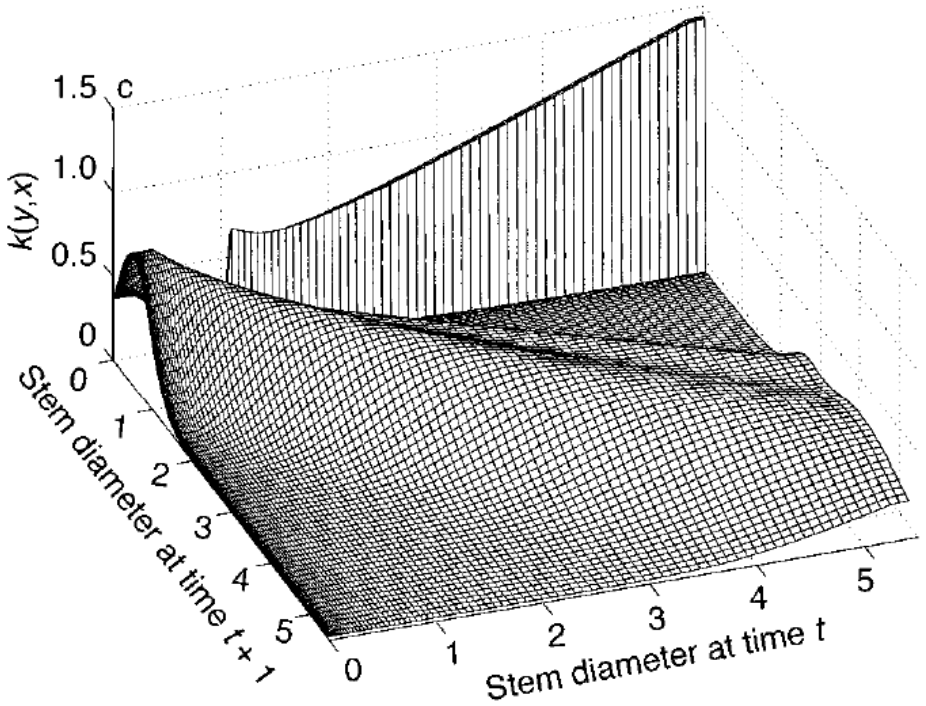
Basics of plant population modelling and its application



Pieter Zuidema, Pieter.zuidema@wur.nl

Programme

Monday**: Matrix models**

Tuesday**: Integral Projection Models: construction**
Plus first paper discussion

Wednesday**: Integral Projection Models: output**
Plus: second paper discussion

Thursday**: Integral Projection Models: more applications**
Plus: preparing presentations

Friday**: Presentations**

Programme

Thursday February 13th: Integral Projection Models: output & applications

9-9.30 Lecture: IPM output & applications

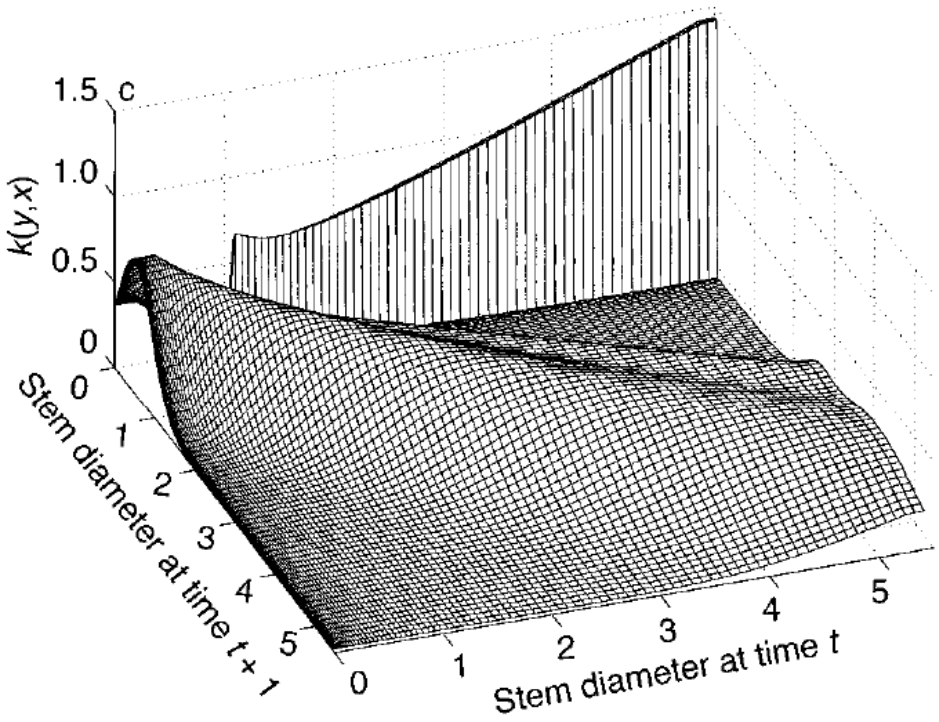
9.30-12 Exercises: IPM output & applications

