Fishery-dependent data in a spatio-temporal context

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There’s a lot more information in fishery data

\[
\times 500
\]

\[
\times 10,000
\]
Spatial structure can be induced through movement

\[ P_{t+1} = MP_t \]
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Spatial structure can be induced through movement

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Example abundance map
Targeting varies by fleet
Targeting varies by fleet
Targeting varies by fleet
Schaefer population dynamics

\[ p_{s,t+1} = p_{s,t} + rp_{s,t} \left( 1 - \frac{\sum_s p_{s,t}}{K_t} \right) \]

\[ K_t \sim \text{LogNormal} \left( \log(K) - \frac{0.1^2}{2}, 0.1^2 \right) \]
VAST makes model fitting easy

\[ r_1(s, t) = 1 - \exp(\left[1 - a_i \exp(p_1(s, t))\right]) \]

\[ \Pr(C_{s,t} > 0) = r_1(s, t) \]

\[ r_2(s, t) = \frac{a_i \exp(p_1(s, t))}{r_1(s, t)} \exp(p_2(s, t)) \]

\[ C_{s,t} \mid C_{s,t} > 0 \sim \text{LogNormal}(r_2(s, t), \sigma^2) \]
VAST makes model fitting easy

\[ p_1(s, t) = \beta_1(t) + \omega_1(s) + \varepsilon_1(s, t) \]

\[ p_2(s, t) = \beta_2(t) + \omega_2(s) + \varepsilon_2(s, t) \]
The bias is there for a reason

\[ Y = \beta_0 \mathbf{1} + \omega \]

\[ \omega \sim MVN(0, \Sigma) \]

\[ (\Sigma)_{ij} = k(s_i, s_j) \]
The bias is there for a reason

\[ Y = \beta_0 \mathbf{1} + \omega \]

\[ \omega \sim MVN(0, \Sigma) \]

\[ (\Sigma)_{ij} = k(s_i, s_j) \]
True process
Random sampling
Preferential sampling
All together now
There’s a lot left to do

\[
\log(\text{CPUE}_s) = \mu_s + \omega_d + \epsilon_s
\]

\[
\log(\text{CPUE}_f) = \mu_f + \omega_d + \omega_q + \epsilon_f
\]
There’s a lot left to do

$$\log(\text{CPUE}_s) = \mu_s + \omega_d$$

$$\log(\text{CPUE}_f) = \mu_f + \omega_d + \omega_q$$
There’s a lot left to do

Preferential sampling
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