POPGROUP v.4

User Guide 6

How to Integrate Population, Housing and Labour Force Projections

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Contents

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Introduction

This Guide shows how to integrate population, household and labour force projections. In a single population projection from POPGROUP, the Derived Forecasts program will be run in the background to link the population to households and housing, and to economic activity and jobs. These derived variables appear on POPGROUP's `comp` output file.

Either housing (dwellings) or jobs may be named as a constraint for a projection:

- A planned change in the future number of jobs will determine the future population and its age-sex composition. The housing required by the population projection will also be calculated.
- Alternatively, a planned change in the future number of dwellings will constrain future population and its age-sex composition. The jobs required by the population projection will also be calculated.

The integration of population, household and labour force projections is an extension of the dwelling-led forecasts of User Guide 4 and the jobs-led forecasts of User Guide 5, available from popgroup@edgeanalytics.co.uk. Integration of this sort is common in the development of Local Plans, which usually involves projections of whole local authority districts, as in the example in this Guide. The approach is also used with projections for smaller (sub-district) areas to assess the impact of a proposed development on population.

POPGROUP is used for many other aspects of assessing the need for services according to the projected future age-composition of the population. This Guide focuses on one specific application in the development of Local Plans, to estimate the impact of population, housing and jobs on each other.

1.1. How much time do I need?

No files are required for this Guide other than those already prepared for User Guides 4 and 5. Once the earlier User Guides have been completed, the projections of this Guide will take about an hour. Consideration of the results and of alternative assumptions will take a little longer.

1.2. What else will I need to know?

This Guide is intended for those who have already prepared population projections, housing-led projections, and jobs-led projections, described in earlier User Guides. Choose one population projection, and one set each of household and labour force assumptions that will be the starting point for your use of this User Guide in Sections 2-4. Later sections will ask you to implement alternative scenarios.

In the example used in this Guide, the population, household and the labour force projections all start in 2001. The population projection is the government 2012-based sub-national projection, updated with government population estimates to mid-2014. In Wales the equivalent projections are from 2011 at the time of writing. During 2016, the sub-national population projections for England, Wales and Scotland will all be updated to be 2014-based. However, the Guide's instructions may be used with any set of population, household and labour force projections. You can, for example, use 2012-based projections, starting in 2012 and not updated with mid-year estimates, so long as:

- The population, household and labour force projections all name the same district(s) and
- The labour force and household projections start in the same year as the population projection, or in an earlier year.

The POPGROUP v.4 reference manual remains the comprehensive guide that should also be consulted to learn how the software operates and its full range of functionality. Its section 11.8 on constraints in POPGROUP includes the mathematics of how population, household and labour force projections are integrated.

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1.3. About this Guide

In this document, the names of Excel workbooks are written in bold grey font (e.g. **POPGROUP_Scenario.xls**). Sheets within workbooks are written in bold grey italics surrounded by single quotation marks (e.g. **'Sched'**).

References to cells within worksheets, or to buttons/options within the workbooks are in blue italics surrounded by single quotations, for example, *'Validate'*.

Two types of text box are used in this document:

(i)	**Information**

!	**Warning**

2 A Population Projection without Constraints: What is the Impact on Housing and Jobs?

In this Section, you will run both a household and a labour force projection by entering their details in a POPGROUP scenario. POPGROUP will derive the household/dwelling and labour force/jobs implications of your population projection, using the assumptions you define. Record the results under 'Your Answers', on page 20. In this Section, you will not include a constraint of housing or jobs – that will happen in the next two sections.

Before you begin, decide which will be the starting assumptions. They may be the government projections or the projections favoured in your organisation as a starting point for planning services, or the projections you have prepared when using earlier User Guides.

