

## Week 1

- Broad goal: Fix code.
  - ☒ Use less filtered dataset
  - ☐ Distance matrix argument to dist?
    - Need both forms, so may or may not be useful
  - ☐ Check if phi is correct now, and see how is used
  - ☒ Figure out large alpha problem
    - Seems the + and one loop beta fixed this?
  - ☐ Try a different covariate?
  - ☐ Figure out why geem code uses + instead of - on update
    - I think + is correct. At least it converges.
  - ☐ Identify which covariate is causing the trouble.
  - ☐ Try removing the single OTU that seems to be contributing to problem.
  - ☐ Save everything to list correctly to look at later.
    - Saving rho, omega, phi, beta, diff (abs), num iterations
    - Also do residuals. Which residuals? Cross product ones? Squared ones? Standardized squared ones? Probably standardized but not squared. Should be distributed around zero. ?
  - ☒ Plot lists
    - Plotted rhos, omegas, phis, diffs, not sure what else to plot.
  - ☒ Remove scalar update.
    - Doesn't work. see journal
  - ☐ Write up algorithm for Yuan to go through? Ask to check.
  - ☐ Final run through before meeting of graphs and numbers
  - ☒ Move timing into function

## Week 2

Main tasks:

- To-do from sheet
- Prepare presentation
- ☒ Wednesday email research update.
- ☒ Include more taxa: more zero-inflation
  - Not great results. see journal  $\omega = .99$ ,  $\rho = .1$
  - runtime of 20 min.
- ☒ Add computation time in model.
- ☒ Make presentation
- ☒ Figure out why adding the minus sign changes the code.

- Pretty sure this is because we are then adding or subtracting the  $\lambda I$  incorrectly.
- ✓ Try changing the minus sign on larger dataset.
  - Either immediate convergence or infinite alpha values on 1st iteration.....
- ✓ Set up automatic save outputs along with description
- ✓ Try with a medium sized dataset, like prevalence of .2?
- ✓ Save test datasets to files for easy loading
- ✓ Only include last beta output?
- ☐ Try different covariates (parasite burden/antibiotics/exposure)
- ☐ Think about genus level analysis/ phylogenetic tree for taxonomic units
- ☐ Choose  $\alpha$  automatically (simple line search)
- ☐ Write up line-search steps and goals
- ☐ Understand how Hessian is calculated and expected values equal zero.
- ☐ Run on previous dataset from original paper.
- ☐ Rename file with algorithm
- ☐ Compare to independence GEE written already geeglm?
- ☐ Calculate sandwich variance estimators for asymptotic significance tests
- ☐ See if new shared tree that Tom had is the same?
- ☐ Add residuals to output and look at plots
- ☐ Change initial value to something different?
  - change initial rho to 10. Changes results (of at least ests of rho and omega)
  - Try previous iterations rho and omega.
  - See how beta estimates change
  - Run code with initial value of 1 again to compare.
- ☐ Read numerical optimization book.
- ☐ Save convergence results of nls optim
- ☐ Make sure subtraction in  $\phi$  is correct

## Week 3

- General
  - \*☐ Read numerical optimization book.
  - \*☐ Understand how Hessian is calculated and expected values equal zero.
  - \*☐ Run on previous dataset from original paper.
  - \*☐ Rename file with algorithm
    - ☒ Take pictures of meeting notes.
    - ☐ Figure out how to send jobs to server
- Line search
  - \*☐ Choose  $\alpha$  automatically (simple line search)
  - \*☐ Write up line-search steps and goals
    - ☐ Add condition if infinity or NA to halve gamma
    - ☐ Clean up code for speed and remove redundancy.
    - ☐ Look at notes from meeting about (different?) conditions
    - ☐ Code was set up incorrectly. Fix. Shouldnt be updating betas each time, just checking.
    - ☐ Save sum of absolute G for each iteration.
- Convergence
  - \*☐ Save convergence results of nls optim
    - ☐ Change  $\lambda$  to be based on eigenvalues.
    - ☐ Save eigenvalues and look at ratio.
    - ☐ Test to see difference within iterations of if starting values (eg rho = 10) give different results.
- Correlation: Importance of  $\rho, \omega$ 
  - \*☐ Compare to independence GEE written already geeglm?
  - \*☐ Calculate sandwich variance estimators for asymptotic significance tests.
    - ☐ Keep  $\rho$  or  $\omega$  the same throughout the algorithm
- Other
  - \*☐ See if new shared tree that Tom had is the same?
  - \*☐ Try different covariates (parasite burden/antibiotics/exposure)
  - \*☐ Think about genus level analysis/ phylogenetic tree for taxonomic units
    - ☐ Add condition to make sure  $\rho, \omega$  also converge
    - ☐ Email Tom with questions
    - ☐ Think about how hypothesis tests work
    - ☐ Read about GEE hypothesis tests

## Week 4

- ☐ Writeup meeting notes
- ☐ Email Tom (response to my email) about more information
- ☐ Look into \*resolving nodes\*
- ☐ Select one Genus/Family to only have 10 ish ASVs. Filter dataset, and tree.
- ☐ Test against identity, fixed values of  $\omega$  and  $\rho$ .

## Week 5

- ✓ Make gamma, lambda values arguments in the functions.
- ✓ Save final residuals in model.
- ✓ Convert initialization to one line list.
- ✓ See if weird jump still happens. figure this out.
  - Seems like jump does not exist anymore.
- ✓ Add model call to result list
- ✓ Create diagnostics plot function
  - Patchwork outputs
- ✓ Clean up old code
- ✓ Save beta values again and look at changes.
- ✓ Run through with bug fixed. See what goes on. Write up results
- ✓ Figure out a way to compare beta values
  - Using a line plot across iterations
- ✓ Add GEE values to plot.
- ✓ Check if gamma = 1 betas are same as gamma = .1 betas
  - They are not.
- ✓ Figure out how to compare betas across different model runs (probably same line function?)
- Think about how to do simulations, since we need to have something to check against.
- Try to sum up phylogenetic tree and see if there are any problems.
- Email Tom about summing up the phylogenetic tree
- Look at residual matrix (cross residuals). See if close to zero.
- Use data that is just random common taxa.
- Try different covariates
- Consider moving functions to new files
- Convert all nls functions to matrices to make sure all entries match indeces.
- Update roxygen skeletons for functions
- Add final values of omega, rho and phi to patchwork plot
- ✓ Try independence
- Compare independence to geem beta values.
- Try fixed values of  $\omega, \rho$
- ✓ Figure out why flavo + 30p dataset stops in 2 iterations
  - Figured out where the problem occurs, but not sure why it occurs...

- ☐ See how  $\lambda$  values change beta values.
- ☐ Explore convergence of optim loop.
- ☐ Check variances are correctly between 0 and 1.
- ☐ Compare beta values with a larger/smaller gamma to .1 and see if beta values are different.
- ☐ Implement line search? maybe will work now that bug is found.