An introduction to geographic modelling with Excel

Dr Sean Manzi
PenCLARHC/PenCHORD
University of Exeter

What is geographic modelling and why is it useful?

Geographic Modelling

Where?

Where to place services…

Where will patients go…

Where do we find people with this disease…

Predictions

…if our demand continued to grow?

…if we close these services?

…and how is it spreading?

Example: Assessing the Impact of MIU Closures

The problem

- Minor Injuries Units (MIUs) in *** receive a high proportion of attendances that would be better served elsewhere

- Case being put to commissioners to reconfigure MIUs in ***, by closing four MIUs, and putting in place measures to reduce ‘unsuitable’ attendances

- PenCHORD asked to provide some idea of impact of MIU closures on patient travel time and attendances to remaining MIUs

Example: Assessing the Impact of MIU Closures

The approach

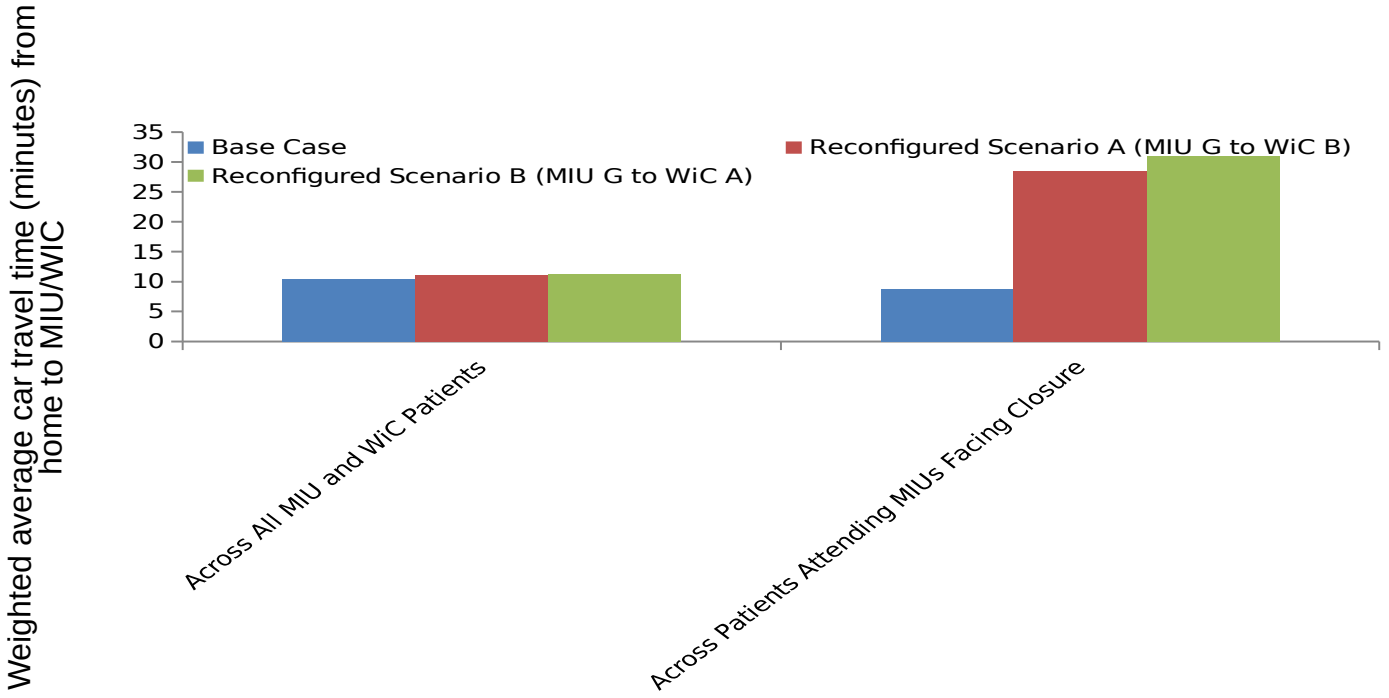
- **What is the current situation?** Analyse existing attendance data to find out where MIU patients come from, and where they go

- **What would happen if some MIUs were closed?** Build a geographic model to determine impact on travel time and attendances at remaining MIUs

