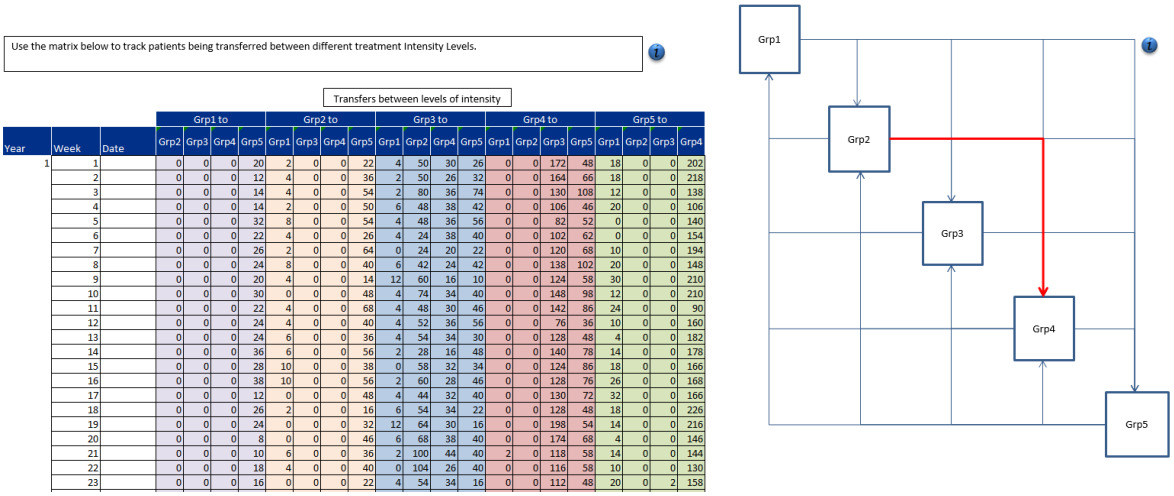
The data entered in to the Demand – External Transfers worksheet is used for caseload size validation (through the MAPE group of worksheets) and the external transfer information is used during the predictive aspects of the model, in particular the Flow Rate (Hide) worksheet.

# f. Demand – Internal Transfers

## General Principles

The Demand – Internal Transfers sheet is a data entry sheet for tracking patient movements between different levels of intensity. The number of data rows entered should match the number of data rows for the patient caseload information entered on the Demand – External Transfers tab. The data entered in this sheet is used to drive the predictions from the model. Conditional formatting rules identify the number of rows of data that should be entered to match the number of weeks of patient caseload data that was entered in the Demand – External Transfers worksheet.

Mousing over the table headings will start the function MyMouseOverEvent to change the style of the arrows on the patient flow diagram on the right. Further information on the MyMouseOverEvent workings can be found in Appendix A.



Use the matrix below to track patients being transferred between different treatment Intensity Levels.

Transfers between levels of intensity

| | | | Grp1 to | | | | Grp2 to | | | | Grp3 to | | | | Grp4 to | | | | Grp5 to | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Week | Date | Grp2 | Grp3 | Grp4 | Grp5 | Grp1 | Grp3 | Grp4 | Grp5 | Grp1 | Grp2 | Grp4 | Grp5 | Grp1 | Grp2 | Grp3 | Grp5 | Grp1 | Grp2 | Grp3 | Grp4 |
| 1 | 1 | | 0 | 0 | 0 | 20 | 2 | 0 | 0 | 22 | 4 | 50 | 30 | 26 | 0 | 0 | 172 | 48 | 18 | 0 | 0 | 202 |
| | 2 | | 0 | 0 | 0 | 12 | 4 | 0 | 0 | 36 | 2 | 50 | 26 | 32 | 0 | 0 | 164 | 66 | 18 | 0 | 0 | 218 |
| | 3 | | 0 | 0 | 0 | 14 | 4 | 0 | 0 | 54 | 2 | 80 | 36 | 74 | 0 | 0 | 130 | 108 | 12 | 0 | 0 | 138 |
| | 4 | | 0 | 0 | 0 | 14 | 2 | 0 | 0 | 50 | 6 | 48 | 38 | 42 | 0 | 0 | 106 | 46 | 20 | 0 | 0 | 106 |
| | 5 | | 0 | 0 | 0 | 32 | 8 | 0 | 0 | 54 | 4 | 48 | 36 | 56 | 0 | 0 | 82 | 52 | 0 | 0 | 0 | 140 |
| | 6 | | 0 | 0 | 0 | 22 | 4 | 0 | 0 | 26 | 4 | 24 | 38 | 40 | 0 | 0 | 102 | 62 | 0 | 0 | 0 | 154 |
| | 7 | | 0 | 0 | 0 | 26 | 2 | 0 | 0 | 64 | 0 | 24 | 20 | 22 | 0 | 0 | 120 | 68 | 10 | 0 | 0 | 194 |
| | 8 | | 0 | 0 | 0 | 24 | 8 | 0 | 0 | 40 | 6 | 42 | 24 | 42 | 0 | 0 | 138 | 102 | 20 | 0 | 0 | 148 |
| | 9 | | 0 | 0 | 0 | 20 | 4 | 0 | 0 | 14 | 12 | 60 | 16 | 10 | 0 | 0 | 124 | 58 | 30 | 0 | 0 | 210 |
| | 10 | | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 48 | 4 | 74 | 34 | 40 | 0 | 0 | 148 | 98 | 12 | 0 | 0 | 210 |
| | 11 | | 0 | 0 | 0 | 22 | 4 | 0 | 0 | 68 | 4 | 48 | 30 | 46 | 0 | 0 | 142 | 86 | 24 | 0 | 0 | 90 |
| | 12 | | 0 | 0 | 0 | 24 | 4 | 0 | 0 | 40 | 4 | 52 | 36 | 56 | 0 | 0 | 76 | 36 | 10 | 0 | 0 | 160 |
| | 13 | | 0 | 0 | 0 | 24 | 6 | 0 | 0 | 36 | 4 | 54 | 34 | 30 | 0 | 0 | 128 | 48 | 4 | 0 | 0 | 182 |
| | 14 | | 0 | 0 | 0 | 36 | 6 | 0 | 0 | 56 | 2 | 28 | 16 | 48 | 0 | 0 | 140 | 78 | 14 | 0 | 0 | 178 |
| | 15 | | 0 | 0 | 0 | 28 | 10 | 0 | 0 | 38 | 0 | 58 | 32 | 34 | 0 | 0 | 124 | 86 | 18 | 0 | 0 | 166 |
| | 16 | | 0 | 0 | 0 | 38 | 10 | 0 | 0 | 56 | 2 | 60 | 28 | 46 | 0 | 0 | 128 | 76 | 26 | 0 | 0 | 168 |
| | 17 | | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 48 | 4 | 44 | 32 | 40 | 0 | 0 | 130 | 72 | 32 | 0 | 0 | 166 |
| | 18 | | 0 | 0 | 0 | 26 | 2 | 0 | 0 | 16 | 6 | 54 | 34 | 22 | 0 | 0 | 128 | 48 | 18 | 0 | 0 | 226 |
| | 19 | | 0 | 0 | 0 | 24 | 0 | 0 | 0 | 32 | 12 | 64 | 30 | 16 | 0 | 0 | 198 | 54 | 14 | 0 | 0 | 216 |
| | 20 | | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 46 | 6 | 68 | 38 | 40 | 0 | 0 | 174 | 68 | 4 | 0 | 0 | 146 |
| | 21 | | 0 | 0 | 0 | 10 | 6 | 0 | 0 | 36 | 2 | 100 | 44 | 40 | 2 | 0 | 118 | 58 | 14 | 0 | 0 | 144 |
| | 22 | | 0 | 0 | 0 | 18 | 4 | 0 | 0 | 40 | 0 | 104 | 26 | 40 | 0 | 0 | 116 | 58 | 10 | 0 | 0 | 130 |
| | 23 | | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 22 | 4 | 54 | 34 | 16 | 0 | 0 | 112 | 48 | 20 | 0 | 2 | 158 |



## Related Worksheets

The data entered in to the Demand – Internal Transfers worksheet is used in the predictive aspects of the model, in particular the Flow Rate (Hide) worksheet. It is also used to validate the patient caseload size.

# g. Data Validation Backing (Hide)

## General Principles

The Data Validation Backing (Hide) tab calculates the Mean Absolute Percentage Error of the patient caseload information entered by the user compared to the patient caseload calculated by the model using the internal and external transfer rates.

The sheet contains 5 tables (one for each possible level of intensity) within which are:

| Name | Description |
|---|---|
| Week Ref | Week reference, taken from main index in the Demand – External Transfers worksheet Column A. |
| Patients on Caseload – User Entry | Taken from Demand – External Transfers. |
| External Additions | Taken from Demand – External Transfers. |
| All Transfers In | Sums Demand – Internal Transfers data if the recipient group is that tables group. |
| External Discharges | Taken from Demand – External Transfers |
| All Transfers Out | Sums Demand – Internal Transfers data if the source group is that tables group. |
| Forecasted Patients on Caseload | Patients on Caseload – User entry plus External Additions plus All Transfers In minus External Discharges minus All Transfers out. |
| (ABS(E-F))/E | Calculates the absolute value of Patients on Caseload – User Entry minus Forecasted Patients on Caseload, and divides that by Patients on Caseload – User Entry. If the formula produces an error, the value is set to 1. This will make the MAPE larger than expected, and acts as a warning to the user. |

| | |
|---|---|
| MAPE (Average (ABS(E-F))/E) | Sum of (ABS(E-F))/E divided by Count of (ABS(E-F))/E. |

The Data Validation Backing (Hide) sheet also produces a combined table of forecasted patient caseloads. This is not currently used in the model.

| | Standard Name | Intensity 2 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | User-input Name | Grp2 | | | | | | |
| | | In | | Out | | MAPE | | |
| Week Ref | Patients on Caseload - User Entry | External Additions | All Transfers in | External Discharges | All Transfers out | Forecasted Patients on Caseload | (Abs(E - F))/E | MAPE (Average ABS(E - F))/E) |
| 1 | 572 | 0 | 50 | 0 | 24 | 572 | 0 | 0.5% |
| 2 | 582 | 0 | 50 | 0 | 40 | 582 | 0 | |
| 3 | 604 | 2 | 80 | 2 | 58 | 604 | 0 | |
| 4 | 594 | 2 | 48 | 8 | 52 | 594 | 0 | |
| 5 | 580 | 2 | 48 | 2 | 62 | 580 | 0 | |
| 6 | 574 | 0 | 24 | 0 | 30 | 574 | 0 | |
| 7 | 522 | 0 | 24 | 10 | 66 | 522 | 0 | |
| 8 | 516 | 4 | 42 | 4 | 48 | 516 | 0 | |
| 9 | 550 | 2 | 60 | 10 | 18 | 550 | 0 | |
| 10 | 572 | 2 | 74 | 6 | 48 | 572 | 0 | |
| 11 | 534 | 2 | 48 | 16 | 72 | 534 | 0 | |
| 12 | 536 | 0 | 52 | 6 | 44 | 536 | 0 | |
| 13 | 542 | 2 | 54 | 8 | 42 | 542 | 0 | |
| 14 | 510 | 4 | 28 | 2 | 62 | 510 | 0 | |
| 15 | 520 | 2 | 58 | 2 | 48 | 520 | 0 | |
| 16 | 508 | 2 | 60 | 6 | 66 | 510 | 0.003937008 | |
| 17 | 500 | 2 | 44 | 6 | 48 | 502 | 0.004 | |
| 18 | 536 | 4 | 54 | 4 | 18 | 538 | 0.003731343 | |
| 19 | 566 | 0 | 64 | 2 | 32 | 568 | 0.003533569 | |
| 20 | 584 | 0 | 68 | 4 | 46 | 586 | 0.003424658 | |

## Related Worksheets

The Data Validation Backing (Hide) worksheet is mainly used to drive the Data Validation worksheet. The worksheet also calculates the forecasted patients on caseload, which are the values used in the model if the user selects the option of using validated data in the Data Validation worksheet. These values will the replace any reference to the Patient Caseload that is normally fed from the Demand – External Transfers worksheet.