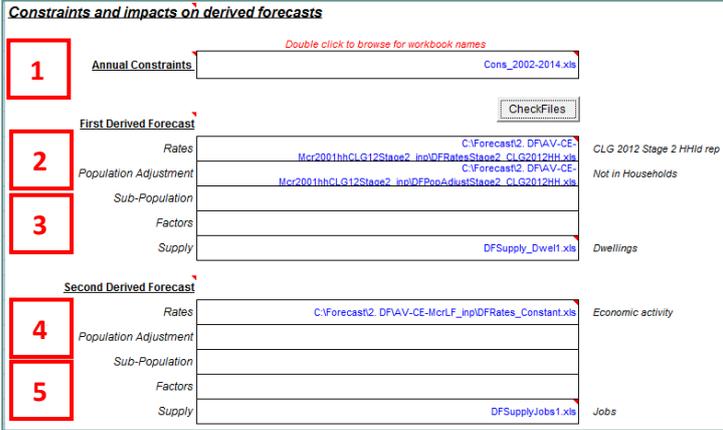| !	**The household and labour force projections must start in the same year or an earlier year than the population projections.**
	You will be asking POPGROUP to calculate the households and labour force from the population projection. To do this, for each year of the population projection there will need to be information about household formation and economic activity.

You will need these files to name on a POPGROUP `Scenario` file. From your POPGROUP input folder, you will define:

- the *population projection*. Files for the base population (`PopBase`), fertility (`Fert`), mortality (`Mort`) and migration (`Mig`), and optionally a constraint (`Cons`) for past population estimates.
- the `DFSupply` file that contains the assumptions to convert *between households* and *dwellings*.
- the `DFSupply` file that contains the assumptions to convert between *labour force* and *jobs*.

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From your Derived Forecast input folders:

- the *household assumptions*. These will be held in your DF input folder for household projections and will likely include headship/membership rates (`DFRates`), a population adjustment (`PopAdjust`) and, if in Wales, a factor (`DFFactor`).
- the *labour force assumptions*. These will be held in your DF input folders for labour force projections and will be the economic activity rates (DFRates).

Action: Amend a POPGROUP scenario to run household and labour force projections, run and view the results	POPGROUP View
From your POPGROUP model's input folder, open the `Scenario` file, e.g. `C:\Forecast\POPGROUP V4.0\<ModelID>_inp\ScenarioXX.xls` Change the *'Scenario ID'*, which will be used to name this file and the output files, e.g. to include 'Impact'.	Scenario identifier: ONS2012from2014Impact

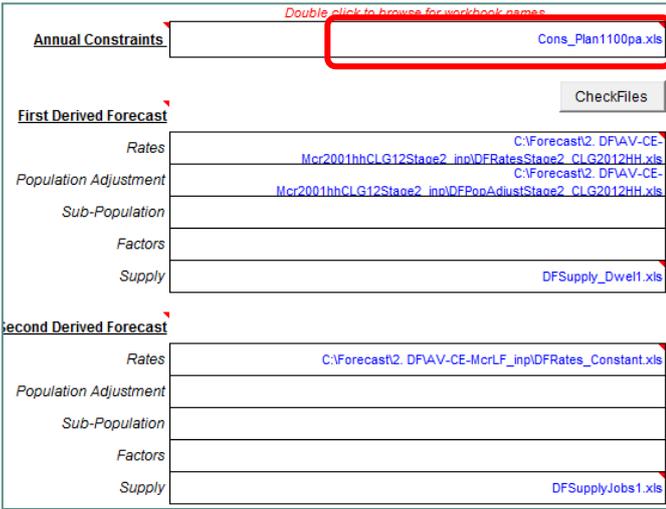| Action: Amend a POPGROUP scenario to run household and labour force projections, run and view the results	POPGROUP View
On the '*Constraints_and_impacts*' sheet: 1. Remove any constraint that refers to housing or jobs. There may be population constraints. 2. Add the household assumption files to the first section. In Wales there will be an extra file, the **Factors** file for household size. 3. Add the '**DFSupply.xls**' file for housing 4. Add the '**Economic Activity Rates.xls**' file 5. Add the '**DF supply.xls**' file for jobs	*Constraints and impacts on derived forecasts* Find a file by double-clicking its cell and navigating to the file on your computer. The text to the right of the file names will be revised when you click: **CheckFiles** POPGROUP will then check that the file is of the right type, and write in what it refers to.
Return to the '*Run_details*' sheet: • Amend the *'Notes for this scenario'* in the box below the file details. • Click: **RUN THE MODEL**	