Example: Assessing the Impact of MIU Closures

	WiC A	WiC B	MIU A	MIU B	MIU C	MIU D	MIU E	MIU F	MIU G	MIU H
	EX1 1AA	EX2 2AA	EX3 3AA	EX4 4AA	EX5 5AA	EX6 6AA	EX7 7AA	EX8 8AA	EX9 9AA	EX10 1AA
EX1 1	7.016666667	2.716666667	21.86666667	25.53333333	18.2	37.95	25.86666667	28.6	30.53333333	52.01666667
EX1 2	6.85	2.583333333	23.15	26.81666667	17.78333333	37.53333333	25.45	28.18333333	32.71666667	54.2
EX1 3	9.316666667	5.516666667	23.71666667	27.38333333	18.31666667	38.06666667	25.98333333	28.73333333	35.65	57.13333333
EX1 4	70.28333333	66.61666667	77.83333333	81.5	72	81.46666667	69.6	41.76666667	47.33333333	43.46666667
EX1 6	40.26666667	34.08333333	53.08333333	56.75	49.9	69.65	57.56666667	31.43333333	24.66666667	42.01666667
EX1 7	41.48333333	41.11666667	48.98333333	32.13333333	29.96666667	9.65	22.03333333	46.63333333	65.53333333	87.01666667
EX1 8	40.46666667	40.1	41.28333333	22.9	27.63333333	6.616666667	21.01666667	45.2	64.51666667	86
EX1 9	6.85	2.583333333	23.15	26.81666667	17.78333333	37.53333333	25.45	28.18333333	32.71666667	54.2
EX2 1	35.18333333	30.88333333	44.93333333	48.6	41.75	61.5	49.41666667	44.95	3.266666667	24.76666667
EX2 2	35.91666667	35.55	36.16666667	17.78333333	22.51666667	12.83333333	18.6	43.18333333	58.98333333	80.46666667
EX2 4	9.116666667	4.816666667	23.96666667	27.63333333	20.3	40.05	27.96666667	28.63333333	30.38333333	51.86666667
EX2 5	5.3	6.366666667	21	24.66666667	17.06666667	36.81666667	24.73333333	29.91666667	36.25	57.73333333
EX2 6	6.9	6.933333333	20.45	24.11666667	17.33333333	37.08333333	25	29.75	34.65	56.13333333
EX2 7	11.03333333	11.06666667	20.91666667	24.58333333	17.8	37.55	25.46666667	30.21666667	33.9	55.38333333
EX2 8	10.4	6.1	25.25	28.91666667	21.58333333	41.33333333	29.25	29.91666667	31.38333333	52.86666667
EX2 9	10.86666667	6.566666667	25.53333333	29.2	22.35	42.1	30.01666667	30.38333333	30.63333333	52.11666667
EX3 0	17.41666667	17.28333333	20.73333333	28.26666667	21.56666667	41.31666667	29.23333333	33.98333333	40.71666667	62.2
EX3 3	73.35	69.05	83.1	86.76666667	79.91666667	99.66666667	87.58333333	76.81666667	42.76666667	20.01666667
EX3 4	65.35	61.05	75.1	78.76666667	71.91666667	90.03333333	78.16666667	50.33333333	41.76666667	26.7
EX4 0	13.53333333	9.733333333	28.76666667	32.43333333	22	41.75	29.66666667	22.23333333	39.86666667	61.35
EX4 1	8.716666667	4.416666667	23.56666667	27.23333333	19.9	39.65	27.56666667	28.23333333	30.78333333	52.26666667
EX4 2	12.46666667	7.9	27.31666667	30.98333333	23.65	43.4	31.31666667	25.9	34.58333333	56.06666667
EX4 3	8.5	4.2	23.35	27.01666667	19.68333333	39.43333333	27.35	26.96666667	30.61666667	52.1
EX4 4	10.23333333	4.05	26.53333333	30.2	21.16666667	40.91666667	28.83333333	24.48333333	35.83333333	57.31666667
EX4 5	11.55	5.366666667	27.3	30.96666667	22.48333333	42.23333333	30.15	22.98333333	34.56666667	56.05
EX4 6	9.966666667	4.183333333	26.26666667	29.93333333	20.9	40.65	28.56666667	26.08333333	35.83333333	57.31666667
EX4 7	8.266666667	4.466666667	24.83333333	28.5	19.43333333	39.18333333	27.1	26.01666667	34.6	56.08333333
EX4 8	8.05	4.25	21.96666667	25.63333333	16.56666667	36.31666667	24.23333333	27.46666667	34.38333333	55.86666667
EX4 9	12.46666667	10.2	23.46666667	27.13333333	16.7	36.45	24.36666667	25.93333333	40.08333333	61.56666667
EX5 1	10.13333333	9.766666667	15.65	18.98333333	14.05	33.8	21.71666667	26.46666667	33.2	54.68333333
EX5 2	10.76666667	10.4	18.26666667	21.93333333	10.95	30.7	18.61666667	25.88333333	34.81666667	56.3