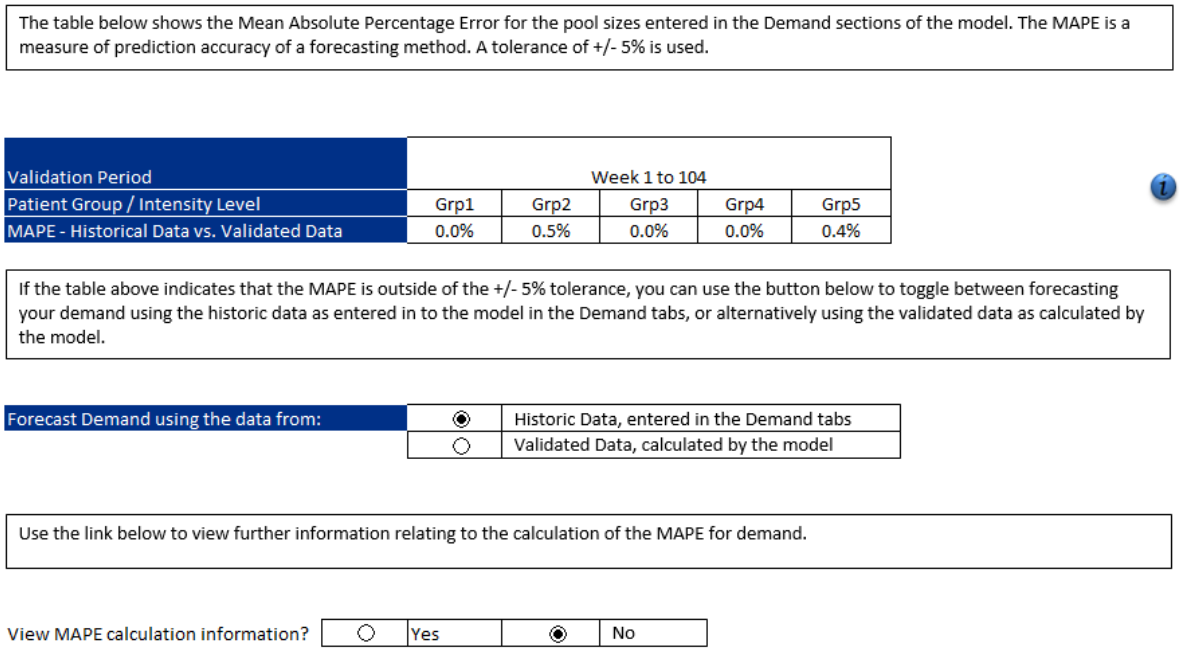
# h. Data Validation

## General Principles

The Data Validation tab displays the information from the backing sheet. The first table displays the MAPE value for each level of intensity. Conditional formatting will flag if the values are above 5%, and therefore warrant investigation.

The second table enables the user to toggle between using 'Historic Data, entered in the Demand tabs' or 'Validated Data, calculated by the model'.

The radio buttons at the bottom of the tab start the assigned macro Show_MAPE_Info or Hide_MAPE_info, which will show or hide the columns that contain the MAPE information. Further information on these macros can be found in Appendix A.



The table below shows the Mean Absolute Percentage Error for the pool sizes entered in the Demand sections of the model. The MAPE is a measure of prediction accuracy of a forecasting method. A tolerance of +/- 5% is used.

| Validation Period | Week 1 to 104 | | | | |
|---|---|---|---|---|---|
| Patient Group / Intensity Level | Grp1 | Grp2 | Grp3 | Grp4 | Grp5 |
| MAPE - Historical Data vs. Validated Data | 0.0% | 0.5% | 0.0% | 0.0% | 0.4% |

If the table above indicates that the MAPE is outside of the +/- 5% tolerance, you can use the button below to toggle between forecasting your demand using the historic data as entered in to the model in the Demand tabs, or alternatively using the validated data as calculated by the model.

| Forecast Demand using the data from: | ◉ | Historic Data, entered in the Demand tabs |
|---|---|---|
| | ○ | Validated Data, calculated by the model |

Use the link below to view further information relating to the calculation of the MAPE for demand.

View MAPE calculation information? ○ Yes ◉ No

## Related Worksheets

The "Forecast Demand using the data from:" option impacts the Caseload SPC Chart Backing, Flow Rate (Hide), Parameters Backing, Demand Modelling – Control and Results Backing (Hide) tabs. Formulas in these tabs will have a simple =if() statement to establish whether to use historic or validated figures based on the value '1' or '2' that this cell produces.

# i. Service

## General Principles

The Service tab is used to configure the service requirement per patient per level of intensity, split between group and non-group sessions.

The 'How many services / modes of treatment are used for…' selections expand the service table. This triggers a worksheet_change macro after a selection has been made, which hides or unhides rows according to the selection.

The 'What are the 'units' used per type of contact' selection dictates whether a 'length of appointment / session' is required in the service setup by triggering a worksheet_change macro that hides/unhides the column. If a selection other than minutes is chosen, the 'length of appointment / session' for all modes of treatment are set to '1'.

Changing the 'Group Session?' selection for a mode of treatment triggers a worksheet_change macro. If 'Group Session?' is set to 'No', then the 'Number of patients seen / treated' cell will be changed and locked as '1'. If 'Group Session' is set to 'Yes', the cell is unlocked and set to blank.

The 'Frequency of Contact' drop down is defined in the GeneralBacking worksheet. There is a hidden multiplier that is used to transform the requirement for each mode of treatment in to a weekly requirement, which is a data validation selection from the GeneralBacking worksheet's table 'Service – Contact Frequency'.

The '[Minutes/Contacts] per week required per patient per type of treatment' is calculated by multiplying the 'length of appointment / session' by the weekly multiplier, and dividing that by the 'number of patients seen / treated'.

The '[Minutes/Contacts] required per patient per level of intensity [non-] group sessions' will sum the '[Minutes/Contacts] per week required per patient per type of treatment' for group or non-group sessions specifically.

The '[Minutes/Contacts] required per level of intensity – Group Sessions' column is not currently used in the model.

As the service / modes of treatment and frequency of contact differs among levels of intensity, it is necessary to calculate the demand in a homogenous and comparable unit.

| | |
|---|---|
| How many services / modes of treatment are used for Grp1? : | 2 |
| How many services / modes of treatment are used for Grp2? : | 2 |
| How many services / modes of treatment are used for Grp3? : | 2 |
| How many services / modes of treatment are used for Grp4? : | 2 |
| How many services / modes of treatment are used for Grp5? : | 2 |
| What are the "units" used per type of contact? | Minutes |

| Intensity | Mode of Service / Treatment | Group Session? | Length of appointment / session | Number of patients seen / treated | Frequency of Contact | Minutes per week required per patient per type of treatment | Minutes required per patient per level of intensity - Non-Group Sessions | Minutes required per patient per level of intensity - Group Sessions | Minutes required per level of intensity - Group Sessions |
|---|---|---|---|---|---|---|---|---|---|
| Grp1 | Group Session | Yes | 60 | 10 | Every four months | 0.36 | 0.9 | 0.36 | 60 |
| | Face to Face | No | 15 | 1 | Every four months | 0.9 | | | |
| Grp2 | Group Session | Yes | 60 | 10 | Every two months | 0.72 | 1.8 | 0.72 | 60 |
| | Face to Face | No | 15 | 1 | Every two months | 1.8 | | | |
| Grp3 | Group Session | Yes | 120 | 10 | Once a month | 2.76 | 3.45 | 2.76 | 120 |
| | Face to Face | No | 15 | 1 | Once a month | 3.45 | | | |
| Grp4 | Group Session | Yes | 180 | 10 | Once a fortnight | 9 | 7.5 | 9 | 180 |
| | Face to Face | No | 15 | 1 | Once a fortnight | 7.5 | | | |
| Grp5 | Group Session | Yes | 300 | 10 | Once a week | 30 | 15 | 30 | 300 |
| | Face to Face | No | 15 | 1 | Once a week | 15 | | | |

## Related Worksheets

The Service worksheet is used to multiply the patient caseload up in to required contacts or minutes, and is therefore used in the Results Backing worksheet to transform from patient caseload to demand.

# j. Caseload SPC Chart

## General Principles

The Caseload SPC Chart displays the change in patient caseload size over time as entered in to the Demand – External Additions worksheet. The data has its mean and SPC limits calculated, and special cause variation rules are applied and flagged on the chart. These calculations are covered in the Caseload SPC Chart Backing worksheet.

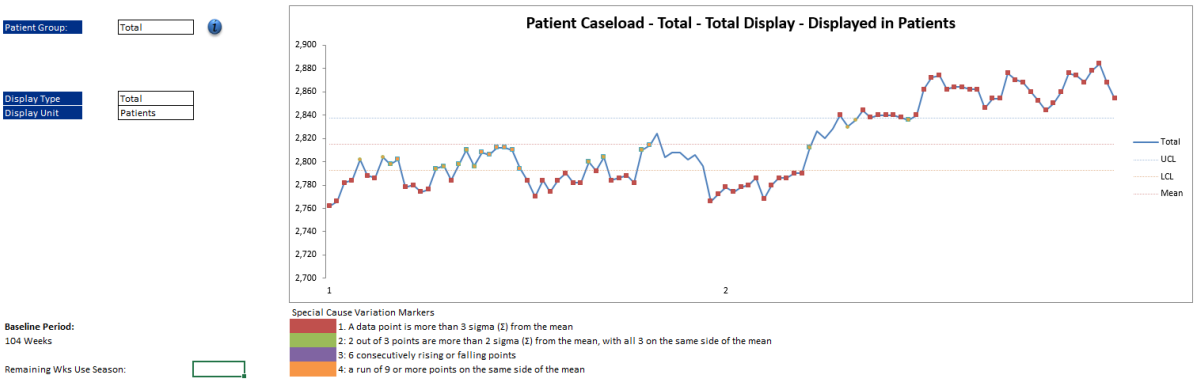
Changing the 'Patient Group:' selection will trigger a worksheet_change macro to hide columns in the Caseload SPC Chart Backing sheet.

Changing the 'Display Type' selection will trigger a worksheet_change macro. The selection and effects are detailed in the table below.

| Selection | Effect |
|---|---|
| Total | Seasonality week selection dropdowns are hidden.<br><br>The seasonality selection text font colour is set to black, and borders are removed.<br><br>The remaining weeks use season selection is set to blank.<br><br>All seasonality flags are hidden in the backing sheets for both the caseload SPC and external additions SPC.<br><br>Seasonal Iterations button is hidden in the Parameters sheet. |
| Baseline | Seasonality week selection dropdowns, besides Season 1 Start and Season 1 End, are hidden.<br><br>Baseline selection text font colour set to black, and borders are added. Seasonal |

| | |
|---|---|
| | selections beyond a first season are set to white text and borders removed.<br><br>'Remaining Wks Use Season' is set to 1.<br><br>All but the first seasonality flags are hidden in the backing sheets for both the caseload SPC and external additions SPC.<br><br>Seasonal Iterations button is hidden in the Parameters sheet. |
| Seasonal | Show all seasonality week selection dropdowns.<br><br>All seasonality selection text font is set to black, and borders are added.<br><br>Unhide seasonality flags based on 'valid season' calculation in backing sheet.<br><br>'Remaining Wks Use Season' is set to a default of 1.<br><br>Seasonal Iterations button is visible in the Parameters sheet. |

Changing the 'Display Unit' selection triggers a worksheet_change macro and is linked to the Service Conversion table in the Caseload SPC Chart Backing worksheet.