12 Lunch

2-5 Work on your own data & prepare your presentation

Lecture: Running & applying IPMs

- My tips for IPMs
- Rpadrino package



What do you need for an IPM?

- An interesting question
  - On population viability
  - On population expansion (invasive species)
  - On harvesting effects
  - On climate/environmental change

What do you need for an IPM?

- The question determines:
  - What you measure and study in the field: where, how long, what classes, how many plots
  - What stages your IPM includes: seeds, seedlings
  - What structure your IPM has: time varying, habitat differences, treatments, landscape level?

What do you need for an IPM?

- Sound data
  - Make sure you sample sufficient individuals (minimum ~ 200; ideally 500)
  - Ensure sufficient coverage of all classes
  - Use statistical logic to determine sampling and experimental design
  - Pool data across habitats, treatments, etc.
  - All vital rates: survival, growth, reproduction & recruitment
  - From permanent sample plots, tree-ring analysis, mark-recapture
  - From individuals outside plots that you remeasure

What do you need for an IPM?

- Sound statistical analyses
  - Use multiple regressions to include effects of both habitat and size
  - Only include fixed effects that you would like to include in your IPM: habitats, years
  - Use mixed effect models if you're interested in variability across years (or plots). In ipmr you can add random year factors to produce stochastic models
  - Some vital rates will not respond to treatment/habitat/etc. In that case they need to be the same ascross your different treatment/habitat/year IPMs

What do you need for an IPM?

- Vital rate regressions: survival
  - Use logistic regressions (glm binomial): survival ~ size or

  survival ~size + size^2
  - Add habitat or year if applicable
  - If not significant, then survival ~ 1

What do you need for an IPM?

- Vital rate regressions: growth
  - For organisms with large size changes compared to maximum size, you can use size_next ~ size
  - For long-lived organisms with small size changes compared to maximum growth, better to use size_next ~ size + growth_function
  - Growth function can be linear (a* size) or more complex (a*size + b*size^2) or Hossefeld or something else
  - In exercises we used curve fitting for this (nls function)

What do you need for an IPM?

- Vital rate regressions: sexual reproduction
  - Most complex
  - You need at least: (1) info on which individuals are reproduction, (2) the number of new recruits per reproductive individuals.
  - But can also be: (1) repro probability, (2) number of inflorescences or seeds produced per repro individual, (3) number of new recruits per inflorescence or per seed
  - Make sure that the recruits are expressed per unit at which you have information about the reproduction.

What do you need for an IPM?

- Vital rate regressions: clonal reproduction
  - You need : (1) info on which individuals are producing new shoots, (2) the number of new shoots per clonally reproducing individual.
  - Add a new kernel in ipmr, see example code

What do you need for an IPM?

- IPM construction
  - Build your kernel carefully, step by step and check the transition rates and lambda values carefully
  - Start simple to test your model
- Mesh size checks
  - Mesh size influence lambda, ages & growth variability
  - Make cross-cuts in IPM to ensure growth variability is described by at least 5 points
  - Check effect of mesh size on lambda
  - Check effect of mesh size on age estimates

What do you need for an IPM?

- IPMs for multiple treatments/habitats
  - build one IPM for all of them together, based on your statistical models
  - Extract each habitat-specific IPM transition matrices and conduct further analyses with these
  - In this way, you have used the strength of all data to build your IPMs and you can use the separate IPMs

What do you need for an IPM?

- Example code!
  - Please feel free to use or share the code we used in the course
  - This is yours and you can use it and adapt it

What do you need for an IPM?

- Assistance?
  - Feel free to ask me for help, involve me in a study, visit us in Wageningen
  - I’m happy to help an collaborate