Example: Assessing the Impact of MIU Closures



Example: Assessing the Impact of MIU Closures

Displacement

- The closure of one of the four proposed MIUs is predicted to result in 2,104 additional attendances per year at the Acute Hospital
- The remaining 1,364 attendances from the other three proposed MIUs is predicted to increase burden on one of the remaining MIUs by this amount

Example: Assessing the Impact of MIU Closures

Commissioner decision

- Decided to close only three of the planned four MIUs, keeping open the MIU that would have displaced patients to the acute hospital

What is geographic modelling and why is it useful?

- Simple geographic modelling (single parameter)
  - Brute force approach – all possibilities calculated
- Multi-objective combinatorial optimisation
  - Heuristics/genetic algorithms – More parameters in addition to travel time optimised
- Route planning
  - Heuristic approaches and genetic algorithms – Large numbers of possible combinations

Today’s case study

The problem

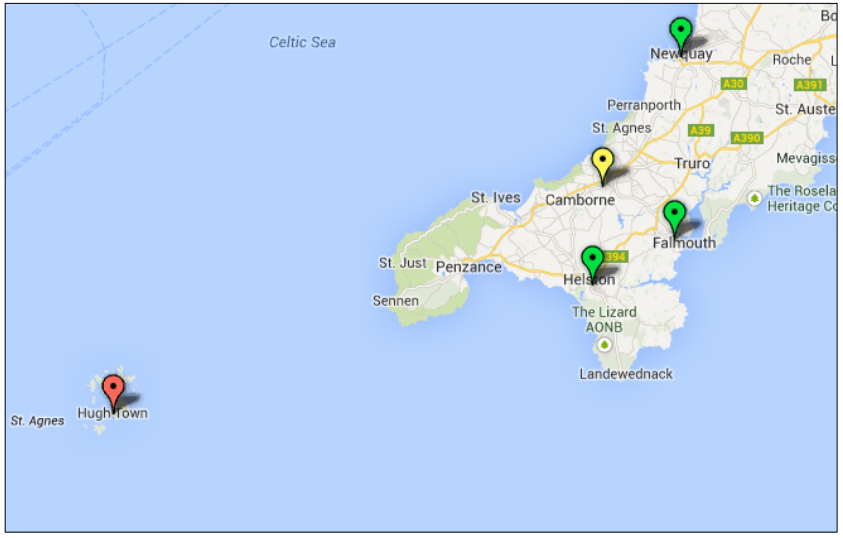
- Cornwall and Isles of Scilly NHS Foundation Trust have approached you about a problem.
- They currently have five Minor Injury Units in East Cornwall, but they are looking to cut costs by closing two of them.
- The two they have identified for closure – Falmouth and Helston – receive low attendances compared to the other three.
- They want to know what the impact of the closures would be on patient travel time and displacement of patients to other services.