Action: Amend a POPGROUP scenario to run household and labour force projections, run and view the results	POPGROUP View
The output files will remain open • The **Reports** output file will be active. You can use the **'Charter'** sheet to chart a time series with the housing and jobs results are at the end of the list: Select component/population summary • The **'Comp'** output file has a sheet for each area. The results for households and the labour force are at the bottom of the sheet.	**Population Estimates & Forecasts - Training Number of Jobs** 	91 **Population impact of constraint** 92 Number of persons 93 94 **Households** 95 Number of Households 64,681 93,196 93,967 94,728 96 Change in Households over previous year +781 +771 +761 97 Number of Dwellings 66,984 96,513 97,312 98,100 98 Change in Dwellings over previous year +809 +798 +788 99 100 101 **Labour Force** 102 Number of Labour Force 89,310 108,485 108,856 109,248 103 Change in Labour Force over previous year +387 +371 +392 104 Number of Jobs 84,309 102,410 102,760 103,130 105 Change in Jobs over previous year +366 +350 +370
• Record the results for the last year of the projection in the section 'Your Answers' on page 20.	

On the **Scenario** file there is space for two 'Derived Forecasts'. It does matter which way round you put the household and labour force forecasts; either can be the first or the second. In the next Sections, you will specify a housing constraint and a jobs constraint. In these instances, the order in which these assumptions are defined *does* matter. With a housing constraint, the 'First Derived Forecast' assumptions must relate to households and dwellings. With a jobs constraint, the 'First Derived Forecast' assumptions must relate to the labour force and jobs.

3 A Housing Plan: What is the Impact on Population and Jobs?

The only difference between this scenario and the previous scenario is the use of a Constraints file to specify the change in the stock of dwellings each year. This is referred to as 'dwelling-led' scenario. In this type of scenario, migration is used to balance between housing and population. For example, if the supply of housing is greater than the amount implied by the projection without a dwelling constraint, migration will be higher as people move to the area to fill the housing. POPGROUP evaluates the impact of the dwelling constraints on the population, and then calculates the labour force and number of jobs consistent with the revised population.

The housing plan that specifies a change in the stock of dwellings is entered on a `Cons` file (constraints). You will have made and used one for User Guide 4. Follow the instructions and write the results in the Section of Your Answers.

