Introduction

This tutorial will not:

- Teach you how to use R – you need to have basic knowledge (preferably tidyverse) and at least an understanding of linear models.
- Go deep into the theory of GAMMs. I'm not a statistician and there are people far more qualified than me – see recommended reading.

This tutorial will:

- Introduce GAMM code and the different types of term (see Soskuthy 2017 for more details)
- Talk about building models that answer your research questions.
- Explain some edits I've made to many other tutorials to work with the complex nature of LVC data. A lot of tutorials are from phonetics or psycholinguistics working with very controlled experimental data and we have a lot more variables.
- Briefly cover model size, parallel processing and high-powered computing options
- Show how to output and plot predicted values and talk about interpretation.

Data

I will be working with trajectory data extracted using FAVE – this takes measurements at 20%, 35%, 50%, 65% and 80%.

I reshaped this using the pivot_longer and pivot_wider() functions (tutorial here) so that I had a column for F1, a column for F2, and a column for the measurement point 'percent'. For your own data, any data with measurements along the trajectory will work.

The data is a subset (see here https://dplyr.tidyverse.org/reference/slice.html) of some data from the Manchester Voices Project (Halfacre & Drummond, submitted).

Scripts, data, and instructions can be found at https://github.com/caitlin91/GAMMsforLVC (note if you access this before Thursday you'll find it's empty – I'll sort it by first thing Thursday!)

Reading

1. Winter, B. (2019) *Statistics for Linguists: An Introduction Using R*, *Statistics for Linguists: An Introduction Using R*. Routledge.
   Available at: https://doi.org/10.4324/9781315165547 or I think the Newcastle Library online
2. Regression models: https://stefanocoretta.github.io/posts/2021-08-21-regression-models-a-cheat-sheet/
3. Random effects: https://stefanocoretta.github.io/posts/2021-03-15-on-random-effects/
4. Lectures slides on various models up to GAMs (not GAMMs) https://www.martijnwieling.nl/statistics.php

5. Introduction to GAMMs Sóskuthy, M. (2017) 'Generalised additive mixed models for dynamic analysis in linguistics: a practical introduction'. Available at: http://arxiv.org/abs/1703.05339.

If you're familiar with other modelling but not GAMMs, 5 will be the most helpful read.

LVC work using GAMMs

- Halfacre, C., 2023. *Variation and change in modern received pronunciation: Understanding interactions between private education and regional accent variation* (Doctoral dissertation, Newcastle University). http://theses.ncl.ac.uk/jspui/handle/10443/6159
- Halfacre, C. and Drummond, R. (submitted) 'The effect of age and regional attitude on the MOUTH vowel in Greater Manchester.' *Journal of Sociolinguistics* submitted version available at https://stummuac-my.sharepoint.com/:w:/g/personal/55038638_ad_mmu_ac_uk/Ef1cIPS1ug5OupuI0HsS1SIBko0sSfonnpBJ-K6xoQQ5rA?e=NMDskP till 27th May 2025 – please do not share further.
- Kirkham, S. *et al.* (2019) 'Dialect variation in formant dynamics: The acoustics of lateral and vowel sequences in Manchester and Liverpool English', *The Journal of the Acoustical Society of America*, 145(2), pp. 784–794. Available at: https://doi.org/10.1121/1.5089886.
- Renwick, M.E.L. *et al.* (2023) 'Boomer Peak or Gen X Cliff? From SVS to LBMS in Georgia English', *Language Variation and Change*, 35(2), pp. 175–197. Available at: https://doi.org/10.1017/S095439452300011X.
- Renwick, M.E.L. and Stanley, J.A. (2020) 'Modeling dynamic trajectories of front vowels in the American South', *The Journal of the Acoustical Society of America*, 147(1), pp. 579–595. Available at: https://doi.org/10.1121/10.0000549.
- Stanley, J.A. *et al.* (2021) 'Back Vowel Dynamics and Distinctions in Southern American English', *Journal of English Linguistics*, 49(4), pp. 389–418. Available at: https://doi.org/10.1177/00754242211043163.
- Warburton, J., 2020. *The merging of the GOAT and THOUGHT vowels in Tyneside English: Evidence from production and perception* (Doctoral dissertation, Newcastle University). http://theses.ncl.ac.uk/jspui/handle/10443/5342

Fun extras

- Animating trajectories: https://joeystanley.com/blog/animating_formant_trajectories/