Today’s case study

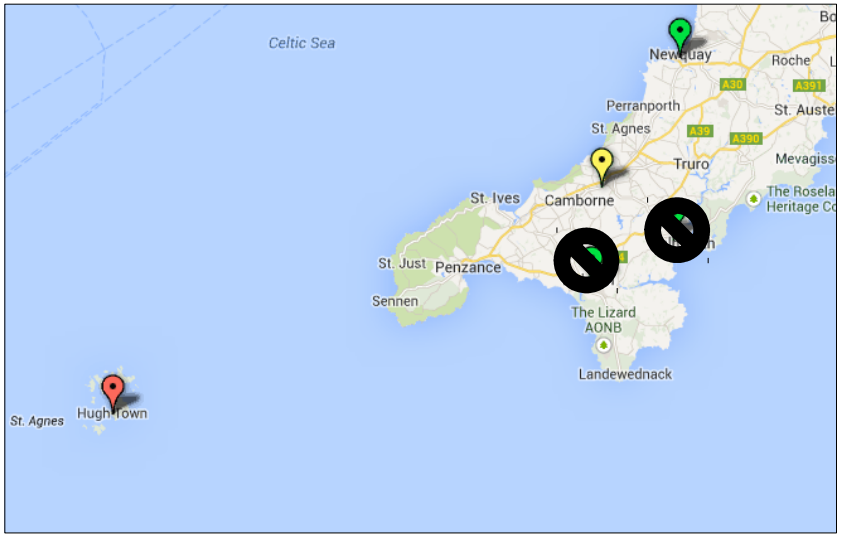
Today’s case study

Two Scenarios :

BASE CASE – The current system



WHAT IF? – The proposed future system



Today’s case study

Defining the outcomes
In small groups, discuss :

- What do you think are the specific outcome measures we will need as outputs to the model?
- What assumptions do you think we’ll need to make when building this model?
- What sort of data do you think we’ll need to build this model?

Today’s case study

Outcome measures

- Average patient travel time (from home to MIU)
- Some measure of variability in average travel time
- Number of attendances to each MIU

Today’s case study

Assumptions

- If it is open, patients travel to the nearest MIU to their home.
- If their nearest MIU is closed, patients travel to the next nearest MIU to their home.
- Patients will not visit other (non-MIU) services.
- All patients travel by car, and take the shortest calculated route.
- The MIU activity given in the data represents all MIU activity (e.g. it does not account for postcodes that have not attended in the data)

Today’s case study

Data

- Where did the patient come from?
- Where did they go?
- When did they go there?

Therefore :

  - Patient Postcode (Sector)
  - MIU Attended
  - Date of Attendance

- Recommend minimum of 12 months of activity, and maximum of three years

Today’s case study

Lets build the model!

Visualising your results with Google fusion tables

Why it is important to visualise your results

- Modelling results can often be overwhelming and / or difficult to interpret. Visualisation helps interpretation.

- The details of models are often difficult for non-specialists to understand or are not of interest – visualising results helps understanding of the model.

- For geographic modelling, this is even more important because the problem is spatial and translates naturally to a visulisation (maps)

Visualising your results with Google fusion tables

Google fusion tables

https://fusiontables.google.com/data?dsrcid=implicit

Visualising your results with Google fusion tables

Our task

We want to create three maps to visualise our results :

- A map visualising the level of attendance at each MIU in the base case scenario
- A map visualising the level of attendance at each MIU in the “What If” scenario
- A map showing where the MIU activity is coming from (where do patients live?)

Visualising your results with Google fusion tables

You might be asked to sign in with your google account

- If you have an account sign in
- If you don’t have an account quickly create one

Visualising your results with Google fusion tables

Preparing our input data
We need two separate tables :

- A table containing MIU name, postcode, Base Case attendances and “What If” attendances

  We will use this to generate our maps of attendance levels at each MIU in each scenario

- A table containing a list of patient postcodes (including repeats)

  We will use this to map where the activity is coming from

Visualising your results with Google fusion tables

A table containing MIU name, postcode, Base Case attendances and “What If” attendances

We will use this to generate our maps of attendance levels at each MIU in each scenario

- Save as a standalone Excel file (e.g. MIUAttendancesForFusionTable.xlsx)

MIU Name	MIU Postcode	Base Case Attendances	What-If Attendances
Camborne and Redruth Community Hospital	TR15 3ER	86	145
Falmouth Hospital	TR11 2JA	33	0
Helston Community Hospital	TR13 8DR	28	0
Newquay Hospital	TR7 1RQ	45	45
St Mary's Community Hospital	TR21 0LE	108	110

