Announcements

- Today's reading Dietze Chapter 2 "From Models to Data"
- # Hands-on Activity 1 due 2/4
- Wednesday 2/6 Discussion "Predictability"
 - Petchey et al. 2015
 - Optional: Dietze 2017 Ecol Appl.
- Friday 2/8 reading: Ch 3 Data
 - Optional: <u>http://www.dataone.org/best-practices</u> Primer



From Models to Forecasts

Lecture 2

1/29/16



How Theory is Taught



Logistic Growth







Observed vs. Modeled Moose Density Linear Scale



Vere





Dietze 2017 "Ecological Forecasting" Princeton University Press









sd = 0.03

sd = 0.001









Think Distributions !!

- What is a random variable
- What is a probability distribution
- Common distributions and their representation in R



Probability distributions

What is a random variable?

- "a variable that can take on more than one value, in
 which the values are
 determined by
 probabilities"
- Does not have a single,fixed value







Coin Flips

What is a probability distribution?

A function that assigns a probability to a random variable $P(X = x_k) = p_k$ P(X = 3) = 1/6

given:

 $0 \le p_k \le 1$





Discrete distributions

Continuous distributions



Absent: beta, binomial, gamma, exponential, Laplace, Pareto, Bernoulli, geometric, hypergeometric, Wishart

uniform	Erlang	uchy
	Weibull	1
logN Poisson		- million
ni-Sq	36	
Normal	Gumbel	1



Drawing random numbers



n = 1

Can we forecast ecology like we forecast weather?

HOW DO WE MEASURE PREDICTABILITY?



Time

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WHAT CAUSES VAR TO INCREASE WITH TIME?



INTERNAL STABILITY



WEATHER FORECASTING: AN INITIAL CONDITIONS PROBLEM



Slingo & Palmer. 2011. Phil. Trans. R. Soc. A



INTERNAL STABILITY



All other terms grow linearly

EXOGENOUS STABILITY





- Predictable if low sensitivity or low uncertainty
- Anova vs Regression design: <u>How much</u> does X affect Y?
- Var[x] also needs to be forecast
 - Different X for forecast than explain?
 - Not in model select, over complex
 - Rel. importance increases with time
- Endogenous (DD) vs Exogenous (DI) continuum

PARAMETER ERROR







PROCESS ERROR



- Inherent stochasticity (irreducible)
- Structural uncertainty
- Heterogeneity & variability
 - need to accommodate, even if can't explain







COV & SCALING

- At large scales, average over drivers (X), heterogeneity
 (α), & variability (ε)
 - Internal stability (Y) increases in importance
 - Scaling very dependent on spatial and temporal auto- & cross-correlation

$$\sum \sum \frac{\partial f}{\partial X_i} \frac{\partial f}{\partial X_j} COV[X_i, X_j]$$



Year

Willow Creek, Net Carbon Flux



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NATURE OF THE PREDICTION PROBLEM ...

Theory

- What drives dynamics?
- Generality across processes and locations

stabilitv uncert

= INTERNAL + EXTERNAL + I

Practice

- What can we predict?
- How to tackle new systems

Methods

- What to measure
- How we build models
- How we assimilate data



DISCOVER WHETHER NATURE IS PREDICTABLE

