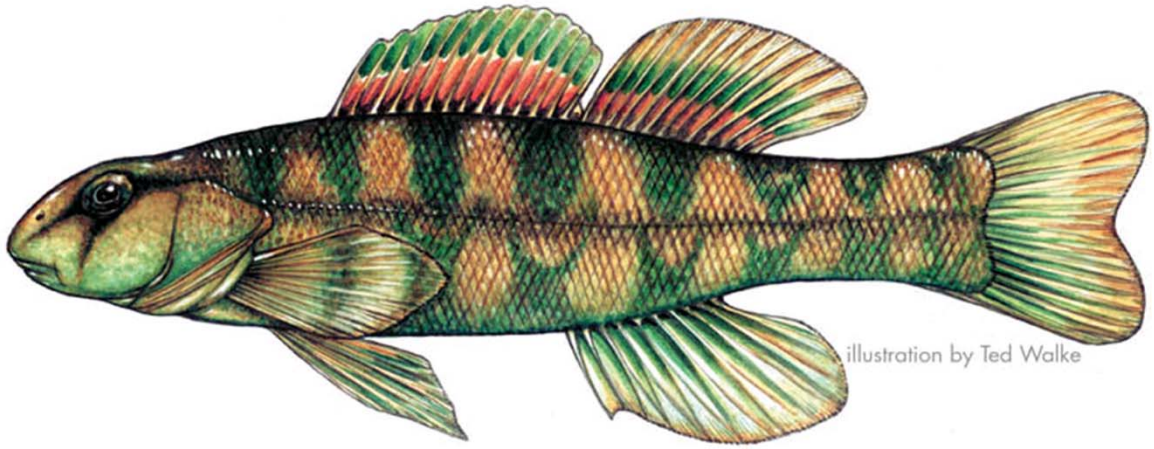
DARTER: Diffusion Approximation Tools for Extinction Risk Estimation



