Accumulator models of response time

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Process models of speeded choice response time

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- After each accumulation step, deciders evaluate whether the total amount of information in favor of a decision is enough to execute a response

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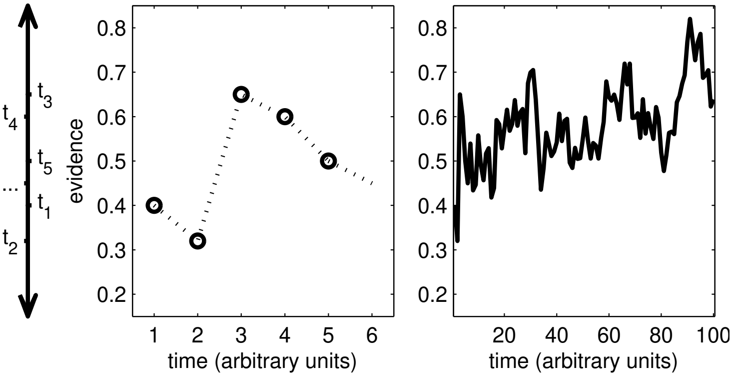
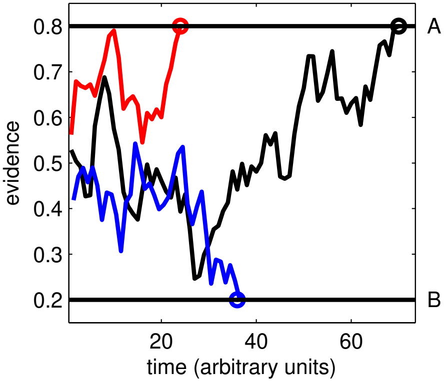
Evidence is accumulated over short periods of time



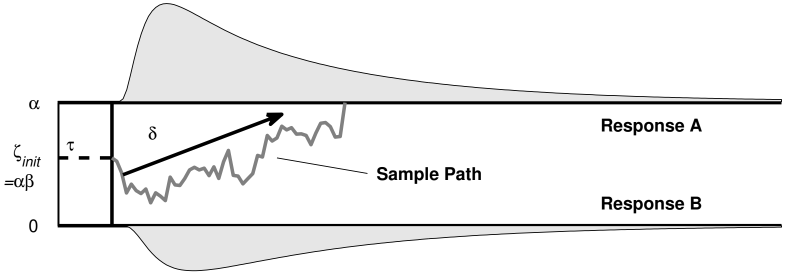
Process models of speeded choice response time

The evidence accumulation process occurs at each trial of an experiment, with each process hitting one or the other boundary at some time point



Process models of speeded choice response time

On repeated runs, the first passage times can form a smooth distribution



This distribution is sometimes called the Wiener distribution:

$$p(t, a) = W(\delta, \alpha, \tau, \beta)$$

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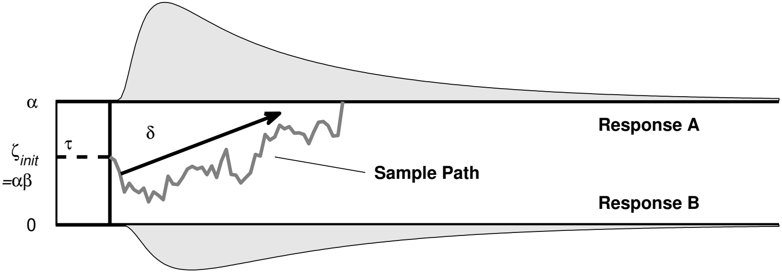
A particularly popular case of this category of models are the diffusion models for two-choice response times

Diffusion models are popular for a few reasons: they are mathematically somewhat convenient, they seem to fit data well in practice, and they have a small number of easy-to-interpret parameters

Diffusion models for two-choice response times

	parameter	*interpretation*
δ	drift rate	dominance (η, d')
α	boundary separation	caution
τ	nondecision time	time for encoding and responding
β	initial bias	a priori response bias



Diffusion model parameters in delta plots

Diffusion model parameter effects become tell-tale patterns in delta plots

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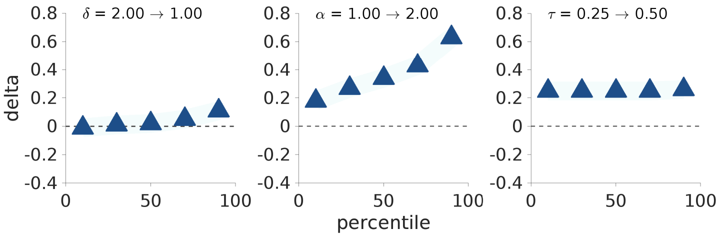
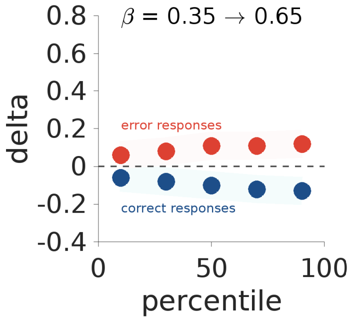


Diffusion model parameters in delta plots

Effects on the initial bias often only show when you split the delta plot by error/correct — they can cancel out if you don't!

parameter
β, initial bias
interpretation
a priori response bias



Diffusion model parameter estimation

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person p	*condition* c	*RT*	*accuracy*
1	3	0.71	correct
1	5	0.49	correct
$\vdots$	$\vdots$	$\vdots$	$\vdots$
1	3	0.43	error
2	4	0.67	error
$\vdots$	$\vdots$	$\vdots$	$\vdots$

$\rightarrow$

α_p	δ_{pc}	τ_p
1.61	0.45	0.24
1.61	1.17	0.24
$\vdots$	$\vdots$	$\vdots$
1.61	0.53	0.24
2.14	0.08	0.31
$\vdots$	$\vdots$	$\vdots$

Weekly assignment: Generate delta plots for diffusion models

- Recreate the delta plots in the slides
- Use the `3-ddm/src/diffusion_simulator.py` script to generate data from a diffusion model
- Write your own script to generate delta plots
- Use as baseline parameters:
  - $\delta = 2.00$ (and as contrast use $\delta = 1.00$)
  - $\alpha = 1.00$ (and as contrast use $\alpha = 2.00$)
  - $\tau = 0.25$ (and as contrast use $\tau = 0.50$)
  - $\beta = 0.35$ (and as contrast use $\beta = 0.65$)
- Select a reasonable number of samples for the simulation
- Use percentiles 10, 30, 50, 70, and 90
- Make sure you label your axes, annotate the plot, and feel free to use pretty (readable!) colors

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