Action: Run population, household and labour force projections, led by a housing plan	POPGROUP View
Use the `Scenario` file for the previous projection – it will probably still be open. • Change the Scenario identifier to indicate the housing plan.	**Scenario identifier:** ImpactPlan1100pa
On the `'Constraints_and_impacts'` sheet: • Change the constraints file by double clicking and navigating to it. • No other changes are needed on this sheet.	*Double click to browse for workbook names* **Annual Constraints** Cons_Plan1100pa.xls CheckFiles **First Derived Forecast** Rates C:\Forecast\2. DF\AV-CE-Mcr2001hhCLG12Stage2_inp\DFRatesStage2_CLG2012HH.xls Population Adjustment C:\Forecast\2. DF\AV-CE-Mcr2001hhCLG12Stage2_inp\DFPopAdjustStage2_CLG2012HH.xls Sub-Population Factors Supply DFSupply_Dwel1.xls **Second Derived Forecast** Rates C:\Forecast\2. DF\AV-CE-McrLF_inp\DFRates_Constant.xls Population Adjustment Sub-Population Factors Supply DFSupplyJobs1.xls
Return to the `'Run_Details'` sheet: • Amend the documentation • Click **RUN THE MODEL** Once run, on the `Comp` output file, the revised population, households and labour force will be recorded. Record the final year's population, dwellings and jobs in the 'Your Answers' section on page 20. The population is further up on the same `Comp` file.	<table><tr><td>91</td><td colspan="4">Population impact of constraint</td></tr><tr><td>92</td><td>Number of persons</td><td>+726</td><td>+737</td><td>+748</td></tr><tr><td>93</td><td></td><td></td><td></td><td></td></tr><tr><td>94</td><td colspan="4">Households</td></tr><tr><td>95</td><td>Number of Households 64,681</td><td>95,785</td><td>96,847</td><td>97,909</td></tr><tr><td>96</td><td>Change in Households over previous year</td><td>+1,062</td><td>+1,062</td><td>+1,062</td></tr><tr><td>97</td><td>Number of Dwellings 66,984</td><td>99,194</td><td>100,294</td><td>101,394</td></tr><tr><td>98</td><td>Change in Dwellings over previous year</td><td>+1,100</td><td>+1,100</td><td>+1,100</td></tr><tr><td>99</td><td></td><td></td><td></td><td></td></tr><tr><td>100</td><td></td><td></td><td></td><td></td></tr><tr><td>101</td><td colspan="4">Labour Force</td></tr><tr><td>102</td><td>Number of Labour Force 89,310</td><td>112,897</td><td>113,747</td><td>114,628</td></tr><tr><td>103</td><td>Change in Labour Force over previous year</td><td>+856</td><td>+850</td><td>+882</td></tr><tr><td>104</td><td>Number of Jobs 84,309</td><td>106,575</td><td>107,377</td><td>108,209</td></tr><tr><td>105</td><td>Change in Jobs over previous year</td><td>+808</td><td>+802</td><td>+832</td></tr></table> The 'Population impact of constraint' is the difference in population with and without the constraint, each year. In this example, the housing plan has resulted in an increased population.

You will see that the housing plan has an impact on population and jobs. The '*Change in Dwellings over previous year*' is directly from the plan. Was it more or less than the housing needed from the base projection in Section 2?

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The impact of the housing plan on population depends on the local nature of migration and household formation, but it is usually more than the impact on housing because, on average, more than one person occupies each house. The number of jobs dependent on a housing plan varies more between areas, because it depends not only on activity rates but on assumptions you may have made about commuting and unemployment.

4 An Economic Plan: What is the Impact on Population and Housing?

This Section repeats the previous exercise, but with a plan for jobs, rather than a plan for housing.

The jobs target from an economic plan specifies a net change in number of jobs and is entered on a `Cons` file (constraints). You will have made and used one for User Guide 5. You will use the same `Scenario` file from the previous Section of this report, replacing the housing targets with the jobs target.

You will also swap the entries for labour force/jobs and household/dwelling files on the `'Constraints and Impacts'` worksheet of the `Scenario` file, so that the 'First Derived Forecast' set of files relate to the jobs `Cons` file you have specified. Follow the instructions and write the results in the 'Your Answers' Section.

Action: Run population, household and labour force projections, led by an economic plan	POPGROUP View
Use the `Scenario` file for the previous projection – it will probably still be open. • Change the *'Scenario identifier'* to indicate the economic plan.	**Scenario identifier:** **ImpactJobsPlanA**

On the `'Constraints_and_impacts'` sheet:
 	
• Change the constraints file by double clicking and navigating to the jobs plan.
• Swap the files so that the labour force and jobs files appear in the *'First Derived Forecast'* section, and the household and housing files in the *'Second Derived forecast'* section. You can either double click on each file to replace it, or copy the entries to another Excel file and paste back as Values.
	Double click to browse for workbook names
	Annual Constraints Cons_JobsPlanA.xls
	
	                                 [CheckFiles]
	First Derived Forecast
	Rates C:\Forecast\2. DF\AV-CE-McrLF_inp\DFRates_Constant.xls
	Population Adjustment
	Sub-Population
	Factors
	Supply DFSupplyJobs1.xls
	
