Math 426 Objectives

- Convert continuous mathematical problems into numerical algorithms to solve the problems quickly and accurately.
- Implementing such numerical algorithms in Matlab.
- Understanding how different numerical methods can be analyzed and evaluated. This is for both selection of methods and for evaluating implementation!
- Presenting results in an attractive and succinct way.
- Preparing you to solve a much wider array of problems for subsequent classes and jobs.

Syllabus

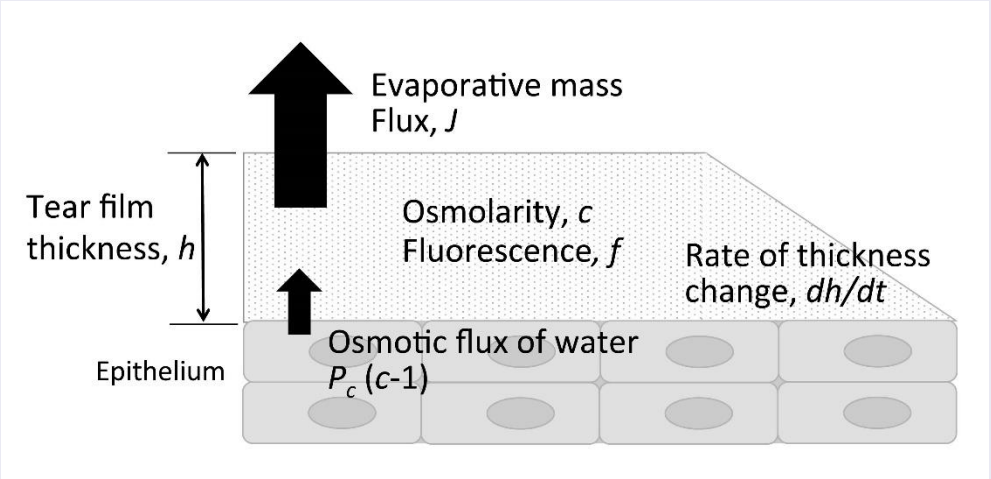
- Contact info and tentative office hours.
- Grade weighting.
- 6 or 7 quizzes+final.
- Matlab naturally integrated in homework and projects.
- Email policy: not a text or tweet.
- Tentative schedule on last page.
- Topics may shift a bit.
- Keep up and do the work.
- I'll work hard to help you succeed.
- TAs will help with office hours and in class.

Some Computing I Do

- Modeling of the human tear film
- Anything from ODEs to tear flow on eye-shaped domain using a system of PDEs
- May involve fluid flow, solutes, evaporation, large systems, moving boundaries, …
- Deciding what model to solve and what method to use are a critical part of what I do in research