## Related Worksheets

The seasonality selections in the Caseload SPC Chart worksheet impact on the required capacity calculations completed in the Results Backing (Hide) worksheet, as the selections dictate the baseline or seasonal period.

# k. Caseload SPC Chart Backing

## General Principles

The Caseload SPC Chart Backing worksheet provides the data used in the Caseload SPC Chart worksheet to populate the SPC chart. It transforms the Patient Caseload data based on the selections made in the Caseload SPC Chart worksheet.

The first table on the sheet is a reference table to ensure the data is aligned to the correct week.

The Week Reference column is dictated by the number of rows completed in the Demand – External Transfers worksheet.

The 52 Week column is based on the Demand – External Transfers worksheet, and sequences between 1 and 52. This is used to help correctly assign seasons to weeks in a consistent manner and removes issues around a 53 week year.

The Season column is dictated by the Demand – External Transfers sheet, which in turn is calculated in the SPC Values table in the Caseload SPC Chart Backing worksheet.

Year, Month, Week and Date mirror the configuration in the Demand – External Transfers worksheet.

The Chart Plot Table is the data source for the chart in the Caseload SPC Chart sheet.

The patients on caseload section pulls the data either from the entered data or from the validated data, depending on the selection made in the data validation sheet. These columns are hidden or shown based on the 'Patient Group' selection made in the Caseload SPC Chart worksheet, and the value of 'Group No' is a numerical expression of the 'Patient Group' selection made. This value is between 1 and 6, with 6 indicating that 'Total' has been selected.

The 'Season [1/2/3/4]' columns are used as flags for the shading on the Caseload SPC Chart. They are driven by the 'Season' column.

The SPC columns 'LCL', '-2 Sigma', '-1 Sigma', 'Mean', '+1 Sigma', '+2 Sigma' and 'UCL' are a lookup of the SPC Values table.

The Exception Rules table applies the SPC rules to the datasets to indicate whether a data point is indicating a special cause of variation. The four rules that are considered for the SPC chart are:

1. A data point is more than 3 sigma from the mean

2. 2 out of 3 points are more than 2 sigma from the mean, with all 3 on the same side of the mean.

3. 6 consecutively rising or falling points

4. A run of 9 or more points on the same side of the mean

The columns that end in a (1) are helper columns to establish whether a data point has broken an SPC rule. An '#N/A' indicates that the SPC rule has not been broken for that data point. If, however, an SPC rule has been broken, the data point value will be shown, and therefore plotted on the graph at the appropriate place.

The Season Conversion Table calculates the SPC limits based on the Seasonality Selection. The 'Start' and 'End' columns are calculated using the selections made in the Caseload SPC Chart and taken from the Seasonality Selection table. The calculations are explained in the table below.

| Heading | Calculation |
|---|---|
| Season 1 Start | Split1Start Selected Value |
| Season 1 End | Split1Start Selected Value + Split1End Length |
| Season [2/3/4] Start | Split[2/3/4]Start Selected Value + 1 |
| Season [2/3/4] End | Season [1/2/3] End + Split[2/3/4]End Length |
| Season 5 Start | 1 |
| Season 5 End | DEM_Max_Rows |

The SPC limits are then calculated using an offset based on the season start and end values.

Under the table, the 'Valid Seasons' figure is calculated on the number of seasons that have been configured. 'Remaining Wks' is 52 minus the number of weeks that have been selected as part of the seasonality selection, and 'Remaining Wks use season' is set by the user on the Caseload SPC Chart worksheet.

The Service Conversion table is used to multiply the patient caseload by the service requirements, such that the SPC chart axis can be changed between plotting patients and plotting minutes or contacts.

The SPC Values table expands the Season Conversion table and assigns the Season to individual weeks, based on a lookup of the week reference. This then allows the other tables in the sheet to pull the SPC limits from this table based on the same week reference.

The Seasonality Selection table is defined by the user in the Caseload SPC Chart when selecting the time periods for the different seasons. The calculations are explained in the table below.

| Heading | Calculation |
|---|---|
| Split1Start – Selected Value | Written to the table by the user selecting the 'Season 1 Starts' date in the Caseload SPC Chart. |
| Split[2/3/4]Start – Selected Value | Written to the table by the user selecting 'Yes' for the 'Include [2/3/4] Season in the Caseload SPC Chart. |
| Split[1/2/3/4]End – Selected Value | Written to the table by the user selecting the 'Season [1/2/3/4] Ends' date in the Caseload SPC Chart. |
| Split1End – From | Split1Start + 9 |
| Split[2/3/4]End – From | If season is included, split[1/2/3]start + split[2/3/4] selected value + 9 |

| | |
|---|---|
| Split1End – To | Minimum value of DEM_Max_Rows or Split1Start + 53 |
| Split[2/3/4]End – To | If season is included, minimum value of DEM_Max_Rows or Split1Start + 53 |
| Split[1/2/3/4]End – Area | Split[1/2/3/4]End To – Split[1/2/3/4]End From |
| Split[1/2/3/4]End – Length | (Split[1/2/3/4]End Selected Value + Split[1/2/3/4]End From) – Split1Start Selected Value – [Split1/2/3 Length] |

| Week Reference Table | | | | | | | Chart Plot Table | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Week Reference | 52 week | Season | Year | Month | Week | Date | | Total | LCL | -2 Sigma | -1 Sigma | Mean | +1 Sigma | +2 Sigma | UCL |
| 1 | 1 | 5 | 1 | 1 | 1 | | | 2762 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 2 | 2 | 5 | | | 2 | | | 2766 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 3 | 3 | 5 | | | 3 | | | 2782 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 4 | 4 | 5 | | | 4 | | | 2784 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 5 | 5 | 5 | | 2 | 5 | | | 2802 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 6 | 6 | 5 | | | 6 | | | 2788 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 7 | 7 | 5 | | | 7 | | | 2786 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 8 | 8 | 5 | | | 8 | | | 2804 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 9 | 9 | 5 | | 3 | 9 | | | 2798 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 10 | 10 | 5 | | | 10 | | | 2802 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 11 | 11 | 5 | | | 11 | | | 2778 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 12 | 12 | 5 | | | 12 | | | 2780 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 13 | 13 | 5 | | | 13 | | | 2774 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |
| 14 | 14 | 5 | | 4 | 14 | | | 2776 | 2792.587 | 2800.058 | 2807.529 | 2815 | 2822.471 | 2829.942 | 2837.413 |

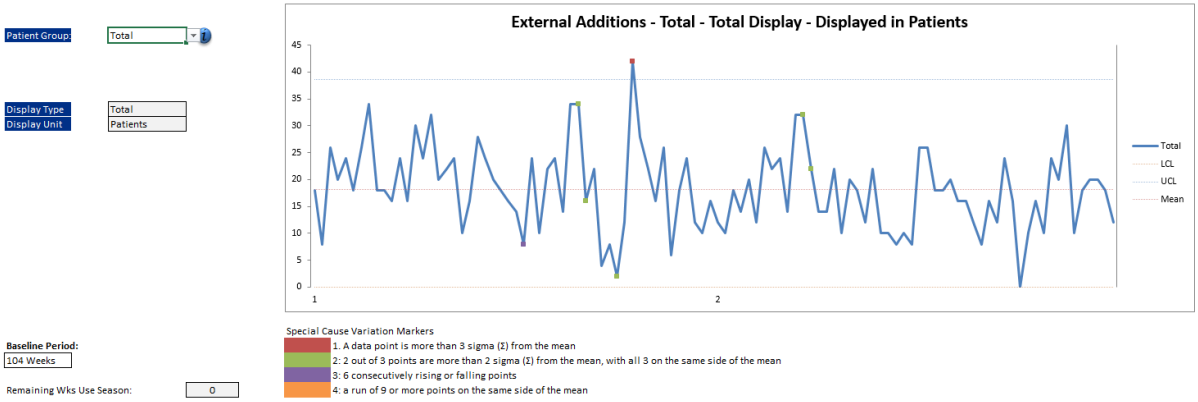
## Related Worksheets

The Caseload SPC Chart Backing worksheet drives the visual elements of the Caseload SPC Chart worksheet, whilst being affected by the selections made by the user in the worksheet. The translated selections are then used in the Results Backing (Hide) worksheet to set seasons for the outputs.

# I. External Additions SPC

## General Principles

The External Additions SPC Chart displays the External Additions data as a time series and applies the same SPC rules to the data as are applied to the Caseload SPC chart. The calculations for the chart are carried out in the Ext. Add. SPC Chart Backing worksheet. The only editable option on the External Additions SPC Chart worksheet is the 'Patient Group:' option, which changes the patient caseload that is displayed on the chart. All the other settings are dictated by the selection made in the Caseload SPC Chart.




## Related Worksheets

The patient caseload selection made in the External Additions SPC Chart worksheet will change the value selection in the Ext. Add. SPC Chart Backing worksheet, to update the graph. The worksheet has no other impact throughout the model.

# m. Ext. Add. SPC Chart Backing

## General Principles

The Ext. Add. SPC Chart Backing worksheet is a copy of the layout of the Caseload SPC Chart Backing worksheet with the data points changed to the External Additions data in the Demand – External Additions worksheet.

As with the External Additions SPC Chart, all the seasonality selection is copied across, and the same process of calculating SPC metrics is carried out on the External Additions data.

| Week Reference | 52 Week | Season | Year | Month | Week | Date | | Total | LCL | -2 Sigma | -1 Sigma | Mean | +1 Sigma | +2 Sigma | UCL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 5 | 1 | 1 | 1 | | | 18 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 2 | 2 | 5 | | | 2 | | | 8 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 3 | 3 | 5 | | | 3 | | | 26 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 4 | 4 | 5 | | | 4 | | | 20 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 5 | 5 | 5 | | 2 | 5 | | | 24 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 6 | 6 | 5 | | | 6 | | | 18 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 7 | 7 | 5 | | | 7 | | | 26 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 8 | 8 | 5 | | | 8 | | | 34 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 9 | 9 | 5 | | 3 | 9 | | | 18 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 10 | 10 | 5 | | | 10 | | | 18 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 11 | 11 | 5 | | | 11 | | | 16 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 12 | 12 | 5 | | | 12 | | | 24 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 13 | 13 | 5 | | | 13 | | | 16 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 14 | 14 | 5 | | 4 | 14 | | | 30 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 15 | 15 | 5 | | | 15 | | | 24 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 16 | 16 | 5 | | | 16 | | | 32 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |
| 17 | 17 | 5 | | | 17 | | | 20 | 0 | 4.573958 | 11.37352 | 18.17308 | 24.97264 | 31.7722 | 38.57175 |

## Related Worksheets

The Ext. Add. SPC Chart Backing worksheet drives the information displayed in the External Additions SPC Chart worksheet. It has now other impact on the model.