Brice semmens

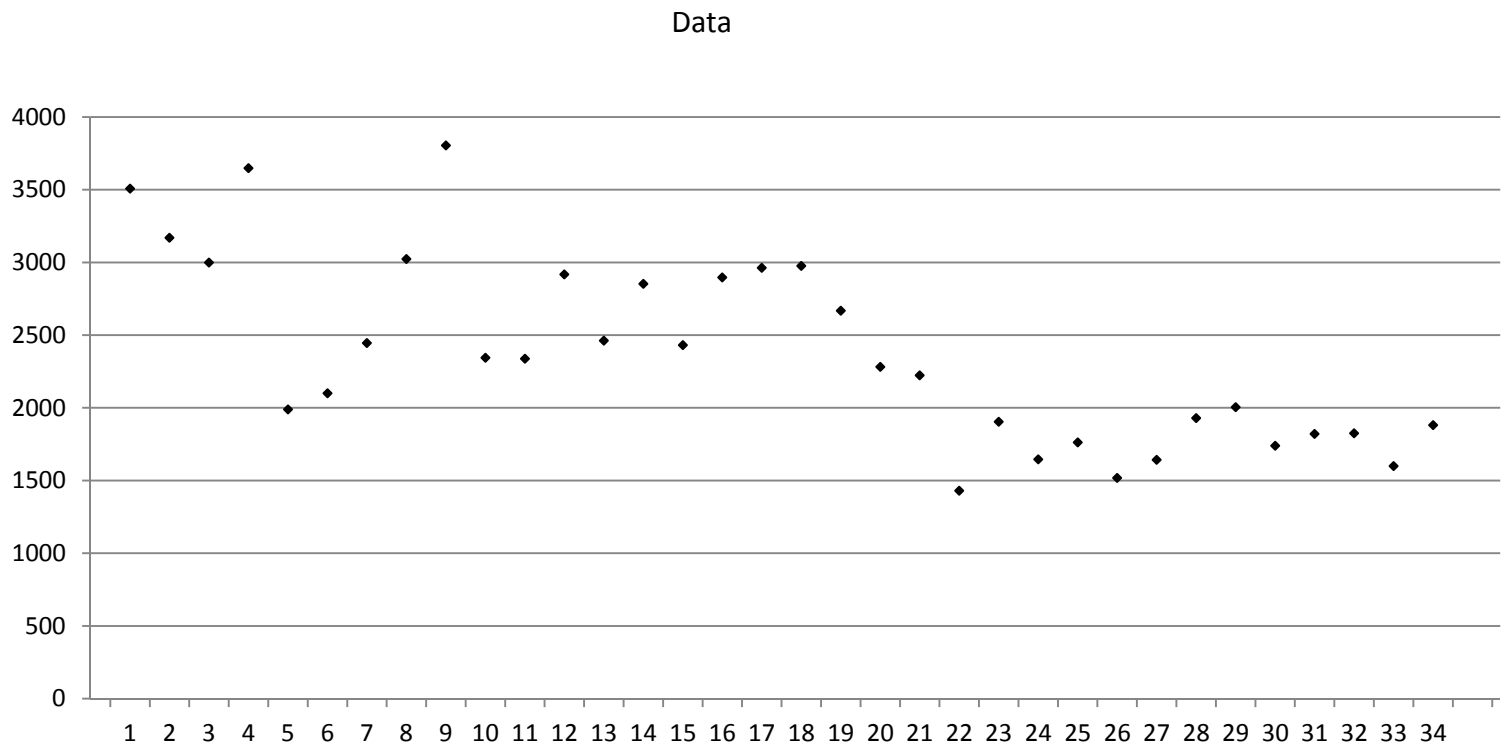
Eli Holmes

Typical PVA: Two Parts

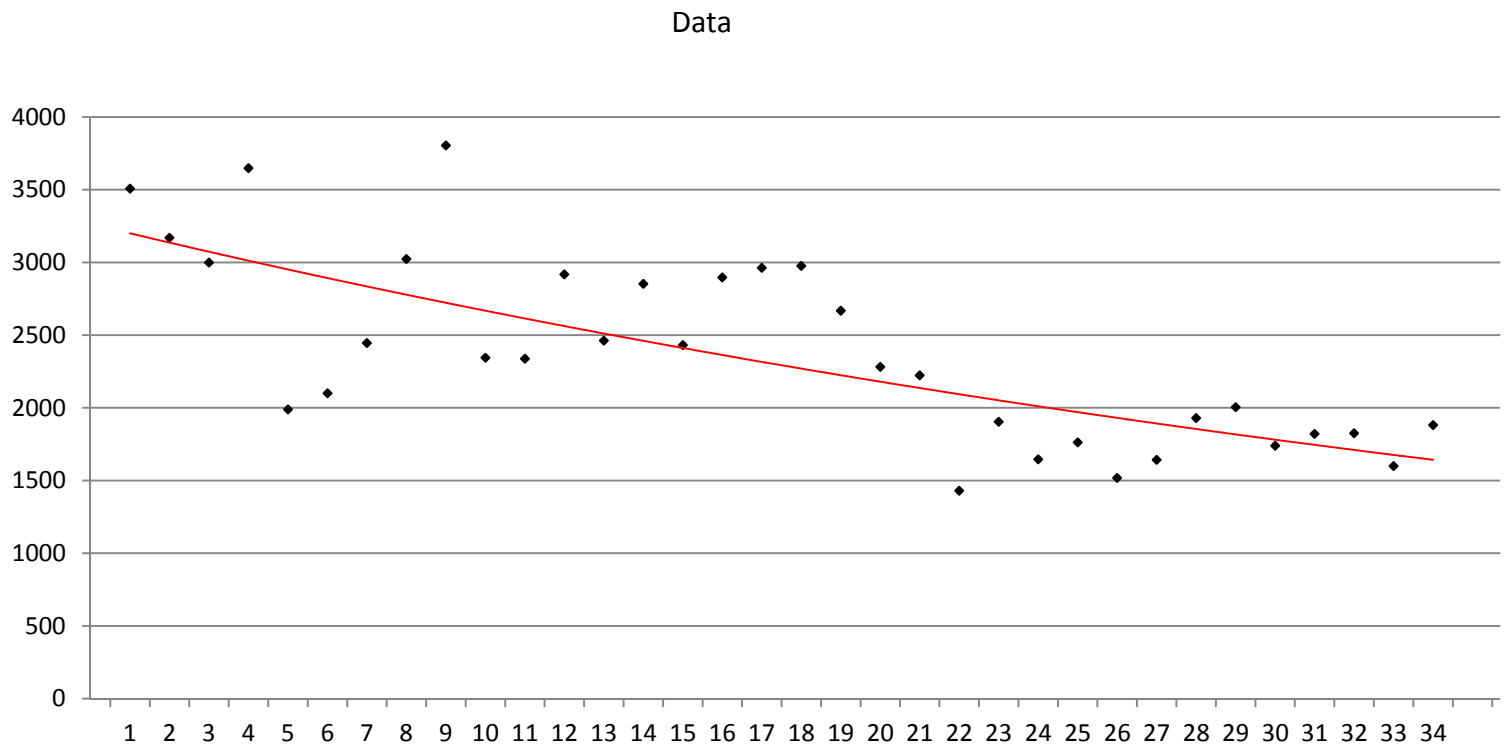
1. parameterize a model for the population trajectory by fitting a stochastic growth with process error model.