	Second Derived Forecast
	Rates C:\Forecast\2. DF\AV-CE-
	         Mcr2001hhCLG12Stage2_inp\DFRatesStage2_CLG2012HH.xls
	                            C:\Forecast\2. DF\AV-CE-
	Population Adjustment Mcr2001hhCLG12Stage2_inp\DFPopAdjustStage2_CLG2012HH.xls
	Sub-Population
	Factors
	Supply DFSupply_Dwel1.xls
	
	After changing the files, click on [CheckFiles] to make sure they are in their right places.

Action: Run population, household and labour force projections, led by an economic plan	POPGROUP View
Return to the *'Run_Details'* sheet: • Amend to the documentation • Click **RUN THE MODEL** Once run, on the `Comp` output file, the revised population, households and labour force will be recorded. NB: As on the `Scenario` workbook, the Labour Force and Household outputs are swapped: the Labour Force and jobs come first. Record the final year's population, dwellings and jobs in Your Answers on page 20 (where the order has not changed).	<table><tr><td>91</td><td colspan="5">**Population impact of constraint**</td></tr><tr><td>92</td><td>Number of persons</td><td></td><td>-1</td><td>+32</td><td>-1</td></tr><tr><td>93</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>94</td><td>**Labour Force**</td><td></td><td></td><td></td><td></td></tr><tr><td>95</td><td>Number of Labour Force</td><td>89,310</td><td>107,991</td><td>108,368</td><td>108,745</td></tr><tr><td>96</td><td>Change in Labour Force over previous year</td><td></td><td>+377</td><td>+377</td><td>+377</td></tr><tr><td>97</td><td>Number of Jobs</td><td>84,309</td><td>101,943</td><td>102,299</td><td>102,655</td></tr><tr><td>98</td><td>Change in Jobs over previous year</td><td></td><td>+356</td><td>+356</td><td>+356</td></tr><tr><td>99</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>100</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>101</td><td>**Households**</td><td></td><td></td><td></td><td></td></tr><tr><td>102</td><td>Number of Households</td><td>64,681</td><td>92,789</td><td>93,569</td><td>94,328</td></tr><tr><td>103</td><td>Change in Households over previous year</td><td></td><td>+781</td><td>+780</td><td>+759</td></tr><tr><td>104</td><td>Number of Dwellings</td><td>66,984</td><td>96,092</td><td>96,900</td><td>97,685</td></tr><tr><td>105</td><td>Change in Dwellings over previous year</td><td></td><td>+808</td><td>+808</td><td>+786</td></tr></table> The '*Population impact of constraint*' was small in this example. The jobs plan was very similar to the number of jobs needed for the projected population before a plan.

5 Alternative Scenarios

The intention of this exercise is to measure the impact of a variety of assumptions on the key dwelling requirement outcomes. This will help you to foresee the impact of these assumptions and other changes you make to assumptions.

As in the previous sections, you will:

- Run each forecast by amending the scenario file and entering a different scenario ID.
- Look at the `Comp` output file to find the *average dwellings change* during the forecast. Highlight the part of the row 'Change in Dwellings over previous year' that refers to the projection years, and read off the average from Excel's summary statistics at the bottom of the screen.
- Record the results in the 'Your Answers' section on page 20.

The table below lists the base and alternative scenarios, and the input files that will be amended. Each alternative scenario is one that is common when preparing a Local Plan.

The table does not specify exactly what changes to make. By now you will probably already have alternative assumptions about household representative rates and economic activity rates. You will have created the `DFSupply` files that have already been use in previous Sections and are easy to amend. The amendments you make for this exercise should be plausible and realistic alternative assumptions.