Visualising your results with Google fusion tables

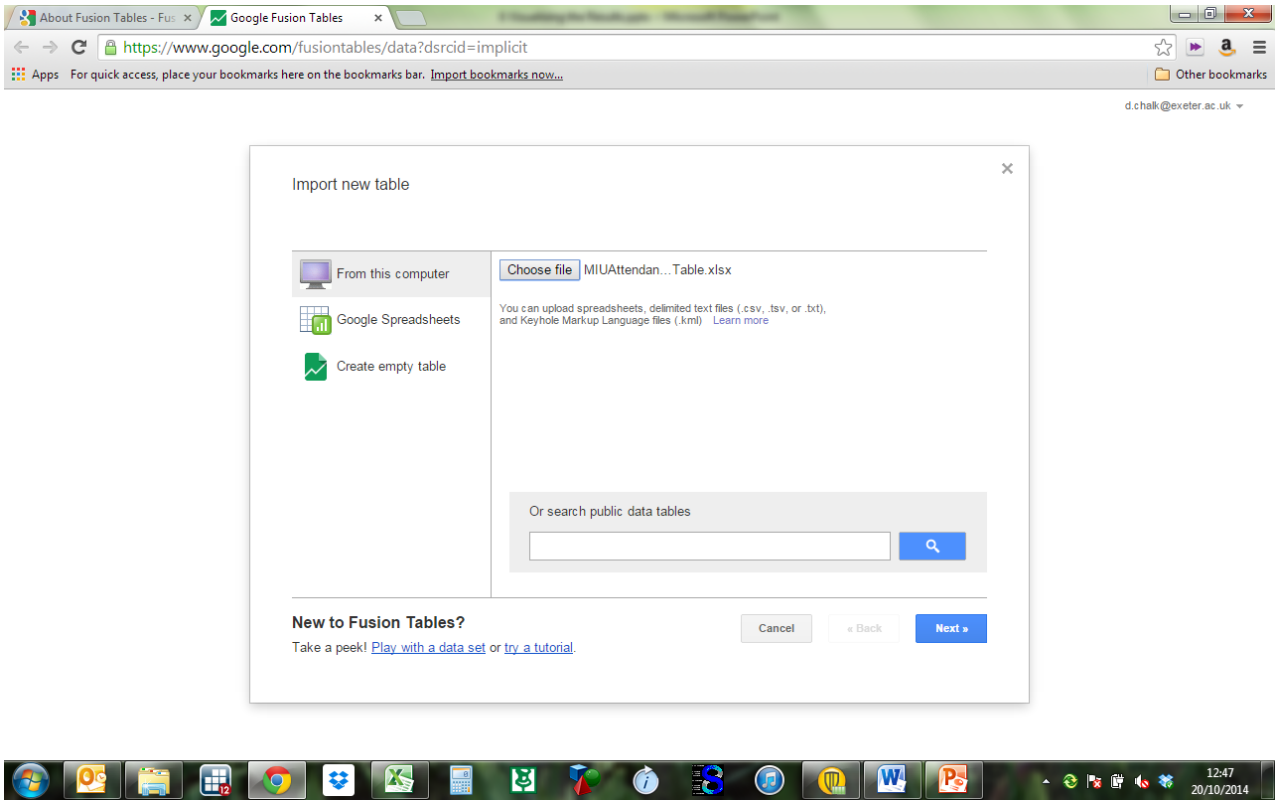
- A table containing a list of patient postcodes (including repeats)

  We will use this to map where the activity is coming from
- Save as a standalone Excel file (e.g. PatientLocationsForFusionTable.xlsx)

Postcode
TR22 0PL
TR22 0PL
TR22 0PL
TR22 0PL
TR22 0PL
TR22 0PL
TR22 0PL
TR22 0PL
TR22 0PL
TR22 0PL
TR22 0PL
TR22 0PL
TR23 0PR
....