2. Use the best-fit parameters to project future states of the population.

For example, here is a 30+ year census of population counts



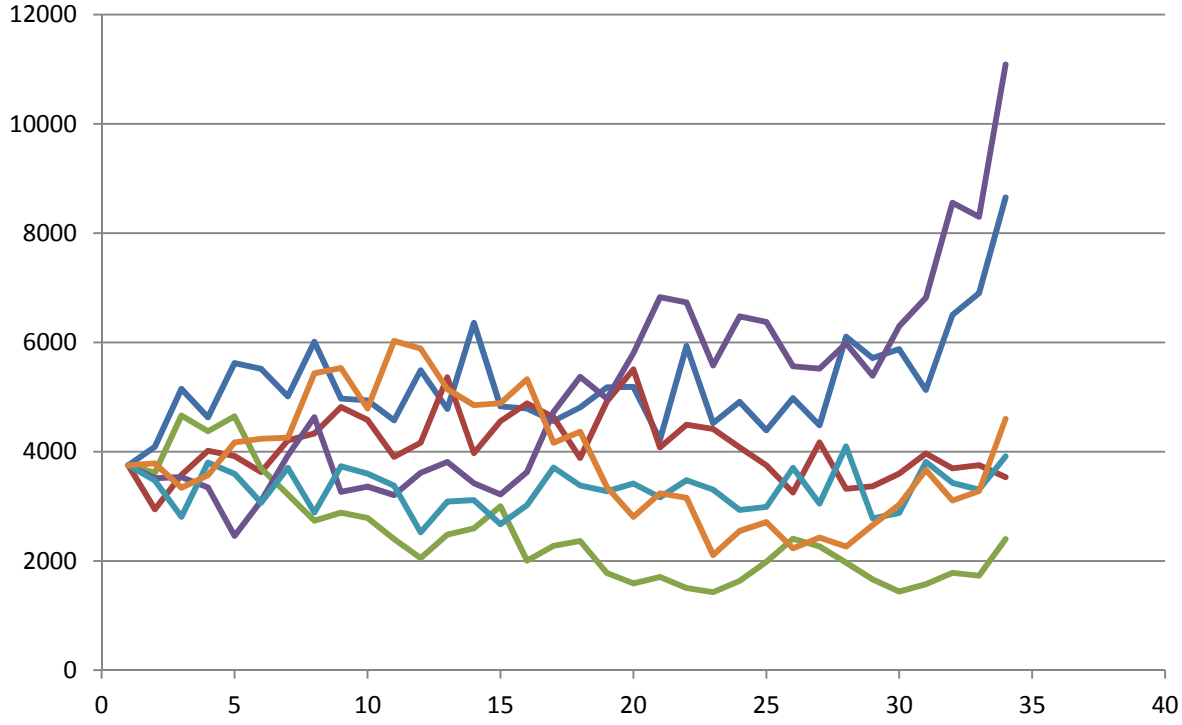
PVA step 1: fit a stochastic exponential model
mean of N_{t+1}/N_t is the growth rate
var of N_{t+1}/N_t is the process variance