Amendment to the base scenario household and labour force files	Input files to amend	Constraint	Comment
1. No amendment to the base scenario	None	No jobs or housing constraint	This is the baseline projection, carrying forward the experience of the recent past, from Section 2.
2. Higher household representative rates	DFRates for house-holds	No jobs or housing constraint	With higher household representative rates, more people will be household 'heads'. There will be more dwellings required.
3. Lower vacant housing rate	DFSupply for housing	No jobs or housing constraint	With fewer vacant dwellings, fewer dwellings will be required.
4. Higher economic activity rate	DFRates for economic activity	No jobs or housing constraint	The economic activity will increase the number of jobs required but will not affect the housing requirement.
5. No amendment	None	Jobs plan as constraint	From Section 4. If the jobs plan is for more jobs than the base projection projected, then there will be more migration into the area. As a result, more housing will be required. However, if the plan is for fewer jobs than the base projection expected, less housing will be required.
6. Higher household representative rates	DFRates for house-holds	Jobs plan as constraint	More housing will be required.
7. Lower vacant housing rate	DFSupply for housing	Jobs plan as constraint	Less housing will be required.
8. Higher economic activity rates	DFRates for economic activity	Jobs plan as constraint	With higher economic activity rates, more of the jobs will be filled by the resident population. Less housing will be required.

Amendment to the base scenario household and labour force files	Input files to amend	Constraint	Comment
9. Higher commuting ratio	DFSupply for jobs	Jobs plan as constraint	A higher commuting ratio means more resident workers compared to those commuting in. More housing will be required.
10. Lower unemployment rate	DFSupply for jobs	Jobs plan as constraint	With lower unemployment, more of the jobs will be filled by the existing population. Less housing will be required.

6 What Other Types of Constraints Can be Used?

This Section addresses some questions which are often asked about integrating forecasts in practice.

6.1. Why can't there be housing and jobs targets in the same plan?

POPGROUP changes the migration to meet a housing or jobs target. It can't change the migration to meet two different figures in the same year. That is why only one of housing or jobs can be specified as a constraint in POPGROUP.

Of course, in reality, a plan can have both a housing and jobs target. If the two targets produce different population forecasts in POPGROUP, it is a warning that one or more of the other assumptions you have made conflicts with the targets.

These other assumptions include: household headship rates, economic activity rates, the conversion between households and dwellings (including vacancy rates and second homes), and the conversion between the labour force and jobs (including unemployment and the commuting ratio). The user can study and change these as has been practised in the Section 5, to ensure that the dwellings and jobs targets are consistent.

6.2. What if I have population and dwelling estimates that are not consistent?

When using POPGROUP, you may find that the population and dwelling outputs do not necessarily align with current or historical data from other sources. For example, you may be using an 'official' population projection as a constraint in POPGROUP, but the estimated number

of dwellings produced by the model is different to your best estimate from planning information. This is not a problem, but a reason to consider whether the assumptions you have entered into POPGROUP files are the best that they can be. You may wish to consider the following:

- The population or dwelling estimate may be wrong. Is the inconsistency big enough to be sure that it is not due to inaccuracy in one or the other?

- The household representative rates not reflect reality. For example, the number of dwellings in London during the 2000s was lower than expected, which indicated that more people were living in each household i.e. that the estimated household representative rates had been too high. This might lead you to alter the `DFRates` file of household representative rates.

- Alternatively, the discrepancy may indicate that the vacancy rate or other assumption on the `DFSupply` file is incorrect.

6.3. I have an accepted population forecast for the District. Can I measure the impact of a housing plan for local areas?

A POPGROUP user with 'small area' (sub-district) forecasts within a District may want to evaluate the impact of different plans for building in each local area. If there is already an accepted population projection for the District as a whole, how can dwellings for the local areas and population for the whole District be entered as constraints?

The short answer is that both dwellings and population cannot be entered in POPGROUP. To get an answer to the question would require some trial and error:

- A scenario with the District population constraint but no dwellings constraint would provide a total future number of dwellings for the District that is consistent with the projected population.