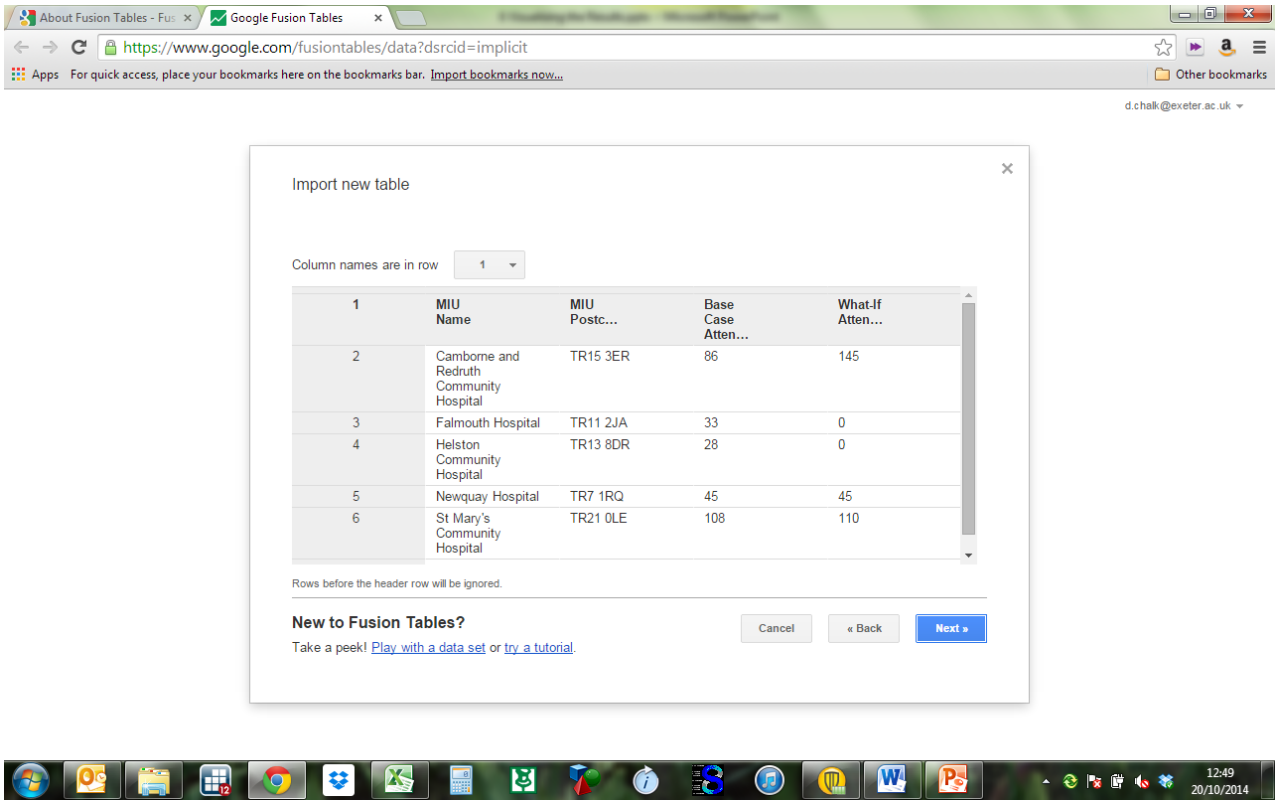
Visualising your results with Google fusion tables

- Import your MIU attendance data table



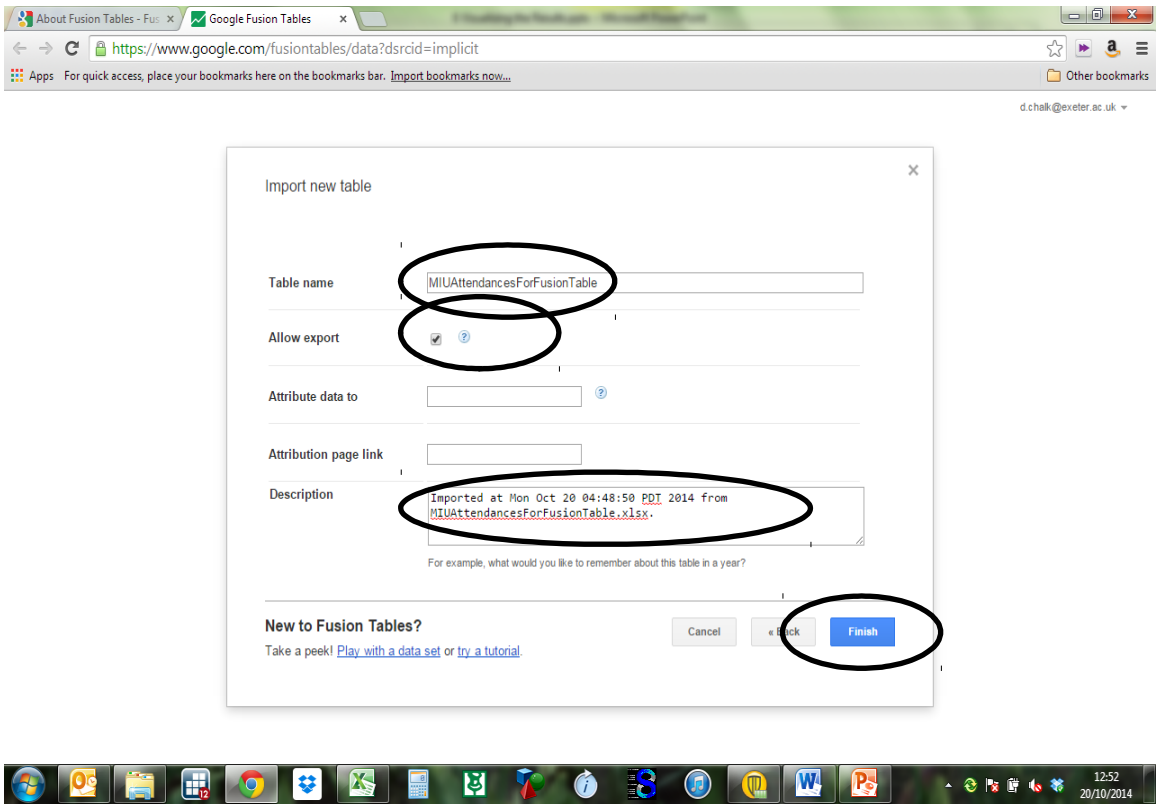
Visualising your results with Google fusion tables