Parameters: GROWTH RATE AND ERROR

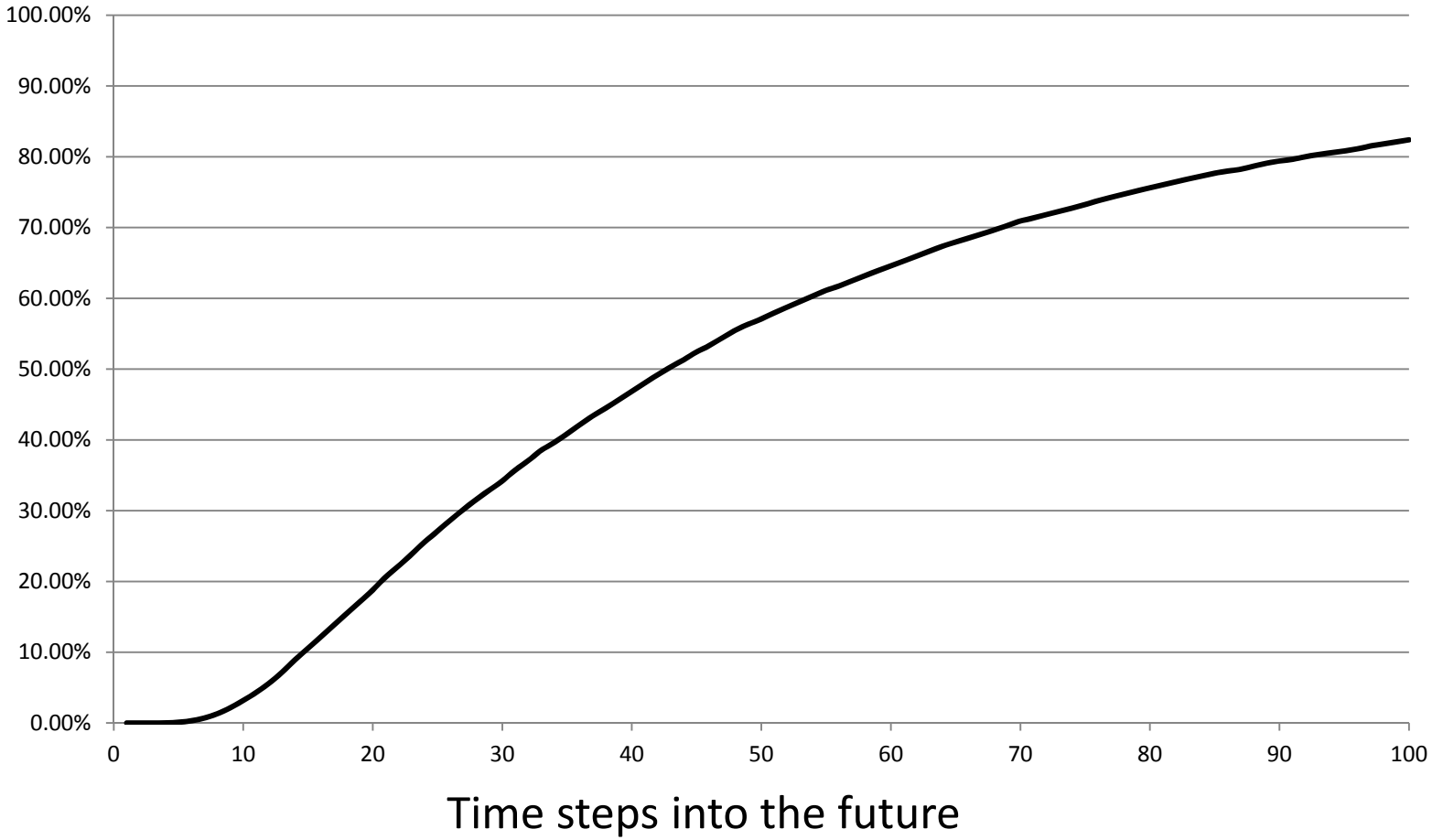
PVA: step two

- Use best parameter fits to simulate future



Do 1000's of times to get probabilities of extinction per time step

Example output would be the probability of extinction by year

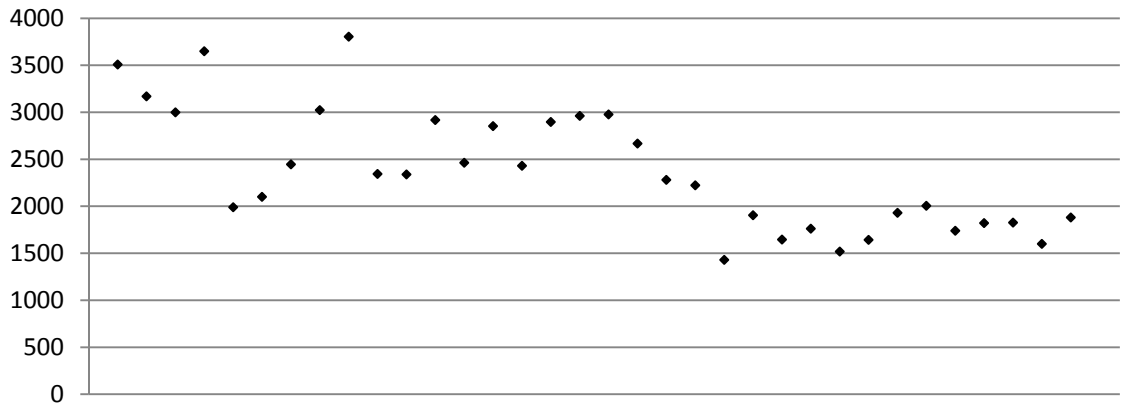


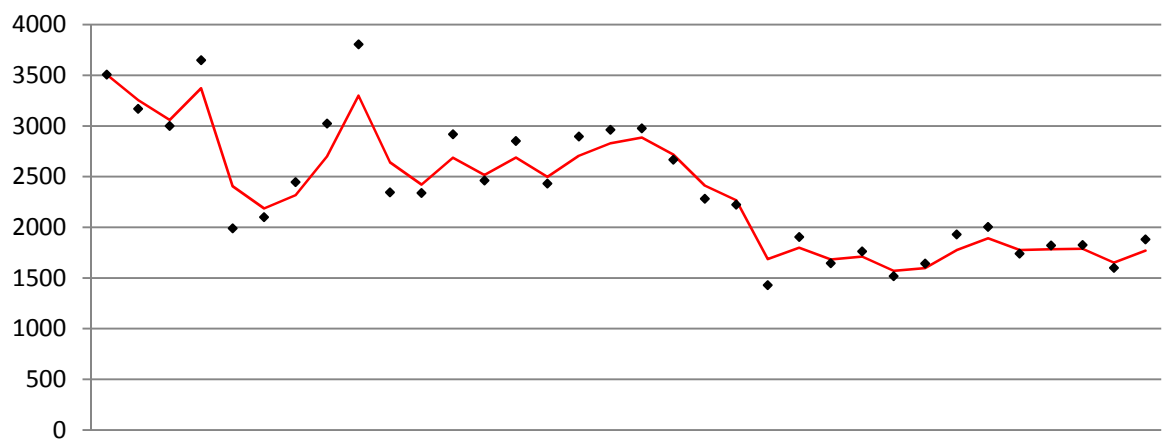
Why is DARTER better (part 1)?

- It uses a state-space model for the population trajectory that allows for both process and non-process error.

  This means it does not treat all the error in N_{t+1}/N_t as process error but allows that some of that error might be due to measurement or observation error.

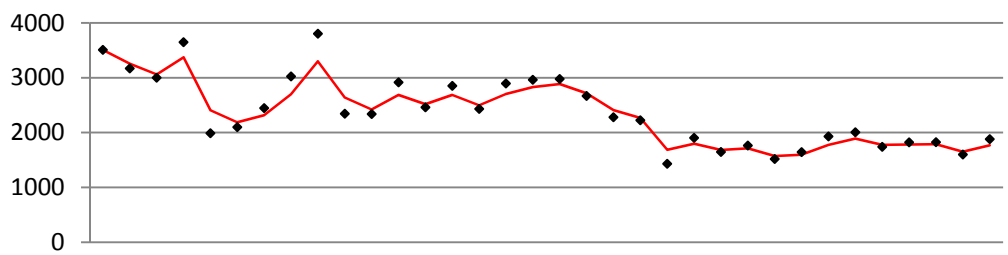
For example, suppose the real population trajectory is the red line and the observed counts are the black dots. Some of the variance in the black dots is due to variability of the true population and some is due to observation errors.