- Next, a plan can distribute this District total to local areas. The resulting total for the District may not be exactly the same as before, because of the different age structures and headship rates (household representative rates) in each area. Some adjustment to the plan may be necessary if a more exact consistency between previous District projections and a local area plan is required.

6.4.   Can I have average household size as a constraint?

Given the uncertainty about levels of household formation in the 21st century, a natural question is 'what would the number of households be if average household size fell by, for example, 5%?'. Or 'What if average household size rose by 5% more than the official projections suggest?'.

Household size is not a good indicator of housing requirements, because it includes children, who do not make a difference to the number of houses needed. In 2016, there are 10% more children in households than a decade before, because fertility rates rose in the 2000s. However, these children won't have much effect on housing need for another decade or two. This is why POPGROUP, like government projections, uses household representative rates rather than household size as its measure of household formation.

If you still want to answer those questions, you could do so straightforwardly with some trial and error. For example:

- Amend the `DFRates` file containing household representative rates, so that headship rates at each age are 5% lower than those projected officially. This will increase household size, but not exactly by 5% because it is also affected by the number of children.
- Examine the results, and make further amendments until you have achieved the change in household size that you aimed for.

6.5.   How would vacancy rates meet a house-building plan, rather than migration?

POPGROUP does not include vacancy rates as a means to meet a constraint. But you can specify different vacancy rates in the `DFSupply` file, rerun the projection and record the result.

For example a reduction of vacancy rates by five percentage points (e.g. from 12% to 7%), will reduce the number of dwellings needed to accommodate the same population. The reduction will be a little less than 5%, and the exact amount will depend on the initial level of unoccupied dwellings.

7 Your Answers

Use this section to record answers for each of your area(s). Write the area names in the column headings.

Section	Area 1	Area 2	Area 3	Area 4
2. A population projection without constraints				
Population in the last year of the projection				
Dwellings in the last year of the projection				
Jobs in the last year of the projection				
3. The impact of a housing plan				
Population in the last year of the projection				
Dwellings in the last year of the projection				
Jobs in the last year of the projection				
4. The impact of an economic plan				
Population in the last year of the projection				
Dwellings in the last year of the projection				
Jobs in the last year of the projection				
5. Alternative scenarios: record the average change in dwellings during the forecast.				
Base scenario				
Higher household representative rates				
Lower vacant housing rate				
Higher economic activity rate				
Base scenario, jobs constraint				
Higher household representative rates, jobs constraint				
Lower vacant housing rate, jobs constraint				
Higher economic activity rates, jobs constraint				
Higher commuting ratio, jobs constraint				
Lower unemployment rate, jobs constraint				

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8 Common Problems

❗	**Message 'Cannot run the Macro' or similar**

POPGROUP works in Excel by using programs known as 'macros'. After installation you must follow the instructions in the manual to enable macros and trust access to Visual Basic. Otherwise, POPGROUP cannot work and you will receive error messages.

If you do not have the manual, contact popgroup@edgeanalytics.co.uk.

❗	**I get a Windows error**

Occasionally there will be a Windows error. Usually it is unclear why it has happened. Coming out of Excel and starting the task again will usually solve the problem. Occasionally after an error, you will be left with a window with program code. Again, close that window and Excel, and try again. These occasional errors are inevitable with a complex program working on many different operating environments, and are not unique to POPGROUP.

If an error occurs more than once, note what happened (take a screen shot if you can), and email details to popgroup@edgeanalytics.co.uk.

9 Next steps

POPGROUP is a versatile tool for analysis of population dynamics. The 'How to...' Guides in this series are:

1. How to get started with population projections

2. How to get started with household projections

3. How to get started with labour force projections

4. How to create population projections led by a plan for house-building

5. How to create population projections led by an economic plan for jobs

6. How to integrate population, housing and labour force projections

Suggestions for improvements to these Guides, or for topics for further guides, should be sent to popgroup@edgeanalytics.co.uk.