- Import your MIU attendance data table



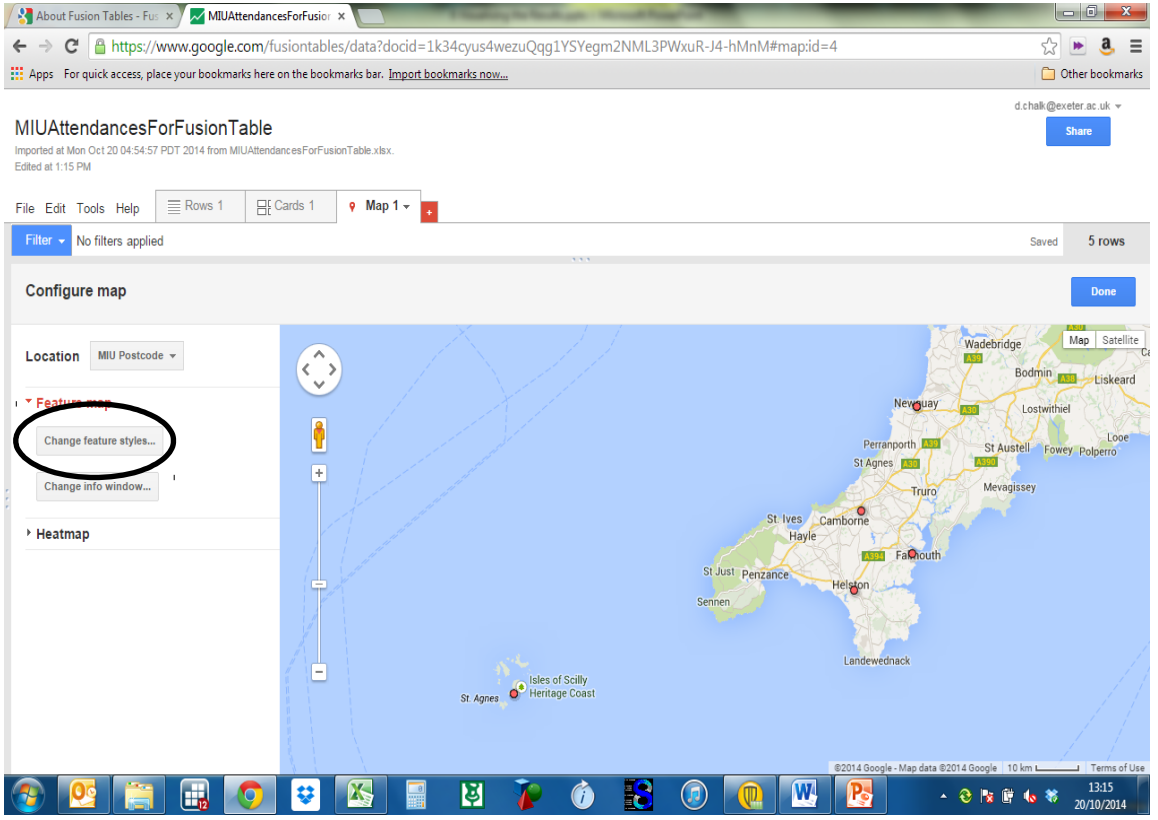
Visualising your results with Google fusion tables