# n. Flow Rate (Hide)

## General Principles

The Flow Rate (Hide) worksheet is used to measure the flow rate between different patient groups as calculated using the demand data entered earlier in the model. There are different calculations for weekly flow rates and monthly, seasonal and annual flow rates, to avoid unintended duplication of calculation. Therefore, the 'Transfer Rate' and 'Discharge Rate' tables apply to weekly iterations, and the 'Flow Rates – Monthly, Seasonally, Annually' and 'Discharge Rate – Monthly, Seasonally, Annually' apply to monthly, seasonal, annual iterations.

The Week Index column is a direct copy of the week index from the Demand – External Transfers sheet.

The Transformed Data table holds the patient caseload information for each level of intensity. The patient caseload is on a lag of one week, as the transfers need to apply *during* the week, whilst the patient caseload represents the number of patients at the *end* of the week. The first week's starting caseload figure is therefore a calculation of the entered patient caseload for week 1, with external additions and transfers in removed from the user entered week one, and external discharges and transfers out added back in. The remaining weeks follow the same pattern, using the previous weeks patient caseload as its starting value.

The Transfer Rate table calculates the percentage flow rate between levels of intensity. Row 5 is a helper row to assist with an index match function later in the model. Year, Season, Month, 52 Week and Date information is pulled from earlier set up in the model. The Flow Rate for each permutation is calculated by dividing the number of patients transferred from the caseload by the total number of patients on the caseload at the end of the last week. This is calculated for each of the possibilities as seen in the Demand – Internal Transfers worksheet. The calculation for the flow rate also takes in to account the historical weighting that can be applied to different years in the Parameters worksheet.

The Discharge Rate table calculates the percentage flow rate of patients out of the system via external discharge. The Year, Week and Date are taken from previous data entry. The discharge rate for each level of intensity is calculated by dividing the external discharges from the level of intensity by the total number of patients on the caseload at the end of the last week. Again, the discharge rate calculation takes in to account the historical weighting that is applied in the Parameters worksheet.

The ‘Flow Rate – Monthly, Seasonally, Annually’ table then sums the flow rates for each index 52 weeks. These are later further collated between Month, Season and Year during the caseload prediction. The ‘Discharge Rate – Monthly, Seasonally, Annually’ table works in the same manner.

| Week Index | Transformed data - Estimated Patients on Caseload for Week 1 using entered external additions, external discharges, and internal transfers | | | | |
|---|---|---|---|---|---|
| | Patients on caseload | | | | |
| | Grp1 | Grp2 | Grp3 | Grp4 | Grp5 |
| 1 | 830 | 546 | 200 | 282 | 894 |
| 2 | 834 | 572 | 260 | 294 | 802 |
| 3 | 848 | 582 | 312 | 306 | 718 |
| 4 | 854 | 604 | 250 | 242 | 832 |
| 5 | 866 | 594 | 220 | 232 | 872 |
| 6 | 844 | 580 | 158 | 272 | 948 |
| 7 | 822 | 574 | 152 | 298 | 942 |
| 8 | 800 | 522 | 204 | 324 | 936 |
| 9 | 806 | 516 | 228 | 256 | 998 |
| 10 | 830 | 550 | 252 | 298 | 868 |

Flow Rate
Transfer Rate

| Year | Season | Month | 52 Week | Date | Grp1 to | | | | Grp2 to | | | | Grp3 to | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Grp1 | Grp1 | Grp1 | Grp1 | Grp2 | Grp2 | Grp2 | Grp2 | Grp3 | Grp3 | Grp3 | Grp3 |
| | | | | | Grp2 | Grp3 | Grp4 | Grp5 | Grp1 | Grp3 | Grp4 | Grp5 | Grp1 | Grp2 | Grp4 | Grp5 |
| 1 | 5 | 1 | 1 | | 0.00% | 0.00% | 0.00% | 1.20% | 0.18% | 0.00% | 0.00% | 2.01% | 1.00% | 12.50% | 7.50% | 6.50% |
| | 5 | 1 | 2 | | 0.00% | 0.00% | 0.00% | 0.72% | 0.35% | 0.00% | 0.00% | 3.15% | 0.38% | 9.62% | 5.00% | 6.15% |
| | 5 | 1 | 3 | | 0.00% | 0.00% | 0.00% | 0.83% | 0.34% | 0.00% | 0.00% | 4.64% | 0.32% | 12.82% | 5.77% | 11.86% |
| | 5 | 1 | 4 | | 0.00% | 0.00% | 0.00% | 0.82% | 0.17% | 0.00% | 0.00% | 4.14% | 1.20% | 9.60% | 7.60% | 8.40% |
| | 5 | 2 | 5 | | 0.00% | 0.00% | 0.00% | 1.85% | 0.67% | 0.00% | 0.00% | 4.55% | 0.91% | 10.91% | 8.18% | 12.73% |
| | 5 | 2 | 6 | | 0.00% | 0.00% | 0.00% | 1.30% | 0.34% | 0.00% | 0.00% | 2.24% | 1.27% | 7.59% | 12.03% | 12.66% |
| | 5 | 2 | 7 | | 0.00% | 0.00% | 0.00% | 1.58% | 0.17% | 0.00% | 0.00% | 5.57% | 0.00% | 7.89% | 6.58% | 7.24% |
| | 5 | 2 | 8 | | 0.00% | 0.00% | 0.00% | 1.50% | 0.77% | 0.00% | 0.00% | 3.83% | 1.47% | 10.29% | 5.88% | 10.29% |
| | 5 | 3 | 9 | | 0.00% | 0.00% | 0.00% | 1.24% | 0.39% | 0.00% | 0.00% | 1.36% | 2.63% | 13.16% | 3.51% | 2.19% |
| | 5 | 3 | 10 | | 0.00% | 0.00% | 0.00% | 1.81% | 0.00% | 0.00% | 0.00% | 4.36% | 0.79% | 14.68% | 6.75% | 7.94% |

## Related Worksheets

The Flow Rates (Hide) worksheet is used by the prediction engine to quantify the flows between the different patient caseloads. Full details of the prediction engine VBA code can be found in Appendix A. The values in the Flow Rate (Hide) worksheet are also displayed in the Parameters worksheet to help visualise the steps taken by the iteration engine.

# o. Capacity

## General Principles

The Capacity worksheet is used to set the service's available capacity for 52 weeks.

A start date can be entered to contextualise the capacity over time. The 'End Date' is set as a year later, taking in to account leap years. If no start date is entered, the model will assume a start date of 'today'.

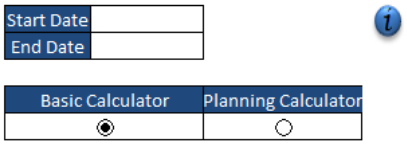
The basic/planning calculator radio buttons are used to toggle between capacity being spread evenly across 52 weeks, or the capacity being modified by the critical resources and their periods of unavailability. The radio buttons are linked to the 'Type Switch' in the Capacity Calculation (hide) worksheet. The Basic Calculator radio button will trigger the macro Simplified_Calculator_Click, which will ensure that the Critical Resources and Capacity Setup worksheets are hidden, and the Planning Calculator radio button will trigger the macro Advanced_Calculator_Click, which will unhide the two additional worksheets.

The Core and Ad Hoc Capacity tables work identically but are split into different sections of the Capacity Calculation (hide) worksheet. The table below describes the purpose of each column.

| Column | Description |
|---|---|
| Clinic Name | Basic data entry field that is used throughout later sheets to identify clinics. |
| Clinic Description (1 & 2) | Basic data entry field that is used throughout later sheets to identify clinics. |
| Suitable Intensity Levels | Selecting suitable intensity levels will divide the average capacity per week by the number of suitable intensity levels to calculate the average per intensity level. This selection dictates the assignment of available capacity in the Results tab. |
| Group Session? | Dictates whether the clinics capacity is assigned as group or non-group capacity. |

| | |
|---|---|
| Weeks Per Year | Used to multiply up capacity for a total annual figure. |
| [Minutes/Contacts] Per Week | The available capacity for the clinic per week. This sets the maximum number of minutes/contacts that are available for the clinic per week. |
| Total [(Minutes)/(Contacts)] | Weeks per year multiplied by [Minutes/Contacts] Per Week |
| Average per Week | Total [(Minutes)/(Contacts)]/ 52 |
| Average per Intensity Level | Average per Week / Count of suitable intensity levels. This is to evenly split the average capacity per week across different patient groups. |

The Totals above the table sum all the entries per column in the table.




**Capacity Calculator**

Core Capacity

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Totals | 1169535 | 22491.1 | 16673.7 |
| Clinic Name | Clinic Description 1 | Clinic Description 2 | Suitable Intensity Levels | | | | | Group Session? | Weeks Per Year | Minutes Per Week | Total (Minutes) | Average per Week | Average per Intensity Level |
| | | | Grp1 | Grp2 | Grp3 | Grp4 | Grp5 | | | | | | |
| Weekly RN | RN | Full week | | X | X | X | | No | 42 | 2250 | 94500 | 1817.3 | 605.8 |
| Weekly SRN | Spec. Nurse | Full week | | | | | X | No | 42 | 2250 | 94500 | 1817.3 | 1817.3 |
| 1/2 RN | RN 1/2 Time | Full week, part time | | X | X | X | | No | 21 | 2250 | 47250 | 908.7 | 302.9 |
| Wed RN | RN | Wed Clinic | | X | | | | No | 42 | 2250 | 94500 | 1817.3 | 1817.3 |
| Wed SRN | Spec. Nurse | Wed Clinic | | | | X | X | No | 42 | 2250 | 94500 | 1817.3 | 908.7 |
| Thu RN | RN | Thur Clinic | X | X | X | | | No | 42 | 2250 | 94500 | 1817.3 | 605.8 |
| Thu SRN | Spec. Nurse | Thur Clinic | | | | X | X | No | 42 | 2250 | 94500 | 1817.3 | 908.7 |
| Fri SRN | Spec. Nurse | Fri Session | | | | | X | No | 42 | 2250 | 94500 | 1817.3 | 1817.3 |
| GS Team 1 | MDT1 | Full Week | | X | X | X | X | Yes | 39 | 563 | 21957 | 422.3 | 105.6 |
| GS Team 2 | MDT2 | Full Week | X | X | X | X | X | Yes | 39 | 563 | 21957 | 422.3 | 84.5 |
| GS Team 3 | Spec. MDT | Full week | | X | X | X | X | Yes | 39 | 563 | 21957 | 422.3 | 105.6 |
| GS Team 4 | Spec. MDT | Part time | | | | | X | Yes | 39 | 563 | 21957 | 422.3 | 422.3 |
| GS Team 5 | Spec. MDT | Full Week | | | | | X | Yes | 39 | 563 | 21957 | 422.3 | 422.3 |
| GS Multi | Spec. MDT | Team 6, 7, 8, 9 | | | | | X | Yes | 39 | 9000 | 351000 | 6750.0 | 6750.0 |

## Related Worksheets

The Capacity worksheet provides the Capacity Calculation (Hide) worksheet with the available capacity for each clinic.