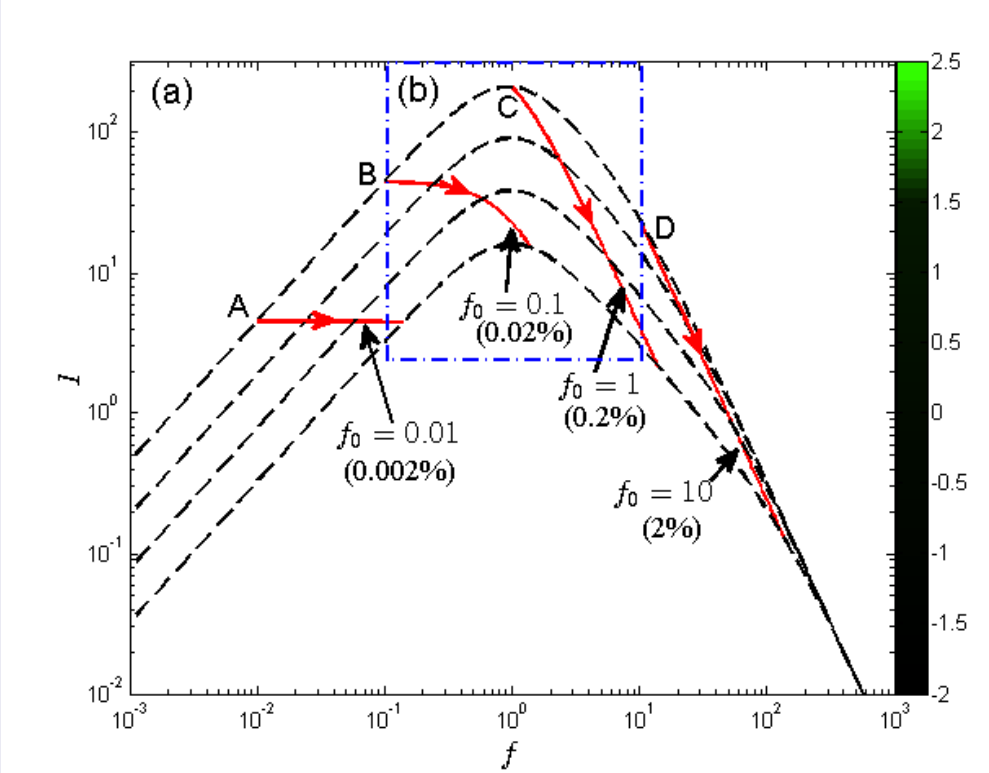
Sample Results

- Tear film thickness *h(t)* and concentrations *c(t)*, *f(t)* from solving ODEs: conserve water and solutes
- Braun et al, Invest Ophthalmol Vis Sci 2014



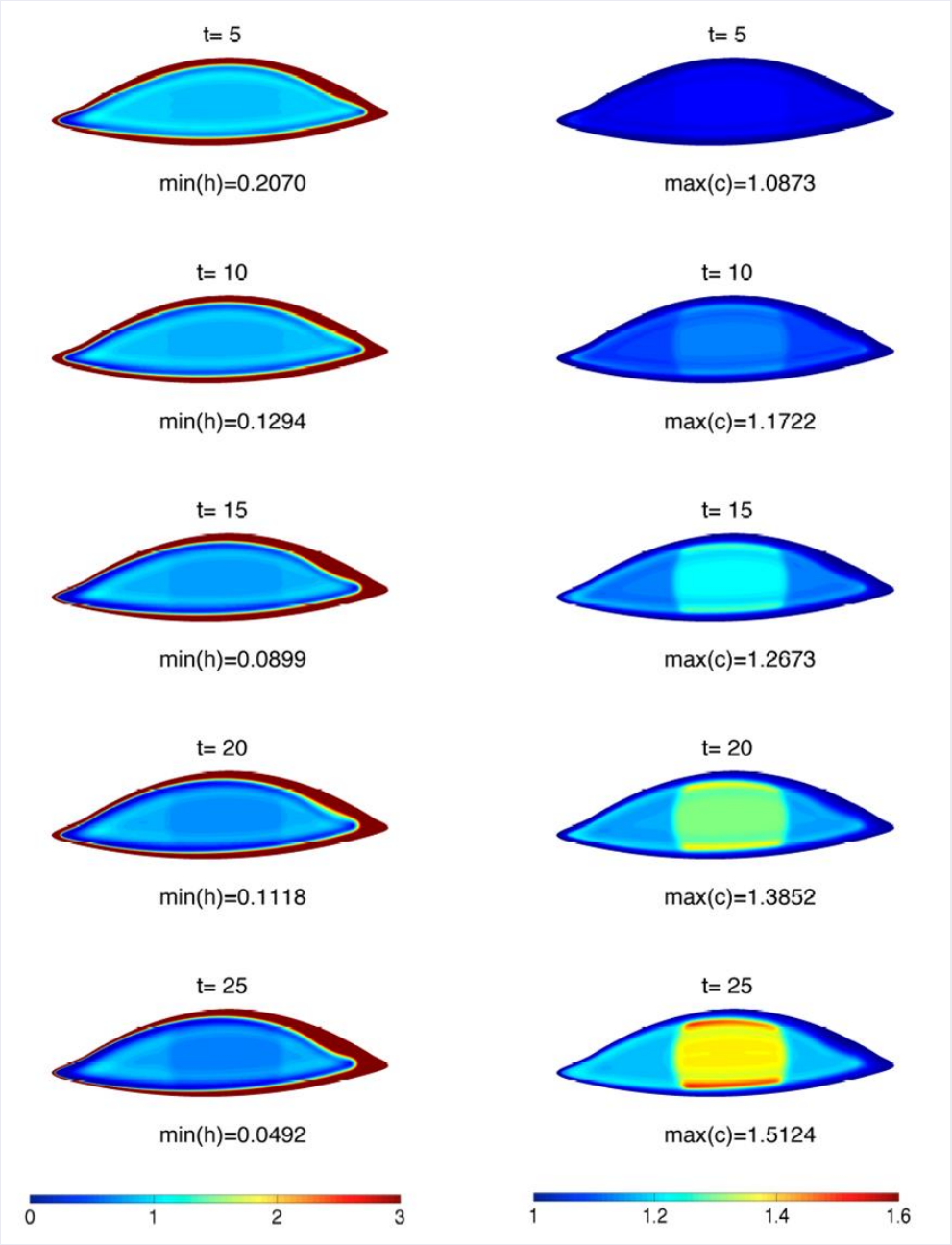
Sample Results

- Each red curve is from solving and ODE system with one IC
- Dashed curves are plot of *I(f,h)* with *h* constant
- Shows how tear film fluorescent intensity changes: news for eye docs
- All done in Matlab