- Import your MIU attendance data table



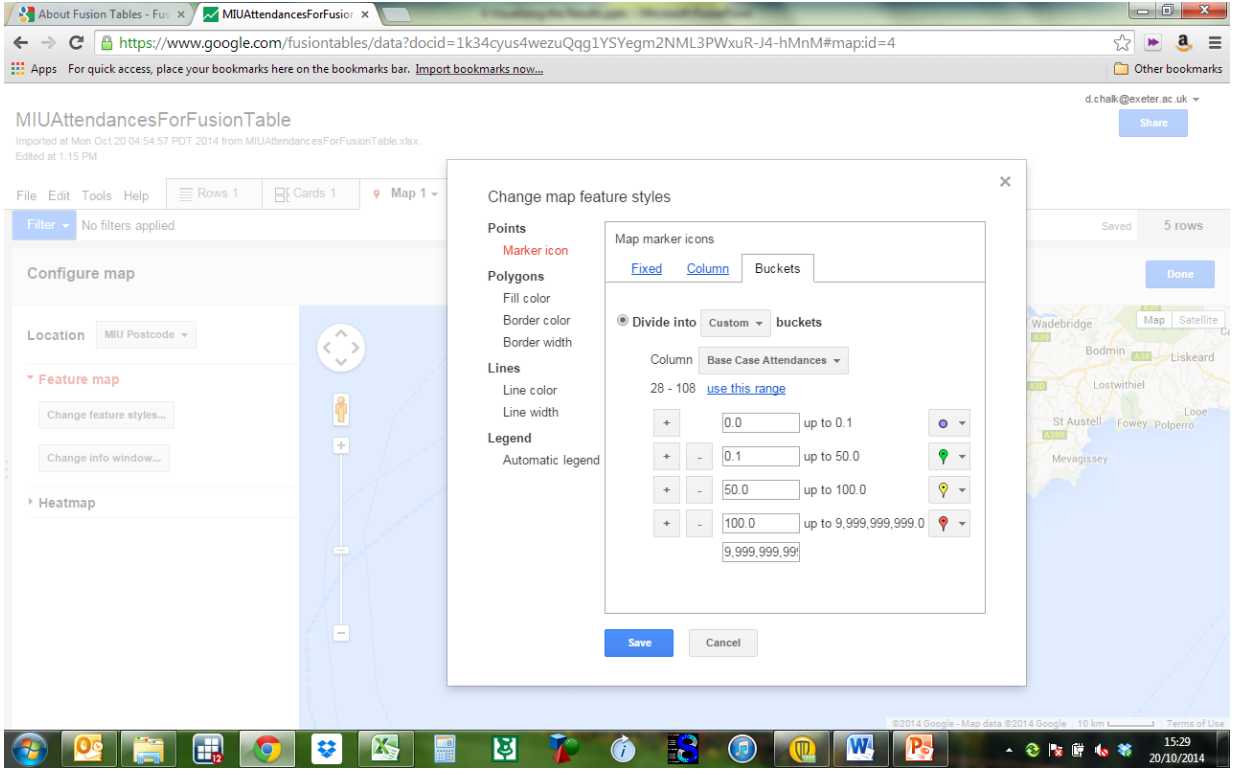
Visualising your results with Google fusion tables

- View the data on the map and change its appearance



Visualising your results with Google fusion tables

- View the data on the map and change its appearance



Visualising your results with Google fusion tables

Exercises

- Generate a map of MIU Attendances for the “What If” Scenario, using the same buckets and colour coding. What becomes immediately obvious upon looking at this visualisation?

- Generate a heatmap showing the density of patient activity over the area. Remember, you will need to import your patient locations table as a Fusion Table. Start a new Fusion Table to do this. What becomes immediately obvious upon looking at this visualisation?

Well done!

Pathway modelling and geographic modelling all in one day

Remember to check out our websites for more information and advanced training materials

http://clahrc-peninsula.nihr.ac.uk/

http://penchord.org

https://pythonhealthcare.org/

More to come soon!!