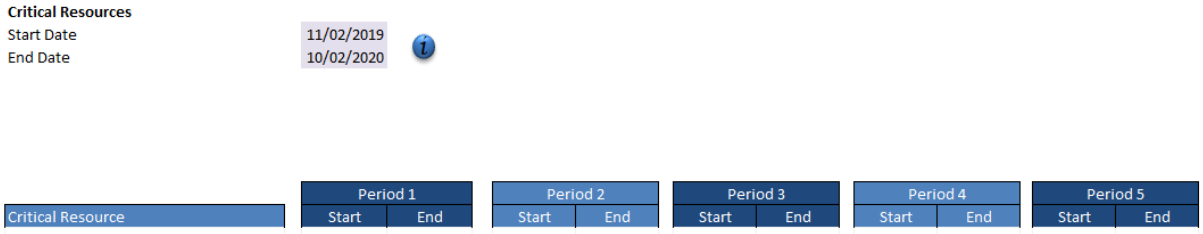
# p. Critical Resources

## General Principles

If the 'Planning' radio button is selected, the Critical Resources worksheet will be available. It is used to define up to one hundred resources that are critical for various units of capacity, without which the capacity for these periods would be zero. The start and end date are pulled through from the Capacity sheet automatically. The table below describes the purpose of each column.

| Column | Description |
|---|---|
| Critical Resource | Basic data entry field that is used throughout later sheets to identify the resource. |
| Period [1/2/3/4/5] Start/End | The periods are defined using a drop-down selection. The drop-down selection is based on the selection made for the Start Date in the Capacity worksheet, and the data validation is based on the Critical Resources (Hide) worksheet table 'Capacity date axis labels'. The End date validation is based on the start date, so that the period is always going forwards. |

Entering data in to the Critical Resource column will enable conditional formatting for the table.




## Related Worksheets

The data entered in to the Critical Resources worksheet is collated in the Capacity Calculation (hide) worksheet, where the information entered is translated in to flags indicating if the clinic is available or not when combining the information with the information from the Capacity Setup worksheet.

# q. Capacity Setup

## General Principles

As with the Critical Resources worksheet, if the 'Planning' radio button has been selected, the Capacity worksheet will be available. The worksheet is used to link the previously created critical resources to the capacity units configured in the Capacity worksheet.

Both the Core and Ad Hoc clinics can have critical resources attached to them, and the 'Show:' cell can be toggled between the two to change the table that is displayed. Changing the cell triggers a worksheet_change macro, which will hide rows in the worksheet based on the selection.

The two tables work in the same way, and a description of the options is below.

| Column | Description |
|---|---|
| Clinic Name | Auto-filled column based on the names of the clinics entered in the Capacity worksheet. |
| Key Resource [1/2/3] | Data entry selection for assigning a critical resource to the clinic. The data validation is based on the named range CAP_Capacity_Resource, which provides the names of the critical resources. |
| Frequency from Calculator | The Weeks per Year value in the Capacity worksheet. |
| Adjusted for critical resources | The adjusted weeks is 52 minus the total number of weeks that have been marked as unavailable via critical resources assigned to the clinic, as calculated in the Capacity Calculation (hide) worksheet. |
| Stated Capacity | The stated capacity is taken from the Total ([Minutes/Contacts]) in the capacity sheet. |

| | |
|---|---|
| Adjusted (minimum) capacity | The adjusted minimum capacity is calculated in the Capacity Calculation (hide) worksheet. |
| Capacity Match? | The capacity match compares the adjusted capacity to the stated capacity and will indicate if it is 'Over' or 'Under' the capacity stated in the Capacity worksheet. |

**Capacity - Link your sessions to your key resoueces here**

**Show:**
Core

**Core Capacity**

| Clinic Name | Key Resource 1 | Key Resource 2 | Key Resource 3 | Frequency from Calculator | Adjusted for critical resources | Stated Capacity | Adjusted (minimum) capacity | Capacity Match? |
|---|---|---|---|---|---|---|---|---|
| Weekly RN | | | | 42 | 52 | 94500 | 94500 | Over |
| Weekly SRN | | | | 42 | 52 | 94500 | 94500 | Over |
| 1/2 RN | | | | 21 | 52 | 47250 | 47250 | Over |
| Wed RN | | | | 42 | 52 | 94500 | 94500 | Over |
| Wed SRN | | | | 42 | 52 | 94500 | 94500 | Over |
| Thu RN | | | | 42 | 52 | 94500 | 94500 | Over |
| Thu SRN | | | | 42 | 52 | 94500 | 94500 | Over |
| Fri SRN | | | | 42 | 52 | 94500 | 94500 | Over |
| GS Team 1 | | | | 39 | 52 | 21957 | 21957 | Over |
| GS Team 2 | | | | 39 | 52 | 21957 | 21957 | Over |
| GS Team 3 | | | | 39 | 52 | 21957 | 21957 | Over |
| GS Team 4 | | | | 39 | 52 | 21957 | 21957 | Over |
| GS Team 5 | | | | 39 | 52 | 21957 | 21957 | Over |
| GS Multi | | | | 39 | 52 | 351000 | 351000 | Over |

## Related Worksheets

The Capacity Setup worksheet is used in combination with the Critical Resources worksheet to determine the flags in the Critical Resource (Hide) worksheet, which indicates the weeks in which the various units of capacity are available and can be used.

# r. Critical Resources (Hide)

## General Principles

The Critical Resources (Hide) worksheet is used to transform the user selections in the Critical Resources worksheet in to availability as a time series.

The first columns are the capacity date axis labels and are set by either the entered capacity start date or 'today'. After the dates have been configured, the table continues with the critical resource information. The critical resource information is populated as follows.

| Column | Description |
|---|---|
| Critical Resource | Creates a number and a period (based on the order of the critical resource) before adding in the name of the Critical Resource from the Critical Resources tab. |
| Period [1/2/3/4/5] Start/Period [1/2/3/4/5] End | A lookup of the date entered in the Critical Resources worksheet for the given Critical Resource. Converts the date in to a week reference number based on the capacity date axis label index. |

The next table in the Critical Resources (Hide) worksheet is used to flag weeks that each resource is unavailable for, based on the critical resource information. The matrix checks, for each resource, if the week index in the header of the table is between any of the periods that the resource has been marked as unavailable for. If the resource is marked as unavailable, the flag will be set to a '1', otherwise the flag will read '0'.

## Related Worksheets

The information in the Critical Resources (Hide) worksheet is used as a flag in the Capacity Calculation (Hide) worksheet to indicate if a clinic is available or not.

# s. Capacity Calculation (hide)

## General Principles

The Capacity Calculation (hide) worksheet is used to set the available capacity per week, per clinic. Core and Ad Hoc clinics are calculated separately, with Ad Hoc clinics calculated from Row 108 down. They work in a similar way, with the exception being that ad hoc clinic availability can be toggled in the 'Adjust ad hoc capacity?' table in the Capacity Summary worksheet.

The Type Switch cell is dictated by the basic/planning calculator radio buttons in the capacity sheet and is used in the Capacity Calculation (hide) worksheet to trigger between using the critical resource flags or not – a selection of '1' indicates that the basic calculator is being used, whilst '2' indicates that the planning calculator is being used.

The first four columns of the resource link table copies the clinics and allocated critical resources from the Capacity Setup worksheet to act as reference points for the capacity flags.

The 'Capacity (Time Based)' section of the worksheet uses the flags on the Critical Resources (Hide) worksheet to establish if the capacity is available (flagged as a '1') or unavailable (flagged as a '0'). The matrix will check if *any* of the three possible critical resources are flagged as unavailable in the Critical Resources (Hide) worksheet to determine if the clinic is marked as available or not. This is repeated for 52 weeks.

Column BH is then a sum of the number of weeks that the clinic is available for. This goes back in to the Capacity Setup worksheet as the 'Adjusted for Critical Resources' figure.

The 'Capacity/Clinic (adjusted)' figure is the calculated capacity that needs to be provided per clinic to meet the available capacity entered in the capacity calculator tables. If the availability of the clinic is marked as 'Under' in the Capacity Setup worksheet, the maximum value this can be is the '[Minutes/Contacts] per Week' as defined in the Capacity calculator. If instead the clinic is marked as 'Over', the Capacity/Clinic (adjusted) figure is reduced to provide the total annual capacity over the available weeks. This means that the capacity for the clinic cannot exceed the stated available capacity in the Capacity worksheet.

Next, the worksheet brings in the intensity level flags from the Capacity worksheet, and these are used to determine how the available capacity is to be split amongst the levels of intensity that use the capacity. An initial cut of the capacity is displayed in the Capacity/Clinic/LOI column, based on the average capacity per week per level of intensity. This figure is used to represent the capacity per level of intensity if the model has not yet run a prediction for the next 52 weeks.

Once a prediction has been made, the model will start to split capacity based on the required capacity for the different levels of intensity. First, the model identifies clinics that are specific to one level of intensity. Next, the model determines the total required capacity across the year for each level of intensity, and group and non-group sessions as a subset of those. It will then remove from that total the available capacity that is specific to that level of intensity, leaving the figures in the 'Required Capacity – [Non-]Group (remaining after non-shared capacity accounted for)' table.

This table then informs the data in the 'Capacity Split % based on req capacity calculations' table. This table divides the available capacity for each clinic by the percentage of the total required capacity that each level of intensity represents to more intelligently assign the available capacity to the different levels of intensity. The effect of this calculation is seen in the Summary table, which provides the data for the graph which is displayed as a pop-up warning when an iteration is run.

The Ad Hoc capacity table differs from the core table in that there are further checks completed to see if the capacity is marked as available. The Capacity Summary worksheet can be used to assign ad hoc capacity to specific weeks. If this has been configured, the 'Capacity (time based) – adjusted – Per Intensity Level' matrix will identify the weeks that have been marked as usable for the ad hoc clinic and will apply capacity to those weeks only. Otherwise, it follows through in the same way as the Core capacity.

## Related Worksheets

The information from the Capacity Calculation (Hide) worksheet is used to create the weekly breakdown of capacity in the Capacity Tables (Hide) worksheet. The summary table of changes and accompanying graph are displayed as a user form during the prediction work of the model.

# t. Capacity Tables (Hide)

## General Principles

The Capacity Tables (Hide) worksheet is used to summarise the weekly capacity levels. It has two main tables – one for the total service, and one that is dependent on the selections made by the user in the Results worksheet. This worksheet also contains the conversion to contacts table, which converts capacity entered in minutes into contacts for the aggregation module.

The capacity is split in to Core and Ad Hoc capacity, however they work in an identical way. The Total Service Capacity tables use the average weekly capacity figure to calculate the weekly capacity for each clinic, and summarises these in to total weekly capacity for each type of appointment (group and non-group).

The Dynamic Table for Chart is populated depending on the selection made in either the Capacity Summary worksheet or the Results worksheet. The Chart Control Value is a lookup of the level of intensity selection made in either of these worksheets, and the formulas in the table are dependent on this value.

The Conversion to Contacts (if required) table is then used to convert the weekly available capacity for each clinic in to the available contacts that each of these represent for each level of intensity. The conversion is calculated by dividing the weekly available capacity by the weekly required capacity, multiplied by the summed total of the contact multipliers per group. The contact multipliers are defined in the Service worksheet via the frequency of contact selection.

## Related Worksheets

The Capacity Tables (Hide) worksheet provides the information that populates the Capacity Summary worksheet, the capacity information on the Results worksheet, and also provides the converted to contact information used in the Aggregation Module (Hide) worksheet.

# u. Capacity Summary

## General Principles

The Capacity Summary worksheet is used to display the available capacity across the 52 weeks in graphical form.

The 'Total Capacity ([Minutes/Contacts] per Year):' is taken from the Capacity Calculation (Hide) worksheet and it considers Critical Resource allocation in its total. Changing the 'Level of Intensity:' will update the totals.

The Basic and Planning radio buttons operate in the same way as those in the Capacity worksheet, initiating the same simplified_calculator_click and advanced_calculator_click macros respectively.