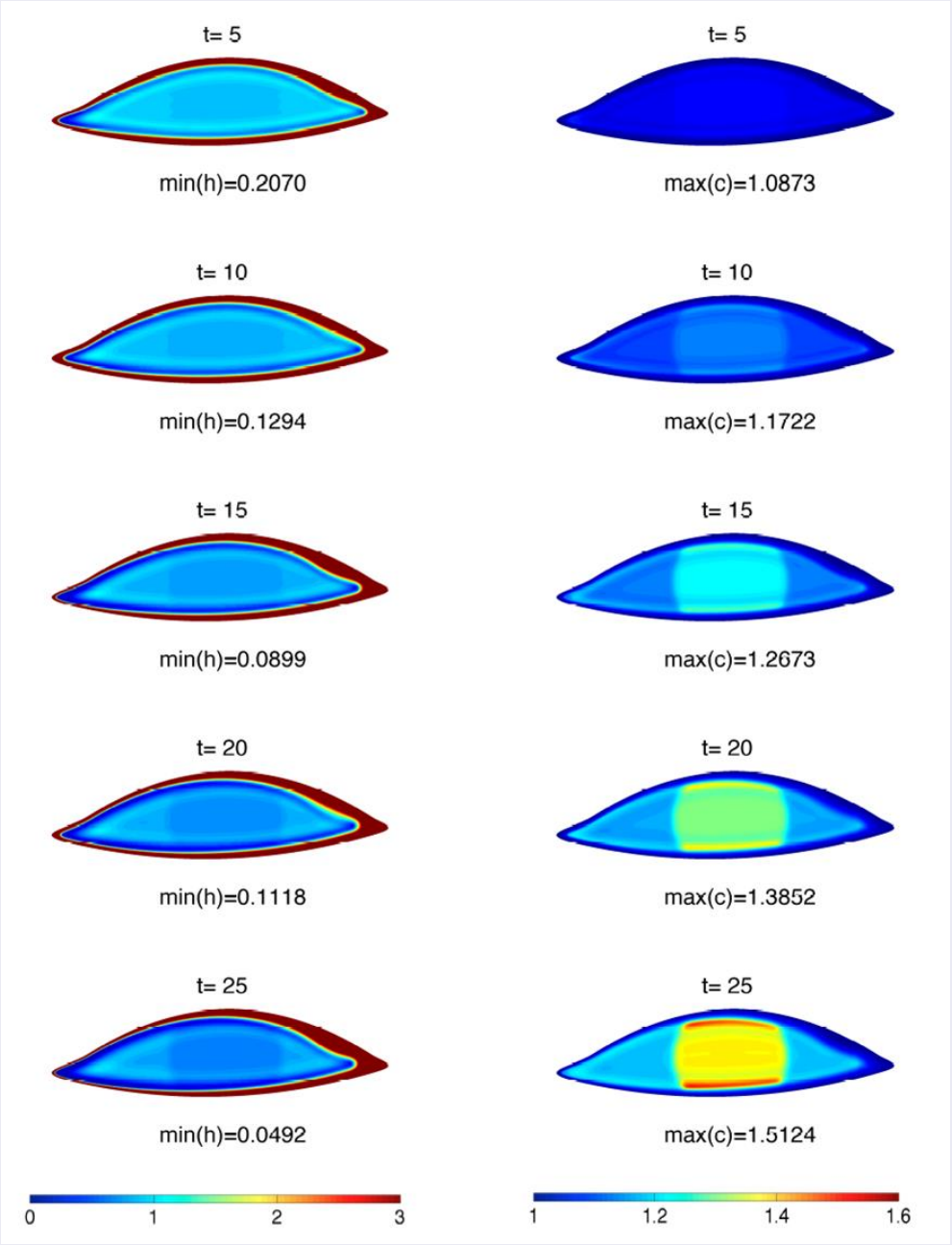
Sample Results

- Tear film thickness on left
- Osmolarity (ion concentration) on right
- Only estimate of this anywhere to my knowledge
- Li, Braun, Driscoll et al, Math Med Biol 2015



Needed math

- Equations for domain from pictures
- Solve PDEs for thickness and osmolarity
- Variable coefficeints and nonlinear PDE
- Hybrid time stepping needed for efficiency



Numerical Methods This Term

- Floating point numbers, conditioning, stability
- Solving linear systems (direct)
- Least squares fits (linear, nonlinear)
- Root finding: solving nonlinear equations
- Interplation
- Numerical Calculus
- ODE IVPs