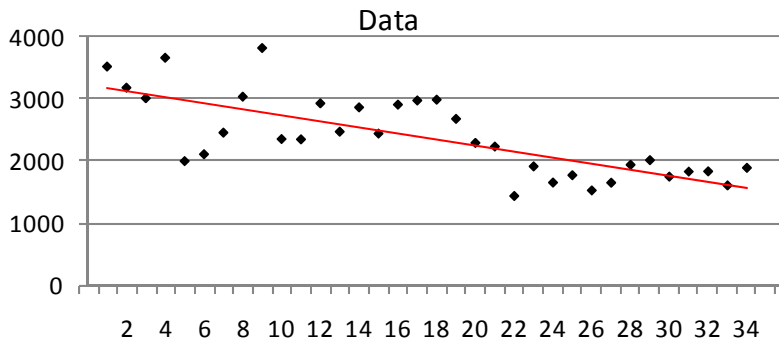
How DARTER deals with process and observation error in the data

- DARTER uses a state-space model to simultaneously account for process and non-process errors
- Functionally it estimates the red line and use the variance in that as the process variance estimate.

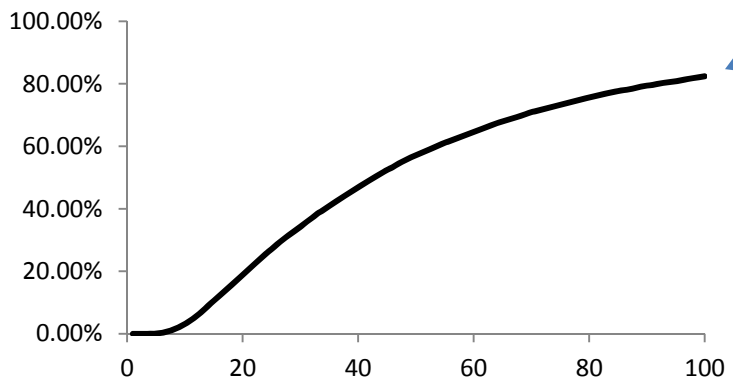


DARTER also accounts for parameter uncertainty

- The best fit is not the only fit!

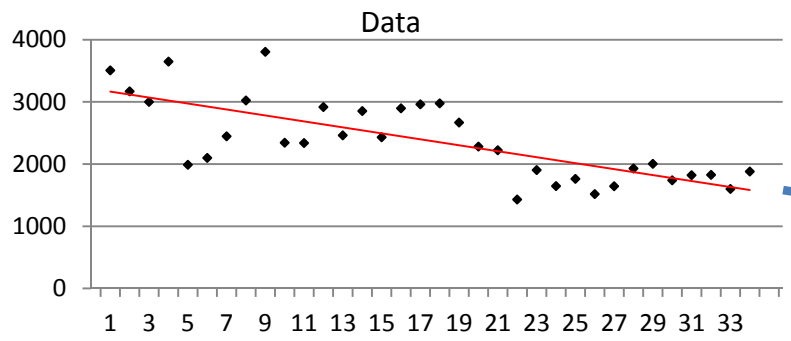
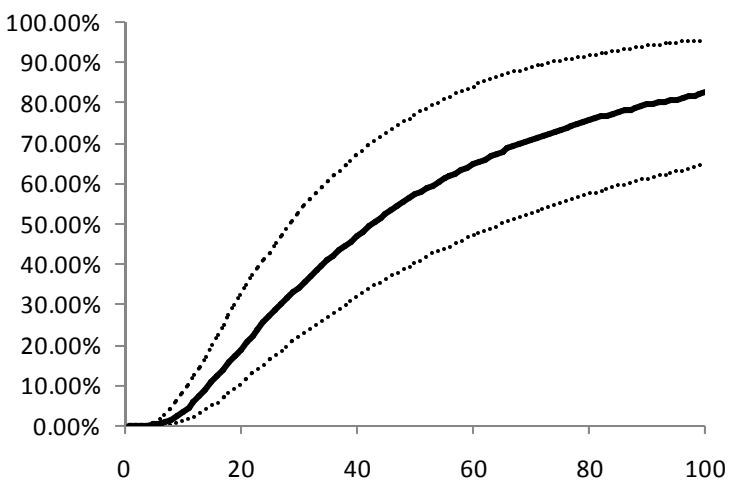


Growth Rate	LIKELIHOOD
-0.1	0.005
-0.08	0.05
-0.06	0.06
-0.04	0.009
-0.02	0.005



DARTER uses a Bayesian framework and the posterior probability distributions for the parameter estimates to account for parameter uncertainty.

- The best fit is not the only fit!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