The 'Display:' settings are used to change the function of the graph. The graph can be changed to show, for both core and ad hoc, the total capacity available, the capacity available per clinic, or alternatively turn off displaying core or ad hoc capacity. The data for the graph is set by the named range CAP_Chart_Core and CAP_Chart_Adhoc. These ranges use the offset function to pull the correct row from the 'Capacity (time based) – adjusted – Per Intensity Level' table in the Capacity Calculation (Hide) worksheet.

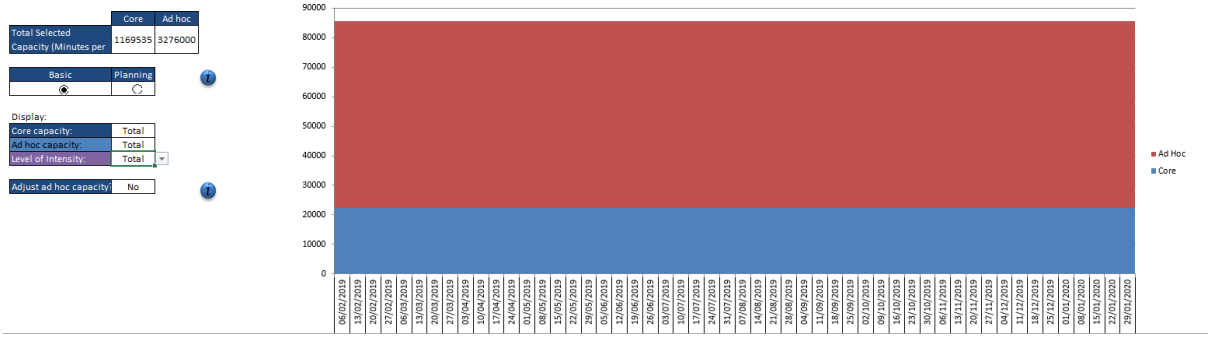
The 'Level of Intensity:' selection starts a worksheet_change macro that copies the entered value of the cell to the Results worksheet. This is done to ensure that the Capacity Summary and Results worksheet show the capacity for the correct level of intensity. This cell also affects the 'Capacity (time based) – adjusted – Per Intensity Level' table, as the capacity available per week may need to be equally split between two or more levels of intensity. This is triggered if anything other than 'Total' is selected.

The 'Adjust ad hoc capacity?' selection triggers a worksheet_change macro that hides or unhides the ad hoc selection grid beneath the capacity summary graph. This is achieved by various formatting options set within the macro. The selection table headings are detailed below.

| Heading | Description |
|---|---|

| | |
|---|---|
| Ad Hoc Session | The name of the session as entered in the Capacity worksheet, Ad Hoc Capacity table. |
| As stated in 'Capacity' Sheet – No. Wks | Number of weeks that the clinic is designed to run for. |
| As state in 'Capacity' Sheet – Capacity / Wk | Capacity per week that the clinic is designed to have. |
| Calculated from table below – No. Wks | Number of weeks set by using the selection matrix under the capacity summary graph |
| Calculated from table below – Capacity / Wk | Capacity per week based on the selection matrix under the capacity summary graph. If more weeks have been selected than are stated in the Capacity worksheet, then the available capacity per week will be reduced accordingly so as not to display more capacity over the entire year than entered in to the calculator. |

The selections made in the ad-hoc grid feed back to the Capacity Calculation (hide) worksheet, and flag toggled weeks appropriately.




## Related Worksheets

The Capacity Summary worksheet's 'Adjust Ad Hoc Capacity?' function triggers flags in the Capacity Calculation (hide) worksheet to determine if an ad hoc clinic is available, or not, on any given week.

# v. Parameters

## General Principles

The Parameters worksheet is used to set the behaviour of the system.

The 'Set Parameters By:' selection determines whether the parameters are set either for the entire service, or by individual level of intensity. Changing the value triggers a worksheet_change macro. If 'Total Service' is selected, the 'Parameters For:' is changed to 'Total' and is hidden. If, on the other hand, 'Level of Intensity' is selected, 'Parameters For:' is unhidden and is set to the first intensity level.

The 'Enter Values By:' selection is used to toggle between entering service behaviour information as a % value or as a volume. Changing the value will start a worksheet_change macro. The effects of this macro are detailed in the table below.

| Selection | Effect |
|---|---|
| % | For both 'NASL' and 'NASL: Discharged' rates, set percentage value as current % value from the Parameters Backing worksheet, and change the Volume cell to a formula applying the percentage to either the estimated bookings (if NASL rate) or to the NASL volume (if NASL: Discharged rate). Toggle the volume cells as locked, and the percentage cells as unlocked. |
| Volume | For both NASL and NASL: Discharged, set the volume to the current Volume value from the Parameters Backing worksheet, and change the % cell to a formula calculating the percentage of the estimated bookings (if NASL rate) or to the NASL volume (if NASL: Discharged rate). Toggle the percentage cells as locked, and the volume cells as unlocked. |

The ‘Units:’ selection is used to change the values used in the Parameters tab between contacts or minutes (if minutes have been used in the Service worksheet).

If ‘Set Parameters By:’ is set to ‘Level of Intensity’, the ‘Parameters For:’ selection will be displayed. This allows the user to switch between the different levels of intensity, to set different parameters per specific level of intensity. Changing the selection triggers a worksheet_change macro. The macro operates by looking up the selected ‘Parameters For:’ level of intensity in the Parameters Backing worksheet, and brings the external additions, external discharges, NASL and NASL: Discharged figures in to the Parameters worksheet.

The ‘Historical Weighting’ table is used to weight data when completing the iterations based on the year the data is in. The radio buttons control cell is set to 1 when ‘Weighting’ is selected, or 2 when ‘Overwrite’ is selected, which dictates the data in the Parameters Backing worksheet. The ‘Historical Weighting’ table runs several validation rules for the overwrite function and will flag to the user if the values entered are a) under 100% b) over 100% or c) a % figure is entered in a year that does not contain any data.

The ‘External Additions’ section of the Parameters table is used to set the number of contacts or minutes coming in to the system. This is set either by the total service, or by level of intensity. The radio button selection of ‘Mean’, ‘Randomised Historic Sample’ or ‘Overwrite’ is applied to all levels of intensity, but the values will change to specific levels of intensity if the parameters are set to be edited per level of intensity. The values are calculated in the Parameters Backing worksheet unless overwrite is selected. If overwrite has been selected, changing the overwrite value will run a worksheet_change macro to update the External Additions table in the Parameters Backing worksheet.

The values for the service flow diagram are taken from the Parameters Backing worksheet and dictated by the selections made at the top of the worksheet. More details for this data being pulled through is given in the Parameters Backing section of this guide. When data is entered in to the cells, a worksheet_change macro runs, which updates the Parameters Backing worksheet tables. Details on the macro can be found in Appendix A.

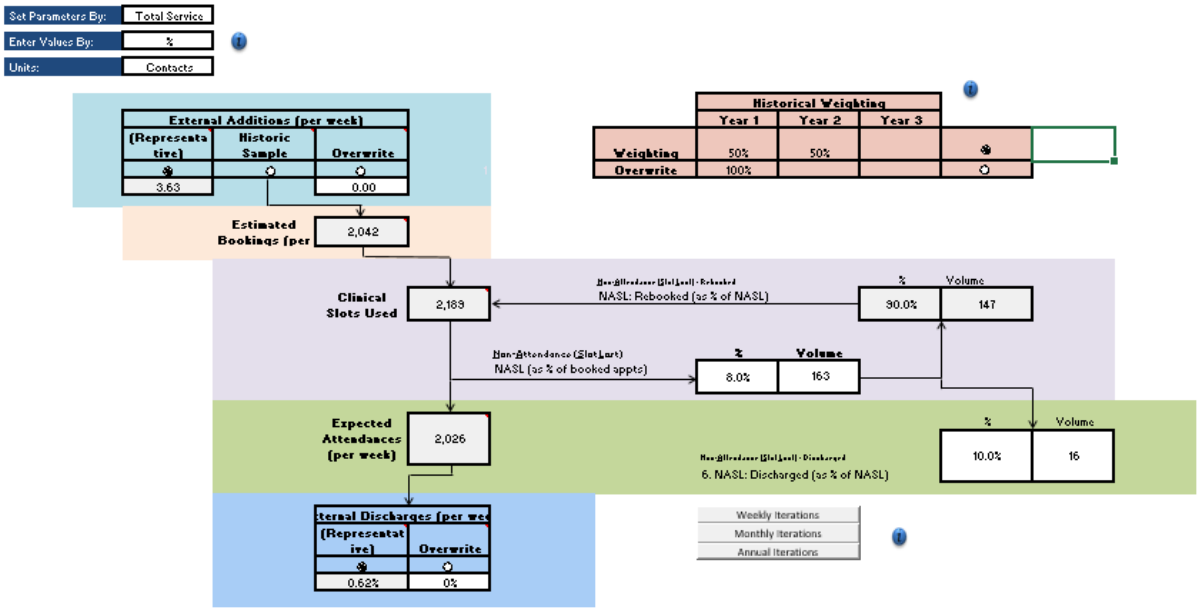
The ‘External Discharges’ table works in a similar way to the ‘External Additions’ table, with the calculations for the mean completed in the Parameters Backing

worksheet, and ‘Overwrite’ runs a similar worksheet_change macro to update the External Discharges table in the backing worksheet.

The Parameters Table is a summary of the Parameters Backing worksheet. This table combines all the different values entered in to the service flow diagram and is especially informative if ‘Set Parameters By:’ is set to Level of Intensity, to track values entered for Additions, Discharges, NASL, and NASL: Discharged.

The Flow Rate Table is used to mirror the functionality of the Demand Modelling – Control worksheet. It allows users to cycle through the weeks, months or seasons that are used when the iteration engine is run. All the tables are pre-configured, and the macro that runs the iteration engine determines which of these tables is visible to the user. The drop-down selection is linked directly to the Demand Modelling – Control worksheet value, and the Flow Rate Table is a copy of this information.

The Weekly, Monthly, Annual, and Seasonal Iterations buttons are used to trigger the relevant iteration macro. Full details on the iteration macros can be found in Appendix A.




**Parameters Table**

| | NASL | NASLD | NASLR | External Additio | External Discharges |
|---|---|---|---|---|---|
| Grp1 | 8.0% | 10.0% | 30.0% | 3.07 | 0.5% |
| Grp2 | 8.0% | 10.0% | 30.0% | 1.51 | 0.3% |
| Grp3 | 8.0% | 10.0% | 30.0% | 0.10 | 0.6% |
| Grp4 | 8.0% | 10.0% | 30.0% | 0.12 | 0.5% |
| Grp5 | 8.0% | 10.0% | 30.0% | 13.38 | 0.6% |

**Weekly Flow Rate Table**

Week Number: 52

| | | | | Transfers | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Source Group | | | | | |
| Target Group | Name | Start | External Flow | Grp1 | Grp2 | Grp3 | Grp4 | Grp5 | External Flow Out |
| Grp1 | Low | 360 | 3 | | 0.4% | 1.1% | 0.0% | 2.8% | 0.1% |
| Grp2 | Mid-Low | 508 | 2 | 0.0% | | 18.7% | 0.0% | 0.0% | 1.1% |
| Grp3 | Mid | 232 | 0 | 0.0% | 0.0% | | 50.2% | 0.0% | 1.0% |
| Grp4 | Mid-High | 290 | 0 | 0.0% | 0.0% | 7.4% | | 22.1% | 0.4% |
| Grp5 | High | 844 | 13 | 2.0% | 9.4% | 13.7% | 19.0% | | 0.9% |

## Related Worksheets

The Parameters worksheet allows the user to set the values in the Parameters Backing worksheet. It also uses the values calculated in the Demand Modelling – Control worksheet to display the Flow Rate Table.

# w. Parameters Backing

## General Principles

The Parameters Backing worksheet is used to calculate and store several data items for the Parameters worksheet.

The first two tables are the 'External Additions' tables. The mean External Additions are calculated using the historical weighting figures entered in the Parameters worksheet. The calculation is completed in the 'Historical Weighting – Modified Values' table, covered more extensively below. The Total figure is calculated as the average of all levels of intensity. The 'Overwrite' table is configured when values are entered in the Parameters worksheet, using a worksheet_change macro. 'Randomised Historic Data' is configured in the bootstrapping tables, using the Bootstrap macro. Again, this is covered in greater detail below.

The next two tables are the 'External Discharges' tables. The 'Mean' values are calculated by averaging the discharge rates in the Flow Rate (Hide) worksheet. The 'Overwrite' values are set in the Parameters tab by the user and are entered in to the Parameters Backing worksheet via a worksheet_change macro.

The 'Estimated Bookings' table is calculated by multiplying the average patient caseload by the summed required contacts or minutes as calculated in the Service tab for each level of intensity. The option to use contacts or minutes is set in the Parameters worksheet by the 'Units:' selection.

The Calculation Tables are used to store the data that the user has entered for the NASL and NASL: Discharged rates. The 'Calculated Rebooking Rate' figures are then calculated as the difference between the NASL and NASL: Discharged figures. This is then summarised in the Final Table, which is then displayed in the Parameters worksheet as the 'Parameters Table', for the user to review their selections.

The 'Historical Weighting – Modified Values' table applies the historical weighting selected to the External Additions entered in the model. The 'Values from Frontsheet' table is defined by the selection in the Parameters worksheet. To calculate the weighted values, the average External Additions for each year are multiplied by the weighting value, and the result of this summed to calculate a revised average external addition figure. This is calculated for each Level of Intensity.

The ‘Bootstrapped External Additions Data’ table is recalculated each time the ‘Randomised Historic Data’ radio button on the Parameters sheet is clicked. The full details for the Bootstrap macro can be found in Appendix A. The table produced randomises the weekly data to produce a new order, indicated by the ‘Order Index’ column. The Month, Season and Week columns are the original references for the data. This data can then be used as the weekly External Additions for the iteration macro.

After the bootstrapping macro has run, the data is then recollected in to seasonal groups. The data is still randomised, but the integrity of the seasons is maintained to ensure accuracy of the seasonality prediction.

## Related Worksheets

The Parameters Backing worksheet is linked back with the Parameters worksheet, accepting user input and then transforming it and feeding it back on the worksheet. The summarised tables in the Parameters Backing worksheet are used in the Results Backing (Hide) worksheet to convert the service’s demand in to required capacity.

# x. Demand Modelling – Control

## General Principles

The Demand Modelling – Control worksheet is used by the iteration macros to provide the data needed to complete the calculation. The sheet is set up in to four different tables, each used specifically for one type of iteration – weekly, monthly, seasonally or annually. The sum to calculate the values for each point varies depending on the table being used, but all the tables follow the same layout.

| Name | Description |
|---|---|
| Target – Group | The receiving Level of Intensity. The rates on each row are taken from the source group and added in to the target group. |
| Target – Name | Level of Intensity Description as entered in the Setup tab. |
| Target – Start | The final historic patient caseload figure (either user entered or validated, depending on Data Validation worksheet selection). The rates in the table are applied to this figure to calculate a figure for prediction week one. |
| Flow In – External | The External Additions for that group for the selected week. This value may be static or change every week, depending on the External Additions type that is selected in the Parameters sheet. |
| Transfers – Source | The % of the source group's patient caseload that is transferred to the target group for the selected week. |
| Flow Out – Discharge | The % of the target groups patient caseload that are External Discharges from the entire system, for the selected week. |

| | |
|---|---|
| Service Requirement – [Non-] Group Sessions | The summed service multiplier for the level of intensity. This is used by the Demand Modelling – Results sheet to calculate the demand on the service. |

The tables are controlled by the specific control values for the type of iteration, and the figures in the tables are updated to reflect an update in those values. A full description of the iteration macro is described further in Appendix A.

## Related Worksheets

The Demand Modelling (Control) worksheet provides the information shown in the Flow Rate Table in the Parameters worksheet.

# y. Demand Modelling – Results

## General Principles

The Demand Modelling – Results worksheet holds the outputs from the iteration engine. The worksheet records the predicted patient caseload, per week, for each of the levels of intensity.

## Related Worksheets

The Demand Modelling – Results worksheet provides the patient caseload levels for the Results Backing worksheet.

# z. Results

## General Principles

The Results worksheet displays the outputs from the model. The worksheet is split in to two parts.

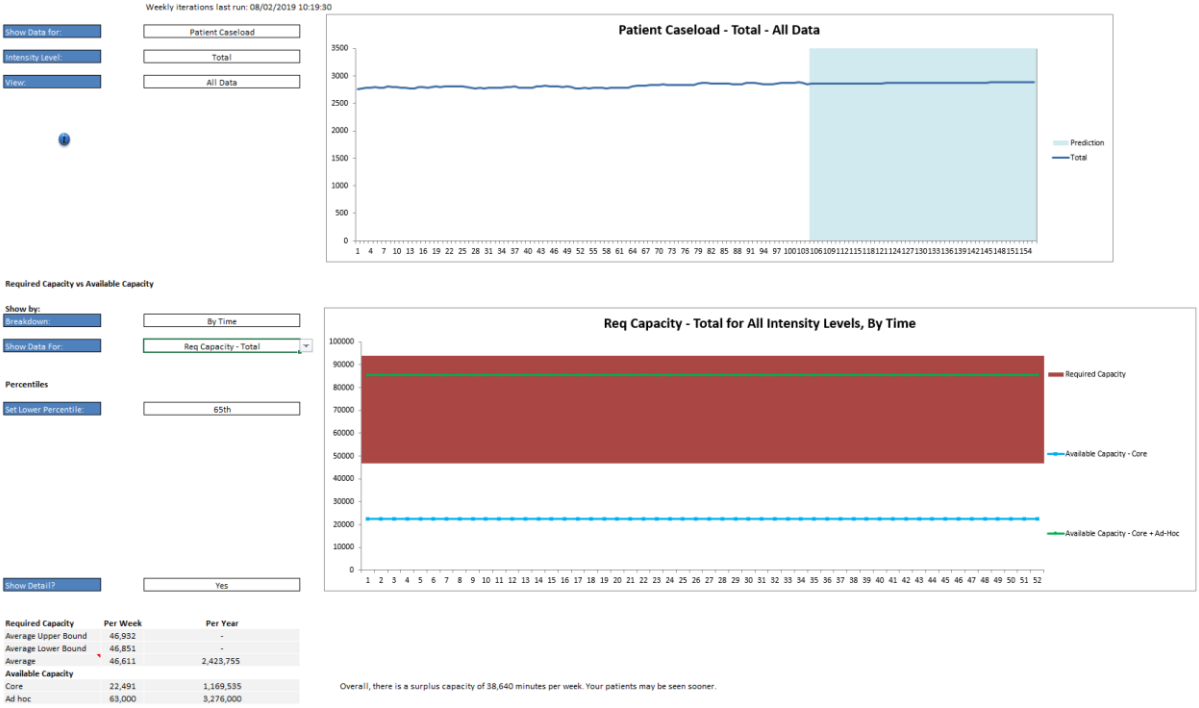
The top half of the worksheet displays the predicted patient caseload figures, and the associated demand. This can be transformed in several different ways. Firstly, the graph can show the patient caseload, the estimated demand for group sessions or the estimated demand for non-group sessions. The selection is linked to the named range RES_Series, which sets the data displayed on the graph, and will also update the required and available capacity balance chart. Secondly, the graph can be changed to show either the entire patient caseload, or specific levels of intensity. Changing the selection follows through to the Results Backing (Hide) worksheet and is used in calculating which data to display. Finally, the graph can display both the historic and predicted data, or alternatively focus just on the predicted data. The 'View:' selection is linked to the RES_Series named range and will update the graph accordingly. If predicted data is chosen, a worksheet_change macro will unhide an option to show seasonality. If the newly visible seasonality selection is set to 'Yes', a further worksheet_change macro will unhide columns in the Results Backing (Hide) worksheet to update the display of the graph with seasonal highlights.

The second half of the worksheet displays the balance between the available capacity and the required capacity. The graph displayed can be toggled between 'Overall' or 'By Time' using the 'Breakdown' selection. This will trigger a worksheet_change macro which hides or displays the required chart dependent on the selection made.

The 'Show Data For:' selection can be changed to show the required capacity for all types of sessions, group sessions only or non-group sessions only. Changing the selection will update a trigger cell in the Results Backing (Hide), which will decide the data that is being displayed.

The 'Set Lower Percentile:' selection is used to change the band of required capacity. The lower percentile can be set to the 65$^{th}$, 70$^{th}$, 75$^{th}$ or 80$^{th}$ percentile of the variation of demand. The upper percentile is fixed to the 85$^{th}$ percentile. Changing the value updates the percentile calculation table in the Results Backing (Hide) worksheet, which updates the data used in the graph.

Finally, the ‘Show Detail?’ selection can be used to show a summary table of the data displayed by the Results worksheet. Changing the selection triggers a worksheet_change macro, which will hide or unhide the table rows, as appropriate.




## Related Worksheets

The Level of Intensity selection in the Results worksheet shares the control cell in the Capacity Tables (Hide) worksheet, to reduce the required backing data. Therefore, changing the Level of Intensity selection in either the Results or Capacity Summary worksheet will change the selection in the other worksheet.

# aa. Results Backing (Hide)

## General Principles

The Results Backing (Hide) worksheet is used to populate the graphs and data in the Results worksheet, and transform the data to be taken to the aggregation modeule. The first table in the worksheet is used to track the patient caseload. The table combines the historic data from the Demand - External Additions worksheet, and the predicted patient caseloads from the Demand Modelling – Results worksheet. The table is used by the RES_Series named range to populate the Patient Caseload graph in the Results worksheet.

The worksheet then calculates the Non-Group Session and Group Session demand. This is calculated by multiplying the patient caseload by the service requirement for the patients within each Level of Intensity.

The worksheet calculates the Required Capacity for both types of session. The Required Capacity is calculated in the following way: Demand + ((Demand * NASL)*NASLR). This means that internally generated demand, via DNAs and rebooking, is considered in the required capacity calculation. Total Required Capacity is calculated by summing the group and non-group sessions.

The worksheet uses this information to create the data tables which populate the graphs on the Results worksheet.

The Seasonality table assigns seasons to the relevant weeks for the predicted data. The table assigns the first week of the predicted data to the correct week number, and then uses the setup in the Caseload SPC Chart worksheet to assign the correct season to that week. If 'Show Seasonality?' is set to 'Yes' in the Results sheet, any relevant season columns will be unhidden by the worksheet_change macro to display the data on the chart. The 'Selected Value' column is calculated using the parameters selected in the demand and capacity balance section of the Results worksheet, and these selections are also displayed above the Seasonality table.

With the parameters set, the model calculates the bounds for the required capacity. The lower bound is determined by the selection made in the Results worksheet, and the upper bound is locked to the 85$^{th}$ percentile. The percentiles are calculated for each season, if more than one season has been selected in the Caseload SPC Chart worksheet.

The Summary table combines the data points together to create backing values for the available vs. required capacity graph. The week (and date, if appropriate) is calculated, and the lower and upper bounds of required capacity are assigned to the different weeks dependent on the seasonality selection. The available capacity for specific weeks is located and added, for both core and ad hoc clinics. This is then summed for the 'Core + Ad Hoc' column.

The Results Backing (Hide) worksheet also calculates the averaged values for the simplified display. The columns in the Summary table are averaged across the 52 weeks for use in the 'Show Detail?' table in the Results worksheet.

The worksheet then converts the demand in to contacts for the aggregation module. The aggregation module is used to calculate the expected activity outturn of a system, modelled across multiple different models.

The Expected Activity (Contacts) tables converts the patient caseload in to expected contacts per week. This is calculated by multiplying the patient caseload by the frequency of contact for that level of intensity. This demand is then converted in to required capacity by multiplying the contacts by the system behaviour parameters in the same way it is done previously in the worksheet. The required capacity is then summed to meet the requirements of the aggregation module. In the same vein, seasonality is configured and upper and lower bounds of demand are configured in the same way as the demand for the model results.

## Related Worksheets

The Results Backing (Hide) worksheet provides the backing data for the Results worksheet and the Aggregation Module (hide) worksheet.

# bb. Aggregation Module (Hide)

## General Principles

The Aggregation Module (Hide) worksheet is used as a control sheet for importing the High Complexity Model in to the Aggregation Module. The data in this sheet is used to drive the calculations in the Aggregation Module, and are basic calculations made from the data entered in to the model. For further information on the Aggregation Module, please see details on the Demand and Capacity Programme's website.

The Mean Demand, Lower Bound and Upper Bound are calculated using the data in the Results Backing (Hide) worksheet. The NASL, NASL DNADischarge and Rebookings rates come from the Parameters worksheet, and the Available Capacity data is from the Capacity Tables (Hide) worksheet. For integration with the aggregation module, a number of blank cells are included that are not relevant to the High Complexity Model, and are set to 0.

## Related Worksheets

The Aggregation Module (Hide) does not impact on any other worksheets in the model.

# Appendix A - VBA

The High Complexity Model makes extensive use of Visual Basic for Applications (VBA) to create macros which have numerous effects throughout the model. There are three main types that the model uses:

1. worksheet_change macros
2. Module macros
3. User Forms

Worksheet_change macros are specific to individual worksheets, whereas module macros and user forms can generally be instigated at any time, from any worksheet. A good working knowledge of VBA programming and experience using macros is advisable before trying to change any of the VBA programming used by the model.

## Worksheet_change macros

Most macros in the High Complexity Model are driven by changes to a cell in specific workbooks. Worksheet_change macros follow the same setup:

```
Private Sub worksheet_change(ByVal Target As Range)
If Not Application.Intersect(Target, Range("")) Is Nothing Then
Macro Code Here
End Sub
```

Where the Range(“”) reference refers to the cell that is to be monitored for a change.

The code is commented to aid with interpretation, and the debug tools in Excel can be used to identify changes specifically.

## Module Macros

There are module level macros that are used by the model for actions that are not specific to a change being made. These are generally activated by the user clicking a button. The code is split over several modules for ease of use.

## Data Import

**Function Import()**

Description

The Data Import module is used for the data import functionality of the worksheet. This module copies the user entered data from one version of the High Complexity Model in to another. Due to the complex setup of the data entry sheets in the model, the code brings across the data as numerous ranges.

Arguments

Not Applicable

Example

Not applicable

## DemandModelling

**Function weeklyiterations(), monthlyiterations(), seasonaliterations(), annualiterations()**

Description

The DemandModelling module is the iteration engine for the predictions made by the model. It has four different modes – weekly, monthly, seasonal and annual. These different modes aggregate the flow rates in different ways according to the user selection.

Arguments

Not applicable

Example

Not applicable

## I_Icon_Macros

**Function i_X_Clicked()**

Description

The I_Icon_Macros within the module are used to power the information buttons throughout the model. Icons on the same page have extended code that will hide other text boxes on the same page, to prevent clutter on the worksheet.

Arguments

Not Applicable

Example

Not Applicable

## Protection Macros

**Function quickprotect()**

Description

The quickprotect function works through each worksheet in the model and will protect user facing worksheets.

Arguments

Not Applicable

Example

Not Applicable

**Function quickunprotect()**

Description

The quickunprotect function works through each worksheet in the model and will unprotect all worksheets.

Arguments

Not Applicable

Example

Not Applicable

**Functions setup_unprotect(), setup_protect(), CaseloadSPC_unprotect(), CaseloadSPC_protect(), service_protect(), service_unprotect(), CapacitySetup_unprotect(), CapacitySetup_protect(), CapacitySummary_unprotect(), CapacitySummary_protect(), Parameters_unprotect(), Parameters_protect(), Results_unprotect(), Results_protect(), DataValidation_unprotect(), DataValidation_protect()**

Description

Specific macros are included to improve the speed of the overall operation of the model.

Arguments

Not Applicable

Example

Not Applicable

## Public Functions

**Function MyMouseOverEvent(iColumn As Integer)**

Description

The Public Functions module is used for the MyMouseOverEvent macros, which highlight the transfer arrows in the Demand – Internal Transfers worksheet. The header of the columns in the Demand – Internal Transfers worksheet are hyperlinks that call the function.

Arguments

| | |
|---|---|
| iColumn | Passed from hyperlink in worksheet, column number for relevant header |

Example

*MyMouseOverEvent(4)*

Will make the arrow for Level of Intensity 1 to Level of Intensity 5 bold on the diagram.

## Season_Macros

The code in the Season_Macros is deprecated and is not in use.

## Specific_Macros

**Function Show_MAPE_Info(), Hide_MAPE_Info()**

Description

The Show_MAPE_Info and Hide_MAPE_Info functions are linked to the selection in the Data Validation worksheet, and triggers the hiding or unhiding of the MAPE information in the worksheet.

Arguments

Not Applicable

Example

Not Applicable

**Function AxisValueCaseload(), AxisValueAdditions()**

Description

These two functions are used to determine if the x-axis on the Patient Caseload or External Additions SPC charts have changed, and highlights this to the user for information.

Arguments

Not Applicable

Example

Not Applicable

**Function Bootstrap()**

Description

The Bootstrap function is used to randomise the external additions for the predictive aspect of the model, rather than using the mean or user-defined values.

Arguments

Not Applicable

Example

Not Applicable

**Function Advanced_Calculator_Click()**

Description

The Advanced_Calculator_Click function is used to configure the model for the advanced capacity setup. This includes displaying the two hidden capacity calculation worksheets, Critical Resources and Capacity Setup.

Arguments

Not Applicable

Example

Not Applicable

**Function Simplified_Calculator_Click()**

Description

The Simplified_Calculator_Click function is used to configure the model for the basic capacity setup. This includes hiding the two advanced calculation worksheets, Critical Resources and Capacity Setup, and setting the Adjust Ad Hoc Capacity cell on the Capacity Summary worksheet to “No”.

Arguments

Not Applicable

Example

Not Applicable

**Function Customise_List(), List_Set()**

Description

The Customise_List function is used to display the List worksheet, to change the data validation selection in the drop downs on the Setup worksheet. Similarly, the List_Set function is used to hide the List worksheet.

Arguments

Not Applicable

Example

Not Applicable

## Standard_Macros

**Function RowVisible(TargetSheet, StartRow, Height, Flag)**

Description

Hides or unhides a defined set of rows in a worksheet.

Arguments

TargetSheet Name of the worksheet in which the target rows are located (*string*)

StartRow Starting row which will be affected by the function (*integer*)

Height Number of rows that will be affected (*integer*)

Flag True/False flag which sets whether specified rows will be visible (value = *True*) or hidden (value = *False*) [*Boolean*]

Example

*Call RowVisible("Demand", 3, 5, False)*

Will result in rows 3 to 5 on the sheet “Demand” becoming hidden.

**Sub ColVisible(TargetSheet, StartCol, Width, Flag)**

Description

Hides or unhides a defined set of columns in a worksheet.

Arguments

TargetSheet Name of the worksheet in which the target rows are located (*string*)

StartCol Starting column which will be affected by the function (*integer*)

Height Number of rows that will be affected (*integer*)

Flag True/False flag which sets whether the specified rows will be visible (value = *True*) or hidden (value = *False*) [*Boolean*]

Example

*Call ColVisible(“Demand”, 3, 5, False)*

Will result in columns C – E on the sheet “Demand” becoming hidden.

**Function ShapeVisible(TargetSheet, Shapename, Shapenumber, Flag)**

Description

The ShapeVisible function is a generic function to hide or unhide shape objects in the workbook. This is mainly used in the model to hide or unhide transfer arrows in the Demand – Internal Transfers worksheet via the Setup worksheet change code. The shape names are composed of a shapename (e.g. arrow) and a shapenumber (e.g. 17)

Arguments

TargetSheet The location of the shape

Shapename The name of the shape

Shapenumber The number of the shape

Flag If True, the shape will be visible, if false it will be hidden

Example

*Call ShapeVisible("Demand – Internal Transfers", "Arrow_", "17", True)*

This will display the shape "Arrow_17" on the Demand – Internal Transfers worksheet.

**Function reset_wb()**

Description

The reset_wb function is used to reset the workbook for user entry, hiding backing sheets from view.

Arguments

Not Applicable

Example

Not Applicable

**Function ShowDependencies()**

This function is deprecated and no longer in use

Description

The showdependencies function is a useful tool for administrators when determining the impact a change to a cell formula will have, as it will list the

Arguments

Example

**Function change_capacity(count_groups)**

Description

This function is used to declare to the user a change in the capacity setup to allocate the capacity across multiple Levels of Intensity, if appropriate. This is called each

time the iterations are run. It calls the user forms, described below, to inform the user of the change.

Arguments

count_groups — The number of Levels of Intensity used in the model, as defined in the Setup worksheet.

Example

*Call change_capacity(5)*

This will split the shared capacity amongst five groups, depending on the proportion of required capacity left after specific capacity has been applied.

### Var_Setup

**Function var_set()**

Description

This function sets a variable for the number of patient groups that are selected in the Setup worksheet.

Arguments

Not Applicable

Example

Not Applicable

## User Forms

The model has two user forms, one to display a warning message that the model is running code that may take a long time, and one to display the change in capacity. The warning message is displayed whilst the import code and the iteration code is running, as the model will be locked whilst these are running. The change in capacity form is shown when the iteration code has been completed, to display any changes to the allocation of capacity.

# Appendix B – Model Named Ranges

The High Complexity Model uses the named range feature of Excel in order to simplify some of the formulas used in the model, especially where a particular range is used frequently throughout the model. A brief description of the range and its purpose is given below.

## CAP_Capacity_Resource

This is the range of names of critical resources that have been configured in the Critical Resources worksheet in the model. It is used when determining if a clinic is running on a particular week in the Capacity Calculation (hide) worksheet. The range is limited only to those critical resources that have a name entered.

## CAP_Chart_Adhoc

This is the range of values for the available ad hoc capacity per week that is used to populate the capacity summary chart in the Capacity Summary worksheet.

## CAP_Chart_Adhoc_Deprecated

This range is no longer in use and is deprecated.

## CAP_Chart_Core

This is the range of values for the available core capacity per week that is used to populate the capacity summary chart in the Capacity Summary worksheet.